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Master Thesis

Thesis Master of Science

Effects of Insulting a Nation:

An Empirical Study on the Impact of the 2010 Nobel Peace Prize on Norwegian Exports

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Start: 15.01.2020 09.00

Finish: 01.09.2020 12.00

Effects of Insulting a Nation

An Empirical Study on the Impact of the 2010 Nobel Peace Prize on Norwegian Exports

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MSc in Business, Major in Economics

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May 2020

Abstract

This master thesis revisits the question of the effects of Chinese trade restriction on Norwegian exports following the awarding of the 2010 Nobel Peace Prize to Chinese dissident Liu Xiaobo. Our study contributes to earlier literature both by having access to more recent data as well as by exploring the possibility of China's neighboring countries being used as intermediaries. Using a diff-in-diff approach where the gravity equation serves as a baseline for the counterfactual, our findings suggest that the USD value of Norwegian exports to China in aggregates were slightly lower than normal during the years of treatment, albeit not significantly so. At the same time, exports to Vietnam and South Korea are found to have been much higher than predicted, the abnormal increase matching to a large degree the timing of the Peace Prize. On disaggregated levels, we find that fresh salmon, frozen halibut, fish meal, and to a lesser degree of certainty petroleum and various mechanical products were likely subjected to such treatment. The total value of re-exported salmon is estimated to be up to USD 560 million and the value of halibut at USD 70 million, making the direct 'Peace Prize effect' even smaller considering that these figures were not recorded as imports to their most likely destination. Next, we apply the same framework to study the outcome of implementing free trade agreements with Beijing, finding that Western nations to do so increase their USD value of exports to China in aggregates by an order of 38 to 55 percent compared to their respective counterfactuals. We nevertheless conclude that this gain comes at a high price, suggesting that the Norwegian delegates who are currently negotiating a similar agreement with China should take care not to be kind to a fault.

*We wish to thank our supervisor Per Botolf Maurseth, Associate Professor at the Department of Economics at BI Norwegian Business School, for excellent guidance during our entire thesis process as well as Professor Emeritus Arne Jon Isachsen for insightful comments and feedback. We are also grateful for help provided by Professor Christian Brinch, Professor Eivind Eriksen, Professor Steffen Grønneberg and PhD Candidate Oda Nedregård.

Contents

List of Figures

List of Tables

1 Introduction

In October 2010 the Norwegian Nobel Committee announced the awarding of the 2010 Nobel Peace Prize to Chinese human rights activist Liu Xiaobo. The award greatly offended the Chinese Government who regarded it a major infringement on their domestic affairs, denouncing the decision as politicized to produce changes in China and “a blasphemy to the peace prize” (Branigan, 2010a). For years Liu had worked actively for democratic reform, taking part in the 1989 protests on Tiananmen Square and co-authored Charter 08 – a manifesto calling for improved human rights and individual freedom in China. At the time of the award he was imprisoned, serving a sentence for ‘inciting subversion of state power’, and Liu became one of the few Laureates ever to not be allowed to collect his prize. While the Norwegian Government denied affiliation with the Nobel Committee, Beijing initiated what would become a six-year lockout of all diplomatic relations with Norway practically overnight. Ongoing negotiations for a free trade agreement which had been planned since 2008 were put on hold. For a while it was expected that Norwegian exports to China would plummet, in a manner similar to the trade-reducing ‘Dalai Lama effect’ observed by Fuchs and Klann (2013) in nations agreeing to officially meet with the exiled spiritual leader of Tibet.

The actual impact on Norwegian exports appears to have been lower than initially feared, however, and has been the topic of studies by Sverdrup-Thygeson (2015), Chen and Garcia (2016) and Kolstad (2019). The first is a largely descriptive study in which the complementarity of Sino-Norwegian trade relations is found to have resulted in a Chinese bark far larger than its bite. The second uses a process of stakeholder interviews and more recent descriptive statistics to infer the existence of a partial boycott on Norwegian salmon, implemented through discriminatory inspection practices and prolonged customs procedures. Chinese importers were largely able to bypass these restrictions, however, transferring the real cost of the sanctions onto mainland consumers through higher transport prices, smuggling and bribery. They also remark that Norway’s refusal to meet with the Dalai Lama during his official 2014 visit is evidence of Norwegian submission. The last study employs a synthetic control approach to construct a counterfactual for Norwegian aggregate exports, finding that the effects of sanctions were substantial, but lasted only until

2014. Kolstad (2019) agrees with Chen and Garcia (2016) that Norway appears to have changed foreign policy decisions in order to comply with China, notably through altered voting patterns on human rights resolutions in the UN General Assembly. Effects of the Peace Prize was also the subject of a master thesis from the University of Oslo by Mathisrud (2018), whose results indicate large losses for Norwegian exporters, and Johansen, King, and Kleiven (2018) – our own bachelor thesis from Oslo Metropolitan University.

