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Brexit Impacts on Ro-Ro Traffic and Logistics at Dover

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Executive Summary

This study investigates the potential short-term impacts of Brexit on the traffic conditions and the implied competitiveness of the Port of Dover, as well as induced supply chain cost changes. The Port of Dover is located at the British side of the English Channel and connected to the hinterland by two main roads A20 and A2. Ro-Ro service between Dover and Calais (France) offers the quickest ferry channel crossing between the UK and the European continent. As the largest Ro-Ro port in Europe, Dover handles £119 billion (17%) of UK's trade (Port of Dover 2019b).

We employ traffic simulations to assess the impact of Brexit (specifically possibly prolonged passport checks and compulsory customs clearance) on traffic fluidity in and around the port. The performance of port operations is evaluated by booth occupancy rates, queue lengths and average vehicle delays.

The main results of the simulation are listed as follows:

- Massive queues (extending beyond the model border of 7km) will happen after Brexit, when checking time is doubled and no measures is taken.
- Traffic congestion on A20 is much severer than A2.
- Maximum delay of 4.5 hours is resulted for trucks, 2 hours for passenger cars, and 6 hours for coaches when checking time is doubled, even after all the non-port-related vehicles are removed and only 90% of port vehicles are retained.
- Border control capacity is the main bottleneck and adding extra booths for border controls will significantly reduce traffic congestion.
- Smoothing the traffic arrivals equally during the day can also improve the traffic condition.

Supply chain cost increase for the short-term is estimated. We conduct a case study of a company in Germany receiving daily delivery from the UK using the ferry service at Dover and compare the alternative routes to the Dover ferry connection. The results are summarized below:

- Supply chain cost increases by 4.79% to 19.44% under different scenarios.
- Safety stock increases up to 71%.
- In the worst-case scenario when checking times are doubled, Ro-Ro port Newhaven is more competitive than Dover.
- For low-value cargo, shifting from Dover to container port Southampton could become a better option.

1. Background of Brexit and Dover

Significant socio-political changes can generate high risk of trade uncertainty. Brexit will cause and have already induced great uncertainties to many aspects of European economies. From the logistics perspective, possible outcomes such as trade tariffs, border controls, customs clearance and inspections on freight and passenger traffic between the UK and the rest of EU countries will challenge the logistics efficiency and restructure the current supply chains.

UK & EU trading facts

- EU is the biggest trading partner of the UK, contributing 52.05% of the UK's total foreign trade value in 2018
- Food, live animals, chemicals, beverages and tobacco have high share among the traded products, accounting for over 70% (Office for National Statistics 2019).
- 208 million tonnage or 54.6% of the total international freight handled by the UK major ports is shipped to/from the EU (see Figure 1)

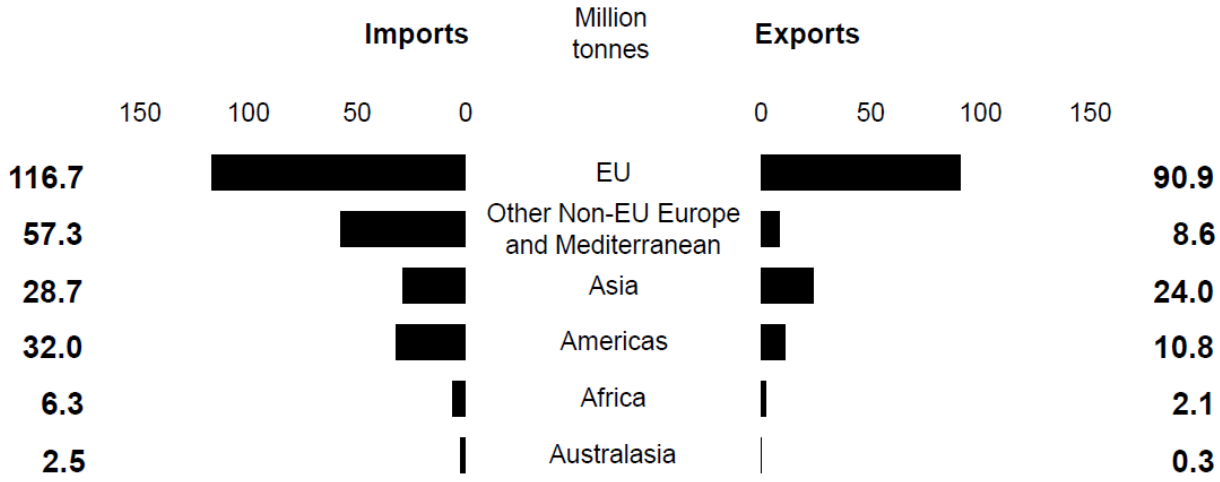


Figure 1: UK's international freight handled by ports (Source: Department for Transport 2018)