In this thesis we revisit the question of the impact of the 2010 Nobel Peace Prize on Norwegian exports. Motivated by the apparent compatibility of Sino-Norwegian trade relations with traditional trade theory, our study challenges China's incentives for reducing imports from Norway in the first place. Using a gravity equation approach, our empirical contributions include an extensive analysis of Norwegian exports to multiple countries of the Far East, expanding on findings from Chen and Garcia (2016) that neighboring regions were used by Chinese importers as intermediaries. In particular, we benefit from having access to post-normalization data, which was not available during any of the papers referred to above. The first question we ask is what happened to Norwegian exports on aggregate levels to China, Vietnam, Japan, Hong Kong, and South Korea in the years after 2010. To our knowledge, analysis of the question to this extent has not been done before. Next, we study disaggregated trade flows, searching for evidence of specific commodities which have been re-exported through any of these countries. We do not restrict our analysis to consider salmon only. Finally, we turn to other exporters, asking what has happened in the aftermath to those countries which did sign a free trade agreement with China. We hope this can be indicative of whether Norway missed out on any significant opportunities in the wake of the prize.

This paper proceeds as follows. In section 2 we explore the Peace Prize event in some detail, and provide an overview of the last 25 years of Sino-Norwegian trade relations. In section 3 we presents one of the most empirically-robust models for estimation of trade flows known as the gravity equation. We provide a brief literature review of its origins and applications and show how it can be derived from a Ricardian framework by Eaton and Kortum (2002), before discussing what the theory implies for the context in question. Our data and econometric approach is discussed in section 4, followed by the presentation and analysis of results for each of the questions in turn in section 5. Finally, in section 6 we address some econometric limitations and relate our findings to the current discussion of how Western democracies should conduct its foreign policy towards an emerging China, before concluding in section 7.

2 Background

2.1 The Peace Prize Incident

On the announcement date of the 2010 Nobel Peace Prize, Chinese spokespersons were quick to denounce the decision by the Norwegian Nobel Committee to award the prize to Liu Xiaobo. Already a few months prior, China's Deputy Foreign Minister, Fu Ying, had delivered a warning to Geir Lundestad, the Director of Norway's Nobel Institute, who later recited: "[Such a decision] would pull the wrong strings in relations between Norway and China, it would be seen as an unfriendly act" (Branigan, 2010b). When the award was announced on October 8, news broadcasts regarding the event were reportedly blocked across China, and the Chinese Foreign Ministry repeated earlier statements that Sino-Norwegian relations would suffer as a result (Branigan, 2010a).

Several direct consequences of the award are well known; according to Krekling and Kolstadbråten (2012), Norwegian government officials and business representatives were routinely denied entry to China and forced to cancel appointments and official visits, while Chinese authorities regularly avoided meetings with Norwegian ministers both in Norway and abroad. As shown by earlier studies, Norwegian exports of fresh salmon to China fell rapidly in the years succeeding the event, widely believed to be a deliberate result of retaliation. Johansen et al. (2018) find that these restrictions also affected Norwegian exports of fish meal, with an anonymous informant even quoted saying that one of their containers was destroyed.

The most substantial consequence of the Peace Prize incident was arguably the stalling of trade negotiations which were well under way at the time. In March 2007, Norwegian Prime Minister Jens Stoltenberg and Chinese Premiere Wen Jiabao launched a Joint Feasibility Study to investigate the potential benefits of establishing a Sino-Norwegian Free Trade Agreement. The finished report, which was published a year later, recommended negotiations to commence as soon as possible (NFD, 2008). In September 2008, the first official step was taken with the signing of a Memorandum of Understanding in Oslo, Norway between Minister of Trade and Industry Sylvia Brustad and Assistant Minister Qui Hong (Brustad & Qiu, 2008). Eight rounds of negotiations were successfully completed over the next couple of years, with the last round reportedly making sound progress on several areas (Sunnanå & Dahl, 2010).

2.2 Sino-Norwegian Trade Relations

Between 1995 and 2018, total bilateral trade between China and Norway amounted to USD 123 billion (current), of which approximately one third, USD 43 billion, were from Norway to China and two thirds, USD 80 billion, were from China to Norway[1]. Table 1 lists the ten most exported commodities in either direction, as classified by the World Customs Organization's Harmonized Commodity Description and Coding System[2], using 4-digit product disaggregation. From Panel A, we see that Norwegian exports to China mostly consist of chemicals[3], seafood, minerals, metals and specific-use machinery like pumps and technology products, while Chinese exports to Norway consist of computers and processing machines, digital appliances, boats, textiles and miscellaneous manufactured goods, as seen from Panel B. When combined, the ten most-traded commodities from either country make up 56 and 34 percent of their respective totals.

To the extent that this kind of classification sufficiently captures industry heterogeneity, it is clear from Table 1 that Norway and China have a high degree of inter-industry trade. This is consistent with findings from the Joint Feasibility Study, which states that "The economies of Norway and China are to a large degree com-

[1] The data we rely on in this paper, presented further in section 4, has been through a process of 'reconciliation'. This implies that they may not always match official reports from either partner.

[2] We use the 'Harmonized System', henceforth referred to as simply HS, to classify disaggregated trade flows. HS is an internationally standardized nomenclature allowing for up to 999999 refined commodity groups arranged in a hierarchy under 9999 Headings, 99 Chapters and 21 Sections, each sub-level containing more detailed product information than the level above. For example, Live Animals and Animal Products are contained in Section 1, under which Chapter 03 denotes Fish and crustaceans, molluscs and other aquatic invertebrates; 0302 identifies Fish, fresh or chilled; and Atlantic Salmon is found under 030212. HS originated in 1988, but has been revised frequently since then to introduce new products and eliminate products that are no longer traded. All listings in this thesis refer to the 1992 version unless otherwise specified.