- Among the 8.5 million units of unitized freight (containers and Ro-Ro units) between the UK and the other EU ports in 2017, 76.5% are Ro-Ro traffic
- 99.6% of the UK's international Ro-Ro traffic is within the EU, about half of which is between the UK and France, as shown in Figure 2 (Department for Transport 2018)

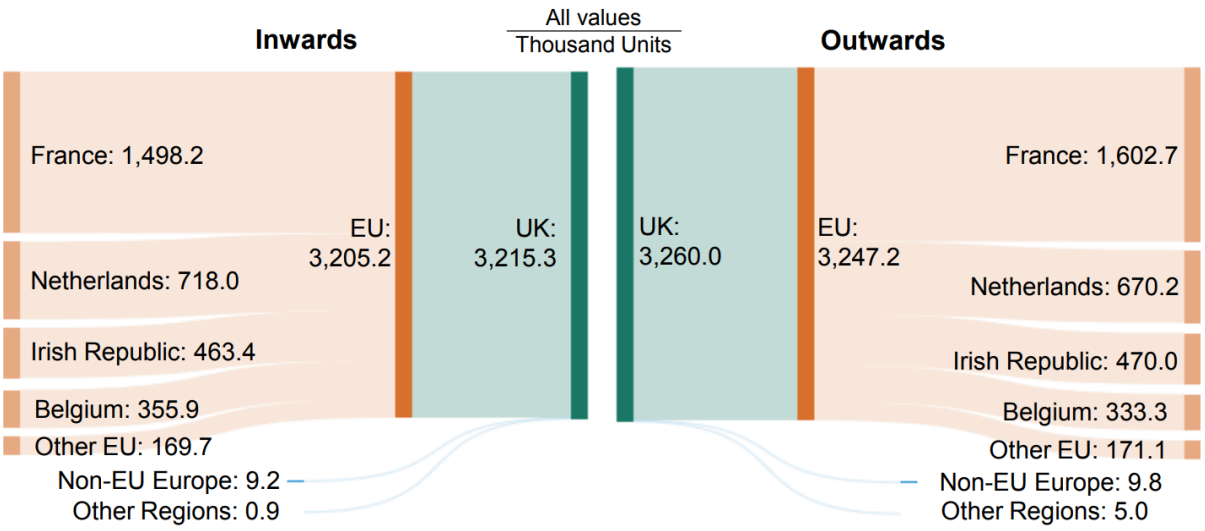


Figure 2: UK's international Ro-Ro freight units in 2017 (Source: Department for Transport 2018)

Dover's importance

- The strait between Dover and Calais is the narrowest part of the English Channel
- Dover is the ninth largest UK port in terms of total cargo volume (26.2 million tons) in 2017 and the largest Ro-Ro port in Europe (Department for Transport 2018)
- Dover handles £119 billion (17%) of the UK's trade (Port of Dover 2019b)
- Trade between Dover and Calais accounts for 23.7% of the UK's major port traffic with the EU (Port Boulogne Calais 2018 and Department for Transport 2018)

Due to the obvious location advantage, the ferry connection between Dover and Calais is one of the quickest and most competitive transit options. It is the gateway connection between the UK and mainland Europe. As Europe's busiest ferry port, there remains no substitutable capacity elsewhere in the UK to handle Dover's trade volumes.

As the main advantage of the Ro-Ro traffic is its quick and flexible transfer between land and marine transport legs, if the UK exists the EU, the expected increased passport checks and compulsory customs clearance will slow down this process greatly and lead to congestions in the surrounding road network. For example, freight arriving from a non-EU country, such as Switzerland, can take one to three hours due to customs documentary check currently (Morris 2019).

As a result, the competitiveness of the ferry services, especially the port of Dover, will be challenged. Furthermore, the supply chain systems of many industries in the UK and its close partners will be tremendously shifted, due to the current unpredictable conditions and the high uncertainties for the future. In the long term, manufacturers will restructure their global supply chains and relocate facilities, in response to the exact Brexit deal and the macroeconomic policy changes made by the British government. For example, car manufacturer Honda might shift some factories to other EU countries to better serve the regional market there, as it has already confirmed the closure of its Swindon plant (Jolly 2019). In the very

short term, a longer turn-around time for cargo shipments between the UK and continental Europe is anticipated, leading to higher supply chain costs for the firms and congestions at the ports and even surrounding networks. Firms that will be affected need to find the best solution to minimize supply chain cost and maintain efficiency. Large inventory stocking up to prepare for the foreseeable chaos after Brexit is already seen.

2. The Simulation Model

There are two main routes connecting the ferry terminal (shown in Figure 3). Motorway M20 is the quickest route from the West under normal traffic conditions (no serious congestion), and merges into the A20 at Folkestone, while M2 leads to the port from the North and merges into the A2 at Faversham (Port of Dover 2019a).

Figure 3: Road connection to Port of Dover (Source: Highways England 2015)

All vehicles must go through three sets of checkpoints before embarkation: French Border Police (Police Aux Frontières, PAF), British border control, and ticket check-in. After Brexit, all goods must be declared to customs before crossing the Channel. The driver of every freight vehicles will have to either show the customs document at the check-in if the vehicle is loaded or declare at check-in if the vehicle is empty (Port of Dover 2019c). At border controls, travel document checking will probably be stricter and takes longer time (European Commission 2019).

The model network is constructed using VISSIM (See the main part shown in Figure 4). An average working day (30th May 2017) is used for the simulation.

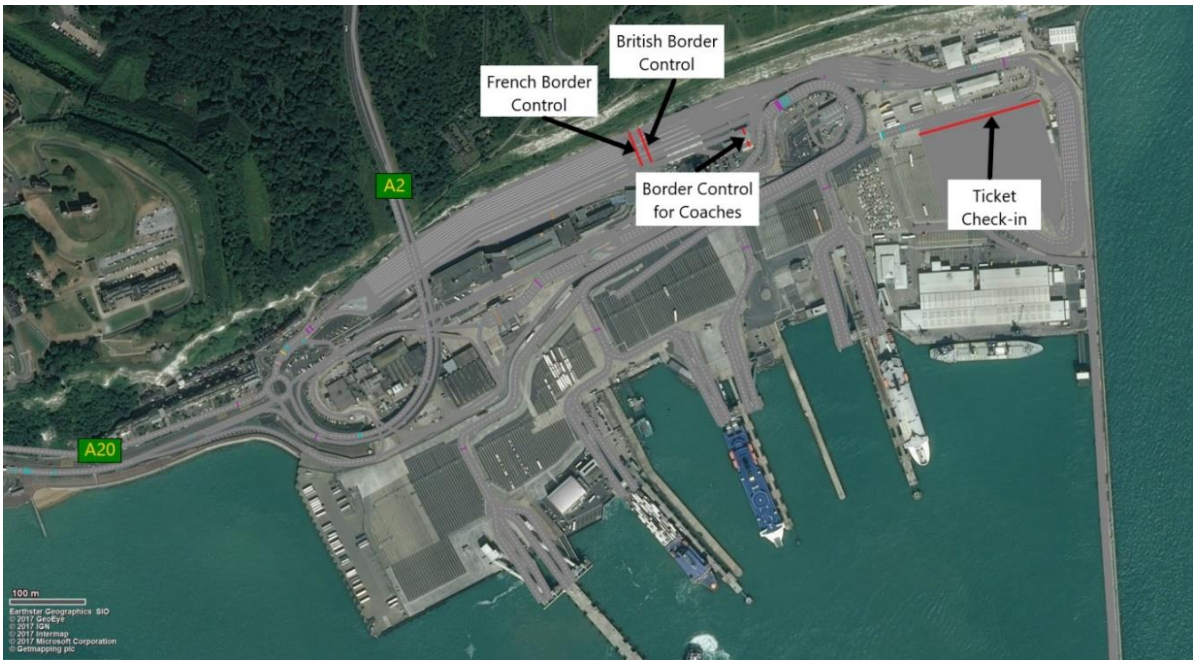


Figure 4: Layout of the simulation model of the Port of Dover

3. Scenario Analysis

We tested a few scenarios that could happen after Brexit and compare the results to the status quo.

Pre-Brexit scenario (Base scenario): This scenario simulates the status quo of the traffic in Dover.

- Traffic flows smoothly, queues rarely appear.