[3] Carboxyamide-function compounds: predominantly cyclic acids, a chemical product which forms polyamides, used in the preparation of textile fibres and articles of plastics.

Table 1: Ten Most Traded Commodities Between Norway and China

Rank	4-digit HS	Commodity	USD thousands	Share
Panel A: Exports from Norway to China, 1995 - 2018				
1	2924	Carboxyamide-function compounds	4 959 658	11.45 %
2	0303	Fish; frozen, excluding fillets	4 295 985	9.92 %
3	2709	Petroleum oils and oils from bituminous minerals; crude	4 212 759	9.73 %
4	3105	Fertilizers; mineral or chemical	2 850 488	6.58 %
5	7502	Nickel; unwrought	2 439 884	5.63 %
6	9032	Regulating or controlling instruments and apparatus; automatic type	1 250 558	2.89 %
7	8413	Pumps; for liquids, liquid elevators	1 248 840	2.88 %
8	8431	Machinery parts	1 089 982	2.52 %
9	2516	Granite, sandstone, other monumental and building stone	1 078 396	2.49 %
10	8479	Machinery and mechanical appliances; having individual functions	1 010 911	2.33 %
Panel B: Exports from China to Norway, 1995 - 2018				
Rank	4-digit HS	Commodity	USD thousands	Share
1	8471	Automatic data processing machines and units thereof	7 598 608	9.55 %
2	8525	Cameras and transmission apparatus for radio-broadcasting or television	4 877 624	6.13 %
3	8901	Cruise ships, excursion boats, ferry-boats, tankers and similar vessels	3 524 304	4.43 %
4	6110	Jerseys, pullovers, cardigans, waistcoats and similar articles	2 201 261	2.77 %
5	9405	Chandeliers, lamps and light fittings	1 830 739	2.30 %
6	8473	Parts and accessories for office machines etc.	1 607 164	2.02 %
7	6204	Women's or girls' garments	1 585 144	1.99 %
8	8517	Telephone sets and printers	1 440 950	1.81 %
9	6210	Other garments	1 391 792	1.75 %
10	9401	Seats and parts thereof	1 336 542	1.68 %

Notes: Commodities are classified on 4-digit HS level. Export values are in totals over all years. The rightmost column is calculated as 4-digit commodity value divided by the sum of total exports from Norway to China (Panel A) and China to Norway (Panel B), respectively. Some commodity names have been altered for simplicity. Data from CEPII (2020).

plementary and Sino-Norwegian trade relations are based on comparative economic strengths" (NFD, 2008, p. 9). Like most of the commodities in Table 1, the report highlights "(...) fish and marine products as well as technological products related to the fisheries industry; petroleum and gas related products (...); and metals, machineries and equipment for the Chinese construction and ship building sectors" as products in the production of which Norway has a comparative advantage[4], and, "[in] the case of China labor intensive manufactures such as textile and apparel, machinery and electronic equipments, as well as primary agriculture products are important" (NFD, 2008, p. 49).

A simple time series plot of aggregated Norwegian exports to China from 1995 to 2018 is shown in Figure 1, including an overview of important events affecting Sino-Norwegian trade relations. Coinciding with the acceptance of China into the World

[4]First presented in David Ricardo's 1817 book *On the Principles of Political Economy and Taxation*, the theory of comparative advantage serves as a fundamental proposition in traditional models of international trade. Its key result is that countries trade not because they specialize in the production of goods in which they are most efficient (i.e. they have an *absolute* advantage), but rather in the production of goods in which the opportunity cost of producing is lower than its partners (i.e. they have a *comparative* advantage). The source of the advantage can vary; for instance, in Ricardo it is due to differences in technology, and in the more recent Heckscher-Ohlin model it is due to different factor endowments. We present a continuous-good, multiple-country Ricardian model in section 3 and discuss its implications further there.

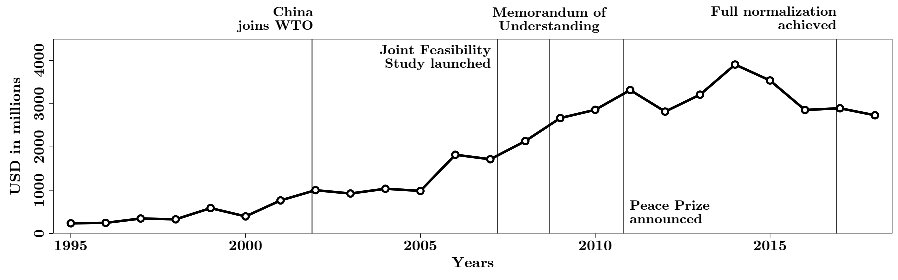

Figure 1: Norwegian Exports to China with Major Events

Trade Organization in December 2001, the value of annual imports from Norway doubled between 2000 and 2002, before doubling again between 2002 and 2007 and again between 2007 and 2009. Trade continued to grow until reaching a temporary peak in 2011, the first year after the announcement of the Peace Prize. In 2012 exports dropped for the first time in over six years, falling almost 17 percent from USD 3.5 billion to USD 2.9 billion – up until this point, the largest decrease in exports over the entire sample, both in levels and in percent. After two years, though, trade was again at an all-time high of over USD 4 billion, before returning to the 2012 level after 2015. One interpretation of Figure 1 suggests that the growth in exports halted around the Peace Prize announcement date and could potentially have been much higher had the increasing trend continued. Another is that the trend had already levelled off around 2009, highlighting the difficulty of saying something about the performance of Norwegian exports to China based on Norwegian exports alone.