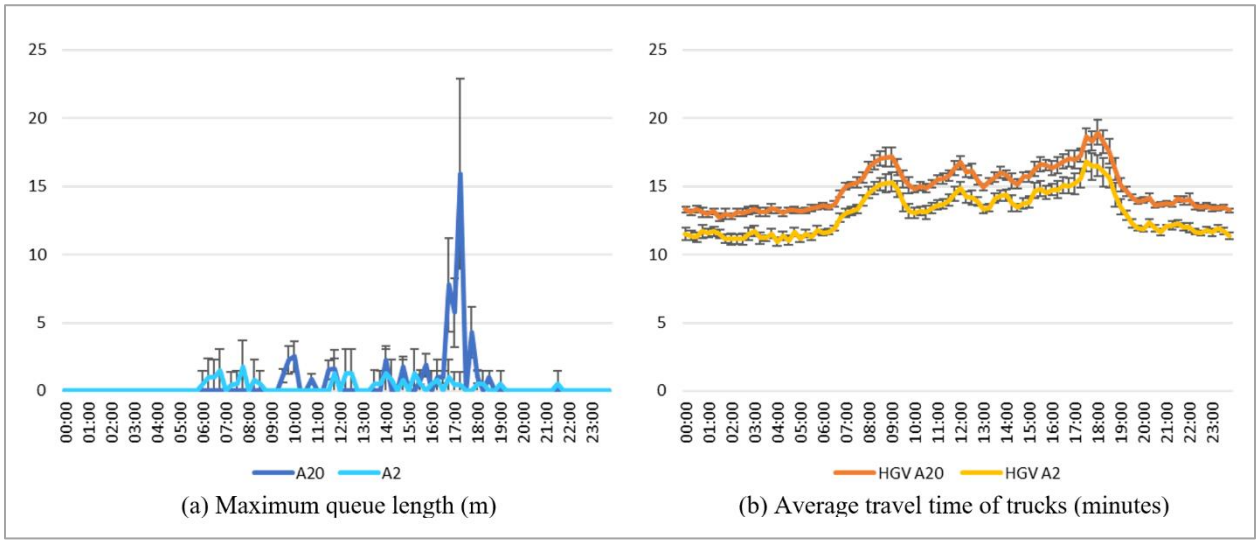


Figure 5:Maximum queue length and average travel time of trucks in Pre-Brexit scenario

Post-Brexit scenario I: Checking times at border controls for all types of vehicles and ticket check-ins only for HGVs are increased by 50%.

- Queues on A20 last from 11:00 until 22:00 (11 hours) and reach a maximum length of 3 km around 19:00. Queues on A2 rarely appear.
- Maximum delay of 56 minutes is resulted for passenger cars, 2 hours for HGVs and 5 hours for coaches.

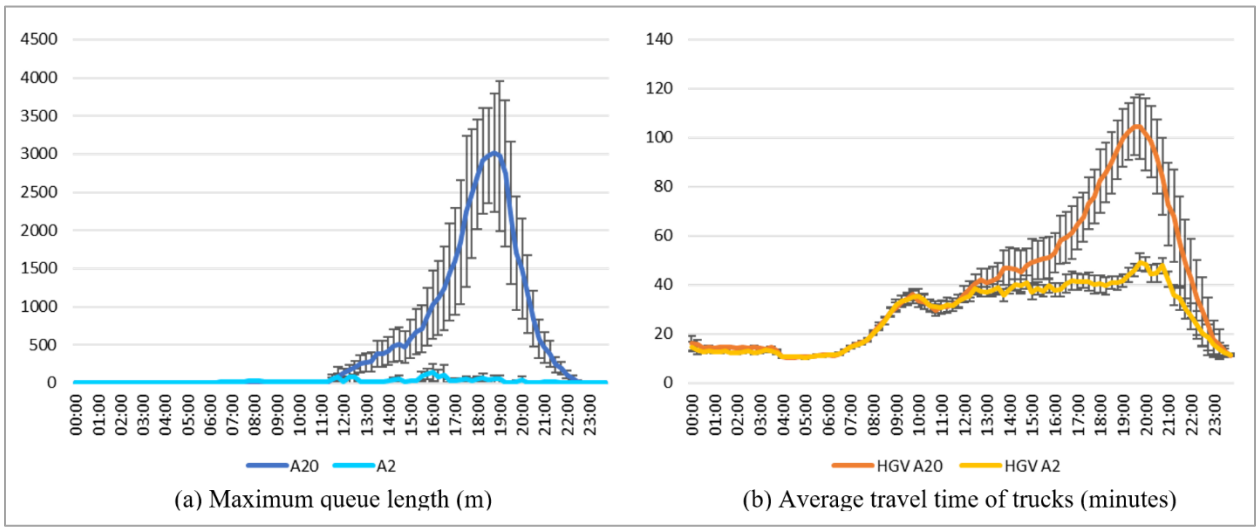


Figure 6:Maximum queue length and average travel time of trucks in Post-Brexit scenario I

Post-Brexit scenario II: Checking times at border controls for all types of vehicles and ticket check-ins only for HGVs are increased by 100%.

- Vehicle queues on A20 reach the border of the model (approx. 7km long).

Post-Brexit scenario III: Checking times at border controls for all types of vehicles and ticket check-ins only for HGVs are increased by 100%; Only the traffic to the Port of Dover is remained, while vehicles not destined for the port are removed, assuming that those vehicles would take a detour to avoid the congestion in the port area.

- Vehicle queues on A20 reach the border of the model (approx. 7km long).

Post-Brexit scenario IV: Based on conditions set in Post-Brexit scenario III, this scenario further assumes that total traffic volume is reduced by 10%. This setting is based on the British government's attempt to charter extra ferries serving other British ports to ease the possible congestion at Dover. These additional crossings are equivalent to about 10% of existing traffic across the Dover strait (Miller 2018).

- Queues on A20 last from 11:00 until 01:00 (14 hours) and reach a maximum length of 3 km around 19:00. Queues also appear on A2 during the peak hours and have a maximum length of 350 m.
- Maximum delay of 2 hours is resulted for passenger cars, 4.5 hours for HGVs and 6 hours for coaches.

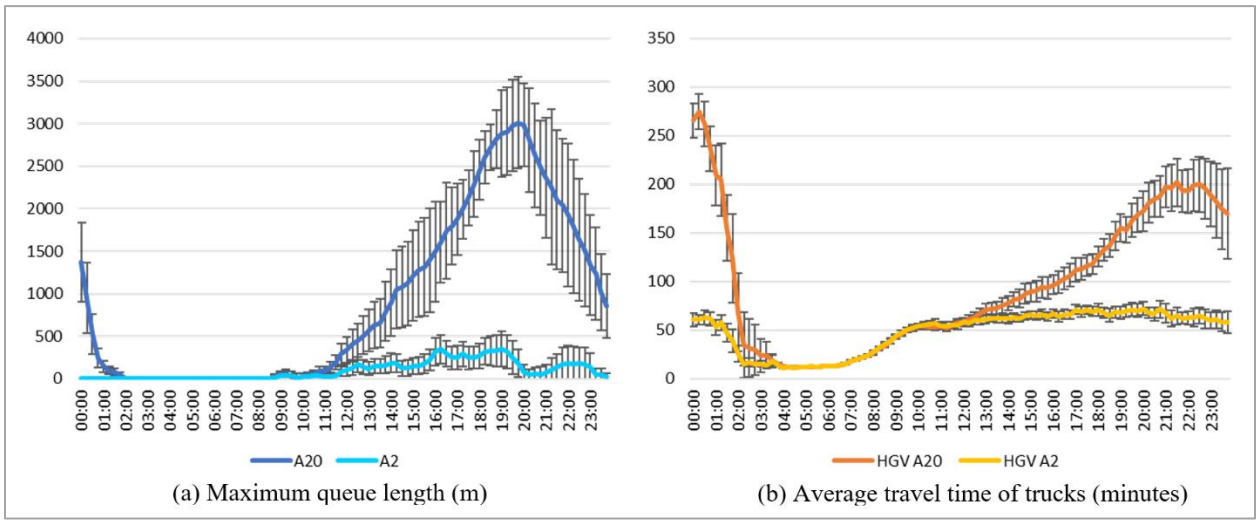
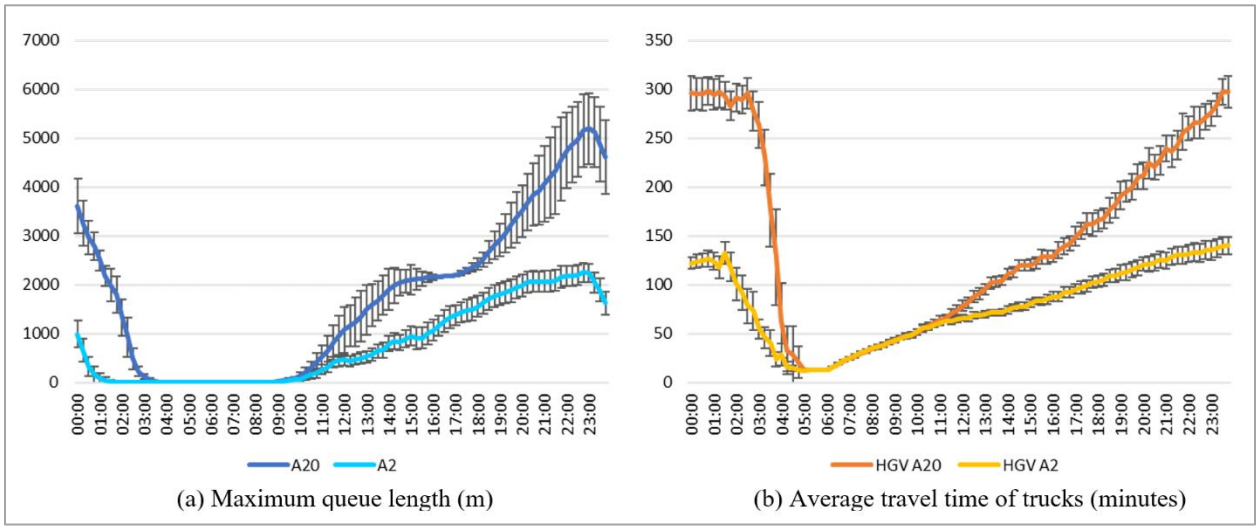