Figure 2 shows how the exports in Figure 1 disaggregate across the five largest HS Sections. Everything not contained by these five are compiled and classified as 'Other'. It is clear that the percentage of exports made up by each Section has been relatively stable over the last ten years, with changes mostly affecting

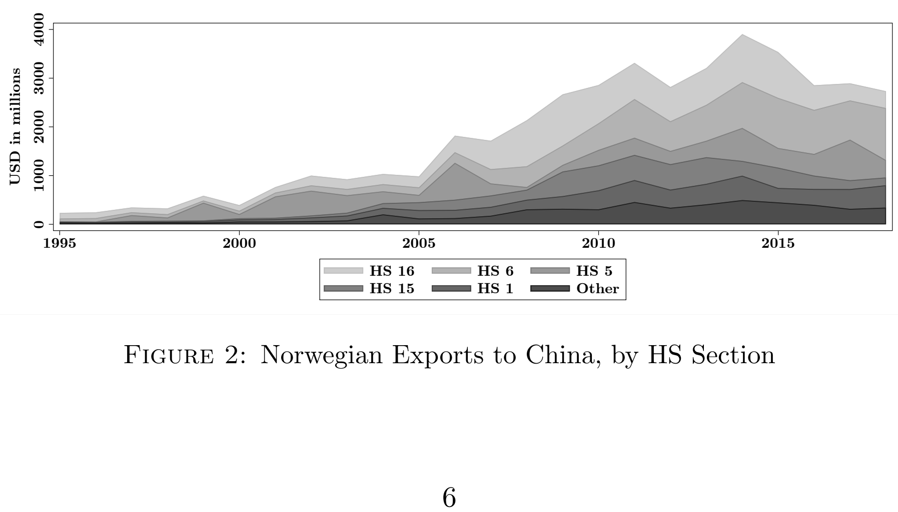

Figure 2: Norwegian Exports to China, by HS Section

Table 2: OLS Estimates of Exports to China in Annual Growth Rates

Dependent Variable: Annual Pct. Change	2011	2012	2013	2014	2015	2016	2017	All Years
Global Baseline	0.21***	0.04	-0.03	0.01	-0.14***	-0.13***	0.13***	0.01
	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.01)
OECD Indicator	0.10*	-0.02	0.17***	0.04	0.01	0.20***	0.10**	0.09***
	(0.06)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)	(0.02)
Nordic Indicator	-0.08	0.03	-0.12*	-0.09	0.21	-0.02	-0.06	-0.02
	(0.09)	(0.11)	(0.07)	(0.09)	(0.14)	(0.07)	(0.05)	(0.04)
Norway Indicator	-0.06	-0.22**	0.13**	0.28***	-0.17	-0.26***	-0.17***	-0.07
	(0.08)	(0.10)	(0.06)	(0.09)	(0.14)	(0.06)	(0.05)	(0.07)
R^2	0.01	0.00	0.03	0.00	0.01	0.04	0.01	0.01
Observations	161	166	165	167	174	181	172	1 186

Notes: Each column represents a separate regression of the form: $\Delta x_i = \alpha + \beta_1 o_i + \beta_2 n_i + \beta_3 y_i + \varepsilon_i$, where Δx_i is the annual percentage change in the USD value of aggregate exports from country i to China in the selected year, o_i, n_i and y_i are indicator variables for OECD, Nordic countries and Norway respectively. The actual mean growth rate for the indicated region less the regions in rows below is obtained by summing all coefficients above and including its own. The last column is a pooled regression of all years from 2011 to 2017. Data is provided from the same source as the main analysis presented in section 4, except that here we have used the full sample of countries. Robust standard errors in parenthesis. *p<0.1, **p<0.05, ***p<0.01.

the total value but not the composition of commodities. The only group which did not grow proportionally between 2000 and 2010 is HS 5 (Mineral Products), reflecting that China has never been a particularly important market for Norwegian petroleum.

2.3 Norway Compared to Other Exporters

To get an overview of how trade flows from Norway to China compare to those of other exporters during the years of treatment, we use OLS to estimate several equations with exports in annual growth rates as the dependent variable and regional indicators as independent variables. The results are reported in Table 2, where each column represents a separate regression of exports to China from the indicated year. Recall that Norway is a Nordic country, which are all members of the OECD, which are all nations of the world. The top coefficient estimate in each column should then be interpreted as the average growth rate in exports to China from all non-OECD member countries, the sum of the first two as the average growth rate for all OECD members excluding Nordic countries, the sum of the first three as the average growth for Nordic countries excluding Norway and the sum of all coefficients as the growth rate for Norway. We restrict the sample to observations where annual growth is less than 100 percent in absolute value. This omits several smaller countries with large fluctuations in trade flows which would otherwise inflate the results; for instance, the growth in exports from Gibraltar to China between 2012 and 2013 was almost 350 000 percent.

The coefficients reported in Table 2 indicate that exports to China fluctuate somewhat from year to year and with no apparent pattern across regions (note the low R^2s in particular). In 2011, the average growth rate in exports from non-OECD members was 21 percent, whereas most OECD countries enjoyed an even higher rate of 31 percent. The coefficients for Nordic countries and Norway are negative, but not significantly so. We stress, however, that since exports are in yearly aggregates, the indicator for Norway contains only one single observation, implying that the standard errors should not be taken too seriously. Rather, we should observe that the average growth in exports from Norway to China in 2011 was 6 percentage points less than other Nordic countries, 14 percentage points less than OECD and 4 percentage points less than non-OECD countries. This result intensifies in 2012, where the growth in Norwegian exports was 19 to 22 percentage points lower than all other regions. The opposite is true in 2013 and 2014, however, but then in the remainder of years, Norwegian exports grew much less than Nordic countries and also considerably less than OECD and non-OECD in 2016 and 2017.

The rightmost column shows the results from a pooled regression of all years from 2011 to 2017. Here, the growth in Norwegian exports is 7 percentage points less than the average for other Nordic countries, 9 percentage points less than the OECD average but about the same as non-OECD. The combined growth in Norwegian exports to China was thus no more than a single percentage point in the entire sample period, whereas Nordic countries and OECD members in particular enjoyed significantly higher growths.

3 The Gravity Model of International Trade

Our empirical approach relies on various specifications of a popular theory for the study of international trade flows known as the gravity equation. In its basic form, the model predicts that bilateral trade increase with the economic size of trading partners and decrease with the distance between them (Van Bergeijk & Brakman, 2010, p. 1). The origins of 'gravity' can be traced to the mid 20th century, when researchers began questioning the lack of location theory – i.e. a distance variable – in economic models to explain international trade. In an age where inaccessibility of data seriously constrained empirical work, Isard and Peck (1954) used statistics from domestic US Class I railroad shipments in the 1940s and international ocean-going freight in the 1920s to show a strong negative correlation between tonnage and distance. Following up on their paper, Isard (1954) constructed a theory using metaphors from the physical science of electric potential to predict the following relationship between distance and trade:

$$V_i = \sum_{j=1}^{n} k \frac{Y_j}{d_{ij}^a},$$

where V is defined as the income potential (from engaging in trade) produced by all nations upon nation i, Y is the income of nation j, and d is the distance between those nations. k is a constant "similar to the gravitational constant" and a is the elasticity of distance (Isard, 1954, p. 308).

3.1 Tinbergen's Gravity

While Isard's formulation was in many ways similar to what would later become known as the gravity equation, the birth of the contemporary model is usually attributed to Dutch economist Jan Tinbergen (1962). In appendix VI of his book, *Shaping the World Economy*, Tinbergen defines the trade flow equation in the following way (notation altered to be consistent with our paper):

$$x_{ij} = \alpha y_i^{\beta_1} y_j^{\beta_2} d_{ij}^{\beta_3}, \tag{1}$$

where x is the trade flow from country i to country j, y is the gross domestic product in each country respectively and d is the distance between them. The elasticities β_1, β_2 and β_3 allow for differences between each variable, but since the purpose of the model is usually to detect diversions from normality, it does not allow for country-specific elasticities. A number of assumptions are required to arrive at this formulation; GDP in the exporting country is assumed to be good proxy for export supply, GDP in the importing country is assumed to be a good proxy for import demand, and distance is assumed to be a good indicator of transportation costs (Tinbergen, 1962).

Estimation of the parameters is usually performed by taking the natural logarithm on both sides of equation (1) and using linear regression, resulting in model fits often in the range of 70-80 percent (Van Bergeijk & Brakman, 2010, p. 5). Further improvements can be achieved by the inclusion of other covariates such as the effective exchange rate or binary variables to account for fixed effects in panel regressions. Specifically, Tinbergen (1962, p. 263) writes “it is obvious that the model could be elaborated considerably so as to give more attention to other aspects of world trade”.

After its publication, gravity quickly gained a popular fanbase. One of the first, Linnemann (1966, p. 211) tests the model on a cross-sectional sample of 80 countries in 1959 and finds a significant trade-reducing effect of population size. Aitken (1973) uses gravity to study the effect of the EEC (predecessor to the European Union) and EFTA on European trade, Pelzman (1977) assesses trade creation and diversion within the COMECON (the Eastern Bloc equivalent of the OECD), Brada and Mendez (1985) compare economic integration across developed, developing and centrally-planned economies and, similar to our own application, van Bergeijk (1992) uses gravity to find a positive significant relationship between bilateral trade and changes in the diplomatic climate. One of the more famous applications include McCallum (1995), who is credited for discovering the ‘border puzzle’ – that, even when the distance is longer, US states trade more with each other than with their Canadian counterparts. Gravity has also been adopted outside the realm of international trade; for instance, Ellis and Van Doren (1966) use the framework to study recreational traffic flows, Olsson (1965) studies social interaction, and Long (1968) assesses the economics of air travel.