Figure 7: Maximum queue length and average travel time of trucks in Post-Brexit scenario IV

Post-Brexit scenario V: Based on conditions set in Post-Brexit scenario III, this scenario analyzes a possible congestion alleviation solution by adjusting vehicle arrivals to follow a uniform distribution between 6:00 and 23:00. This can be done through the port or the ferry operators rescheduling the ferries' departures between 6:00 and 23:00 and assigning fixed time-windows to port users.

- Queues on A20 last from 10:00 until 3:00 (17 hours) and reach a maximum length of 5 km around 22:00. Massive queues with a maximum length of 2 km also occur on A2.
- Maximum delay of 3 hours is resulted for passenger cars, 5 hours for HGVs and 6 hours for coaches.



(a) Maximum queue length (m)

(b) Average travel time of trucks (minutes)

Figure 8: Maximum queue length and average travel time of trucks in Post-Brexit scenario V

Post-Brexit scenario VI: Based on conditions set in Post-Brexit scenario V, this scenario analyzes another possible solution by reconstructing port layout and resources, i.e. adding an extra lane in the buffer area and two booths in the model, one booth for French border control for HGVs and the other for British border control for HGVs, considering that border control capacity is the bottleneck at the port, indicated by our simulation results.

- Queues on A20 last from 16:00 until 01:00 (9 hours) and reach a maximum length of 1.2 km around 19:00. Queues also appear on A2 during the peak hours and have a maximum length of 500 m.
- Maximum delay of 2.3 hours is resulted for passenger cars, 2 hours for HGVs and 6 hours for coaches.