Despite its empirical strength, however, the gravity model has also faced criticism for lacking a solid theoretical underpinning. While several early studies attempted to remedy this (e.g. Anderson (1979) and Bergstrand (1985, 1989)), these have been dismissed as either too complex, or otherwise failed to gain particular academic recognition on their own. As late as 1995, a survey by Leamer and Levinsohn argues that “gravity models are strictly descriptive. They lack a theoretical underpinning so that once the facts are out, it is not clear what to make of them” (Leamer & Levinsohn, 1995, p. 46). On the other hand, some authors have criticized gravity for being too supportive of theory, for instance, Deardorff (1998) shows that the model is consistent with almost every theory from Ricardo to New Trade. While early derivations placed gravity in a framework of increasing returns to scale and monopolistic competition, this assumption also fits with a multiple-good version of the Heckscher-Ohlin model which is characterized by constant returns and perfect competition (Feenstra, 2015, p. 133).

More recently, however, several researchers have received recognition for deriving a theoretical gravity equation, settling the lack-of-theory discussion once and for all. The most prominent solutions arguably come from seminal work by Eaton and Kortum (2002) and Anderson and Van Wincoop (2003). The former, on which we elaborate below, use a probabilistic approach to develop the model in a Ricardian framework. The latter maintains the monopolistic competition world of Anderson (1979) and has become famous both for solving McCallum's 'border puzzle' and for introducing the term 'multilateral resistance' to denote a given partner's relative barriers to trade with respect to all other countries. The downside is that this makes the gravity equation harder to estimate. Some of the first to follow up on Anderson and Van Wincoop's article, Redding and Venables (2004) suggest using importer and exporter fixed effects to allow the data itself determine the effects of multilateral resistance. This approach will also be used in our application.

3.2 A Microfounded Gravity Equation

To derive a gravity equation suitable for our context, we make use of the seminal Eaton and Kortum (2002) multiple-good, multiple-country Ricardian trade model (henceforth EK) where production is characterized by constant returns to scale and different access to technology. As discussed in section 2.2, Sino-Norwegian imports and exports seems to fit well with the implications of this type of traditional trade theory due to the high degree of observed inter-industry trade. We argue that years of cultivation of Norwegian marine and high tech industries at the expense of many low-skilled production processes, coupled with China's easily-mobilized, yet lesser-skilled workforce can be thought of as giving rise to technological differences yielding comparative advantages.

In the model, each country produces a continuum[5] of goods $h \in [0, 1]$. With country-

[5]It may be useful to think of 0 as representing HS commodity 000001 and 1 as representing the final HS commodity 999999, but strictly speaking the model's probabilistic approach requires that

specific input-bundle costs c_i and production efficiency $z_i(h)$, the cost of producing one unit of good h in country i is $\frac{c_i}{z_i(h)}$. Next, geographic barriers are introduced by making Samuelson's iceberg assumption that the transport of commodities require paying some of that commodity itself in shipping costs; i.e. a part of the shipment 'melts' away in transport. The assumption is not realistic, but simplifies the calculation of transport costs by not including "elaborate models of a merchant marine" (Samuelson, 1954, p. 268). Let this factor be denoted by d, and observe that $d_{ij} \geq 1$ for all $i \neq j$ and $d_{ii} = 1$ so that international trade is costly but domestic trade is 'free'[6]. Furthermore, it is never cheaper to transport commodities through a third-party country, so $d_{ij} \leq d_{ik}d_{kj}$ for any three countries i, j and k. The cost of delivering one unit of good h from country i to j thus becomes:

$$p_{ij}(h) = \left(\frac{c_i}{z_i(h)}\right) d_{ij}. \tag{2}$$

Importantly, EK assumes perfect competition, which means the price each buyer actually pays for a product is that offered by the cheapest country:

$$p_j(h) = \min\left\{p_{ij}(h); i = 1, 2, ..., N\right\}, \tag{3}$$

where N is the number of countries. In other words, country j always chooses to buy from the most efficient producer of a good after geographic barriers are taken into account.

The key feature of EK is that each country's efficiency in producing a good $z_i(h)$ is the realization of an independent and identically distributed random variable drawn from a Fréchet distribution[7] which varies across countries. Let $F_i(z)$ denote the

the distribution of goods is continuous.

[6]Specifically, the transport cost factor d is defined as the amount of goods required to ship in order for one unit of that good to arrive at its destination. It directly reflects the regime of international trading; under autarky, $d_{ij} \to \infty$ for all $i \neq j$ and the price of purchasing any good h from i also goes to infinity regardless of how cheap it is domestically. In the opposite case, without geographic barriers ('zero gravity'), $d_{ij} = d_{ii} = 1$, implying a completely frictionless global market. We should, however, remember to think broadly about d; it reflects not only trade tariffs, but also the cost of freight, insurance and all other geographic and non-tariff barriers.

[7]Innovations in technology are assumed to come from a Pareto distribution, reflecting that most innovations are small and larger breakthroughs occur much less frequently. The point of using an extreme value distribution (EVD) to represent technology comes from the idea that the specific invention applied to the production of each good will always reflect the most efficient discovery to date, i.e. the maxima from the Pareto draws. Specifically, Fréchet is used because it is the only one of the three EVD's (Gumbell, Weibull and Fréchet) which also ensures that the distribution of

cumulative distribution function of country i's efficiency, $F_i(z) = \Pr[z_i(h) \leq z]$, so that we have:

$$F_i(z) = e^{-T_i z^{-\theta}}, \tag{4}$$

where $T_i > 0$ and $\theta > 1$ are location and shape parameters respectively[8]. The former captures the overall level of efficiency in each country and is meant to correspond to the Ricardian concept of absolute advantage. A big T_i means that this country is technologically superior, and will typically draw high efficiencies in the production of any goods, whereas a small T_i means that this country is technologically inferior, and the probability of drawing high efficiencies is lower. θ, on the other hand, is common to all countries and affects the shape of the distributions, which is how the model incorporates comparative advantages. A big θ tightens the variability so that the outcomes of each country's efficiency draws become more concentrated and exports are increasingly determined by T_i, whereas a small θ widens the distributions so that even those countries without much absolute advantage can still receive a higher efficiency draw in the production of certain goods. In such cases, having the biggest T_i is beneficial, but does not make you the single global supplier of goods, even in zero gravity. Eaton and Kortum (2002) estimate the parameters from a cross-sectional sample of 19 OECD countries in 1990, finding that the most probable θ is 8.28, which implies a 15 percent standard deviation in efficiency for a given state of technology. Using this value, the technology parameters are then backed out for each country and reported on a scale relative to the United States (in other words, $T_{USA} = 1$); Japan is found to have a T_{JPN} of 0.89, Germany has a T_{GER} of 0.81 and Portugal has the lowest with a T_{PRT} of 0.04. Norway is estimated to have a T_{NOR} of 0.43, ranking its within-sample absolute advantage around average, decidedly lower than the more advanced economies. China is not included in the sample.

We now turn to consider the distribution of prices, keeping in mind that their dependence on efficiency means these too are random. Let $G_{ij}(p)$ denote the cumulative distribution function of country i's prices facing j, $G_{ij}(p) = \Pr[p_{ij}(h) \leq p]$. Substituting $p_{ij}(h)$ with the expression for the cost of purchase from equation (2) allows

prices is an EVD.

[8]Recall that the cumulative distribution function of a standard Fréchet has the following form: $F(x) = e^{x^{-\theta}}$, where θ is the shape parameter. EK also includes location parameters.

us to write[9]:

$$G_{ij}(p) = 1 - e^{-[T_i(c_i d_{ij})^{-\theta}]p^{\theta}}. \tag{5}$$

Since j does not import exclusively from i, but rather purchases its goods from the cheapest among all suppliers, the cumulative price distribution for what country j actually buys, $G_j(p) = \Pr[p_j(h) \leq p]$, is[10]:

$$G_j(p) = 1 - \prod_{i=1}^{N} [1 - G_{ij}(p)],$$

which, by inserting (5), becomes:

$$G_j(p) = 1 - e^{-\phi_j p^{\theta}}, \tag{6}$$

where the price parameter ϕ_j is given by[11]:

$$\phi_j = \sum_{i=1}^{N} T_i(c_i d_{ij})^{-\theta}. \tag{7}$$

To link their model to the gravity literature, Eaton and Kortum (2002) take advantage of several important properties of the price distributions; define π_{ij} to be the probability that the lowest price offered for a good is that provided by country i to j. This probability can be shown to equal i's contribution to j's price parameter, the required steps for which we divert to Appendix A.1. By the law of large numbers, π_{ij} also equals the share of j's purchases from i as well as its fraction of *expenditures*, since there are a continuum of goods and j's average expenditure per product does not vary by source. We can then write:

$$\pi_{ij} = \frac{T_i(c_i d_{ij})^{-\theta}}{\phi_j} = \frac{x_{ij}}{x_j}, \tag{8}$$

[9]We have $G_{ij}(p) = \Pr[p_{ij}(h) \leq p] = \Pr[\frac{c_i}{z_i(h)} d_{ij} \leq p] = 1 - Pr[z_i(h) \leq \frac{c_i}{p} d_{ij}] = 1 - F_i(\frac{c_i}{p} d_{ij}) = 1 - e^{-[T_i(c_i d_{ij})^{-\theta}]p^{\theta}}$.

[10]Here EK relies on the following rule: Let $X_{(1)}$ denote the minimum of $X_1, X_2, \ldots, X_n$ i.i.d. continuous random variables with cumulative distribution function F. The cdf for the minimum is then $F_{(1)}(x) = \Pr(X_{(1)} < x) = 1 - \Pr(X_{(1)} > x) = 1 - \Pr(X_1 > x, \ldots, X_n > x) = 1 - \Pr(X_1 > x) \times \ldots \times \Pr(X_n > x) = 1 - \prod_{i=1}^{n} [1 - F(x)]$.

[11]Since $X^a \times X^b \times ... \times X^n = X^{\sum_{i=a}^{n} i}$.

where x_{ij} is country j's expenditures on goods from i and x_j is j's total spending[12]. At the same time, the exporters total sales q_i is given by:

$$q_i = \sum_{m=1}^{N} x_{im} = T_i c_i^{-\theta} \sum_{m=1}^{N} \frac{d_{im}^{-\theta} x_m}{\phi_m}, \tag{9}$$

that is the sum of i's sales to each individual country m, where the second equality follows from inserting x_{ij} from equation (8).