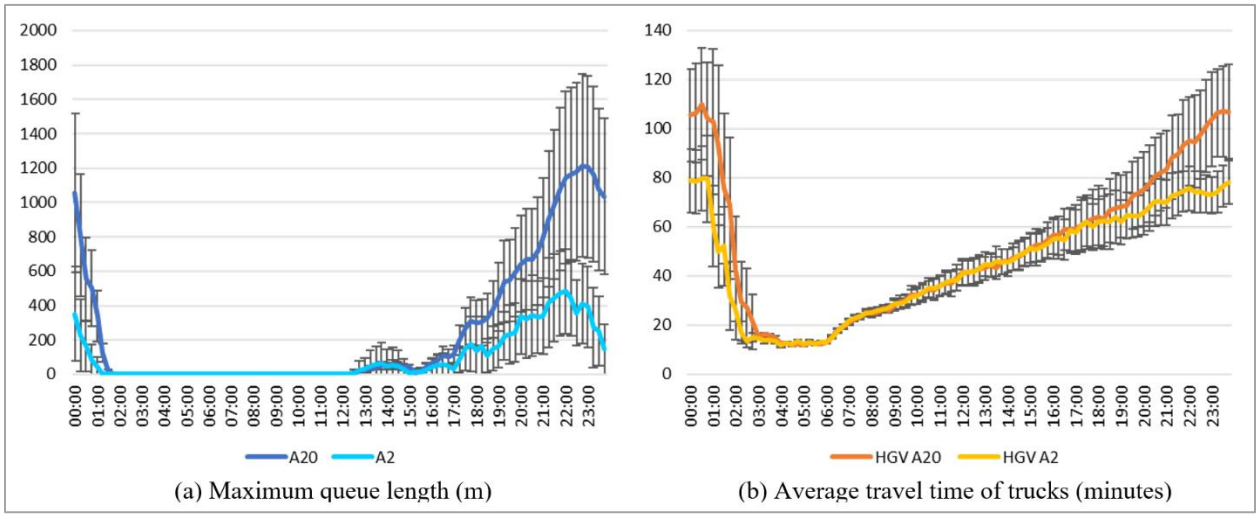


Figure 9: Maximum queue length and average travel time of trucks in Post-Brexit scenario VI

To evaluate the port efficiency, the average booth occupancy rates for each procedure for pre-Brexit and post-Brexit scenarios are compared in Table 1. the occupancy rates at all checkpoints increase after Brexit. The main bottlenecks are at the French border controls and border controls for coaches, as their average occupancy rates are significantly higher than check points. This indicates that a port layout reconstruction and resource reconfiguration can help to improve the port efficiency and traffic flow situations. As shown in post-Brexit scenario VI with two extra booths for border controls for HGVs, the average booth occupancy rate of French border controls for HGVs is reduced from 83% to 65%, and the average maximum queue length on A20 is reduced from 5 km to 1.2 km.

Table 1: Average booth occupancy rate of check points

Check point type	Pre-Brexit	Post-Brexit I: 50% time increase	Post-Brexit IV: 100% time increase; 10% traffic decrease	Post-Brexit V: 100% time increase; smooth traffic	Post-Brexit VI: 100% time increase; port layout redesign
French border control - HGV	45.73%	**63.69%**	**73.73%**	**82.60%**	65.28%
French border control - car	35.96%	**52.20%**	**59.35%**	**71.33%**	74.00%
British border control - HGV	20.82%	26.67%	29.62%	33.12%	27.75%
British border control - car	16.13%	21.28%	23.07%	28.70%	29.47%
Border control - coach	53.51%	**70.53%**	**79.55%**	**87.69%**	88.06%
Ticket check-in	25.00%	34.14%	39.31%	44.29%	45.26%

4. Supply Chain Impacts

In the short term, companies and consumers do not have many options to revise their supply chain configurations. This means the demand and supply situation including total sales volumes, production and consumption locations and order frequencies remain unchanged in the short run as our study period. Even with some cargoes switched to other ports, it is still expected that a large amount of shippers' cargos will be affected with much higher border-crossing time from UK to EU. And two main consequences are expected: (1) congestion and delay at some of main connection points; and (2) higher inventory levels in both in-transit inventory and safety stock due to longer transit procedure and higher uncertainties. To quantify those impacts, we focus on the main supply chain costs that will be affected in the immediate short time mostly, and the order processing cost, manufacturing cost and warehouse expansion cost etc. are not considered.

Using the simulation results, the supply chain cost for a company is estimated as a numeric case study, whose central distribution center in Munich, Germany receives shipments daily from its factory in Birmingham, UK. The supply chain inventories and costs via Port of Dover in different scenarios are calculated and shown in Figure 10 and in Figure 11 respectively. Furthermore, the figures also show the comparison of the Dover-Calais ferry route with two other port connections, namely Ro-Ro service Newhaven - Dieppe and container liner service Southampton - Le Havre. The costs are calculated based on two different cargo value (V) estimations (i.e. V=€100,000 and V=€200,000).

Focusing on the case when V=€100,000, figures below show that although the inventory volume and cost increase a large percentage, shipping cost increase is the largest contributor to the company's supply chain cost. For example, from the status quo to post-Brexit scenario I (50% checking time increase), pipeline stock increases 4%, safety stock increases 11% and the total supply chain cost increases 5% from 1.43 million euros to 1.50 million euros, of which shipping cost account for a large proportion. When port

checking times are doubled, increases of 17% in pipeline stock, 71% in safety stock and 19% in total supply chain cost occur in post-Brexit scenario V.

Regarding the port connection competitiveness comparison, Figure 11 shows that the Newhaven-Dieppe Ro-Ro connection is more economical than using Dover in the worst-case scenario (i.e. post-Brexit Scenario V). Besides, the total cost of using container service via Southampton and Le Havre is higher than the Dover route in the status quo, but will become almost the same as Dover in the post-Brexit scenario I and VI, and clearly lower under other scenarios, in the initial setting with cargo value of €100,000 per truckload/container. When the cargo value increases, the inventory costs becomes more significant. The threshold cargo value in this case study is €155,685 per unit when the supply chain costs of using both alternative connections are the same. If the cargo value further increases, the advantage of cheaper shipping cost by container transport is lost to the quicker transit by Ro-Ro transport. When unit cargo value equals €200,000, the total yearly supply chain cost for the container shipping route increases to 1.91 million euros as shown in Figure 11, which is 26.51% higher than the Dover-Calais route in pre-Brexit period, and 7.38% higher than the Newhaven-Dieppe route.

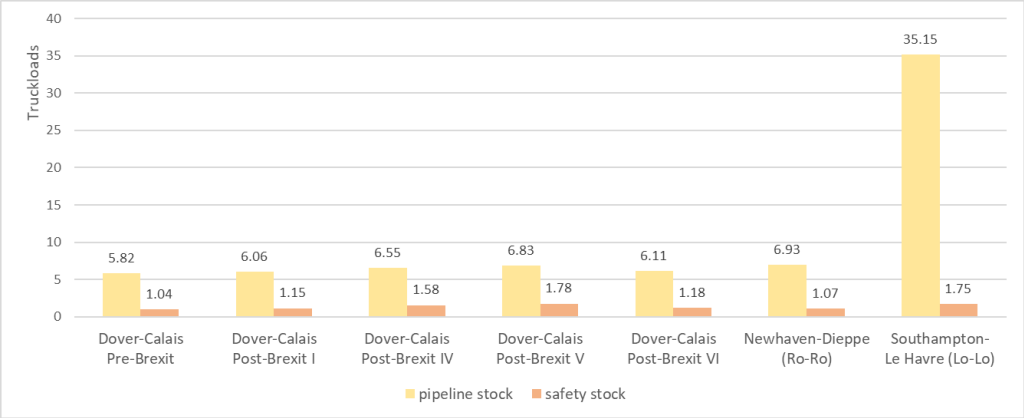


Figure 10:Company inventories under different connections

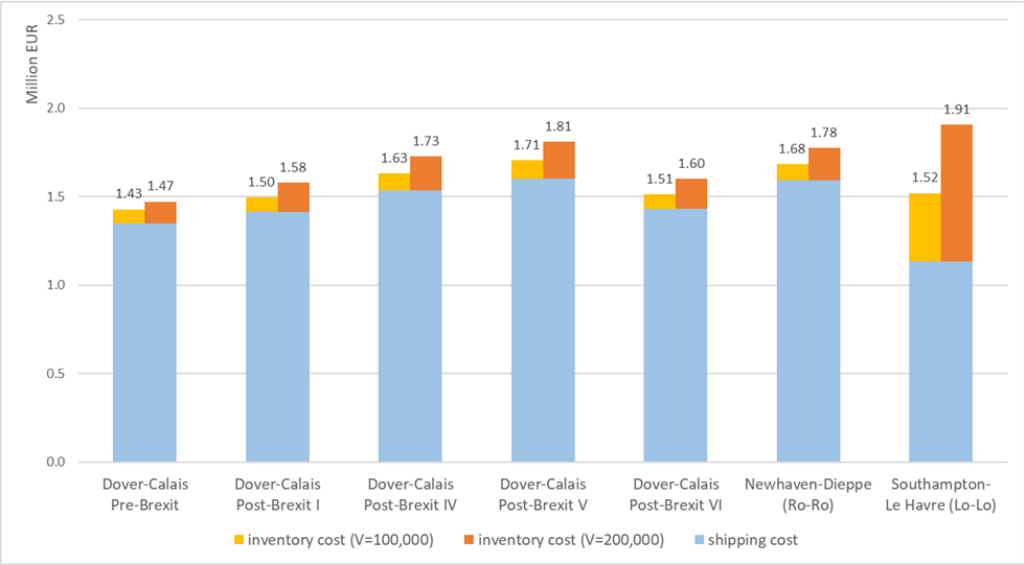


Figure 11: Annual supply chain cost under different connections

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