On the demand side, a representative consumer (or firm, since the model makes no distinction between the two) in each country maximizes a constant elasticity of substitution objective function given by:

$$U_j = \left[\int_0^1 Q_j(h)^{(\sigma-1)/\sigma} dh \right]^{\sigma/(\sigma-1)}, \tag{10}$$

where $Q_j(h)$ denotes expenditures on commodity h in country j and $\sigma > 0$ is the elasticity of substitution between goods. The objective function is subject to the budget constraint $\int_0^1 P_j(h) Q_j(h) dh = X_j$, which simply states that aggregate spending on all goods must equal total expenditures in each country. Note that for simplicity we have made the constraint binding. In Appendix A.2 we solve this maximization problem to show that the exact price index associated with each country is given by[13]:

$$p_j = \gamma \phi_j^{-1/\theta}. \tag{11}$$

By solving equation (11) for the price parameter ϕ_j, and equation (9) for $T_i c_i^{-\theta}$, we can combine equations (8), (9) and (11) to get:

$$x_{ij} = x_j q_i \alpha_{ij}, \tag{12}$$

where $\alpha_{ij} = \frac{(\frac{d_{ij}}{p_j})^{-\theta}}{\sum_{m=1}^{N} (\frac{d_{im}}{pm})^{-\theta} x_m}$. Equation (12) is the closest we get to the traditional gravity equation using Eaton and Kortum's model. The expression relates country

[12]It is important to stress that the latter is not the same as j's gross domestic product; in statistical accounts, x_j is often denoted as the *gross output*, which is equal to the nation's GDP plus its expenditures on intermediary goods.

[13]This expression highlights how geographic barriers create differences between prices faced by each country. If d_{ij} for a particular country j are high (think of a remote importer with strict import tariffs located far away from other nations), then this makes the price parameter ϕ_j for that country smaller and its price index higher.

j's expenditures on commodities from country i, x_{ij}, to j's total expenditures x_j and i's total sales q_i, where both factors enter with unit elasticity. The numerator in the composite term α_{ij} shows how geographical barriers between partners i and j are deflated by the importers price level p_j; just like a larger d_{ij} leads to less trade, lower prices in country j reduces i's access to that market since i's goods are more expensive. The denominator has a similar interpretation, but aggregates over all countries so that it represents the total world market from country i's perspective. With all else unchanged, we see how the sudden addition of a new country (imagine an autarkic country m with $d_{im} = \infty$ which suddenly decides to reduce barriers so $d_{im} \to 1$) leads to lower exports between i and j since the expanded global market absorbs some of their existing trade.

3.3 Implications of the Peace Prize Event

A major result of Eaton and Kortum (2002), and Ricardian trade theory more generally, is that everybody wins by reducing trade costs. In our case, even a country like China, which could arguably be almost entirely self-sufficient (at least with respect to Norway), benefits from specialization and buying from abroad what they are relatively less efficient in producing. With coefficient estimates obtained from their OECD sample, Eaton and Kortum create stylized counterfactuals for every country, considering, in turn, (i) a move to full autarky ($d_{ij} \to \infty$ for all $i \neq j$), (ii) zero gravity ($d_{ij} = 1$ for all i, j) and (iii) a doubling of trade relative to the model's baseline level (corresponding to a reduction in d_{ij} of about 30 percent). In the first case, welfare is reduced for all countries, ranging from 0.2 percent in Japan to 10.3 percent in Belgium, with an average loss of about 3.5 percent[14]. The loss reflects an increase in input prices relative to income, now that every country has to be self-sufficient. In the second case, the completely frictionless global market results in a dramatic fall in prices. Welfare improves substantially, ranging from 16.1 percent in the United States to 24.1 percent in Greece, with an average gain of about 20 percent. The point of including the final case is primarily to show how far we are from a zero-gravity world; even with a doubling of global trade, the benefits are nowhere near the welfare gains in the former setup, averaging 2.5 percent only.

[14] The welfare loss from moving to full autarky in EK is believed by some to be unrealistically small, see for instance Melitz and Redding (2014).

What does all this imply about the effects of the Peace Prize incident on Norwegian exports? We proceed by assuming the trade barrier component d_{ij} can be broken down into two parts: $d_{ij} = d_{1ij} + d_{2ij}$, where the first term reflects non-voluntary resistance such as geography and culture and the second reflects every form of optional resistance measure in place such as treaties (trade-increasing) and sanctions (trade-reducing). We still have $d_{ij} \geq 1$, so we must restrict $d_{1ij} \geq 1$ and $d_{2ij} \geq 0$ – in other words, there is a limit to how beneficial the voluntary measures can be, and no two partners can reduce barriers lower than that imposed by d_{1ij}. When the Nobel Committee awarded the Peace Prize to Liu Xiaobo in 2010, China was inclined to increase d_2 to punish Norwegian interests. While international institutions impose strict limits on how this can be achieved, the halting of FTA-negotiations, imposing customs delays and incentivizing agents to change suppliers without letting it go so far as to trigger a response from the WTO are just some examples of possible channels. The problem for China is that these threats are non-credible since, according to the theory, raising d_2 will have negative effects on Chinese welfare as well. The economic incentives for such punishments are not present.

But we must also consider the case where China regards the Peace Prize awarding as so antagonistic to their sovereignty that the costs of 'letting the matter slide' outweighs the welfare loss of punishment. In that case, it can be optimal for authorities to increase d_2 enough to make their importers better off by changing suppliers, at least for the purchase of certain goods. Thus we would expect Norwegian exports to China in aggregates to decline. However, the story need not end there. While generally incompatible with the perfect competition setup of EK, a popular theory for the study of exporting dynamics suggests that trade flows can be persistent. According to Roberts and Tybout (1997), exporters face fixed costs in both entering, exiting, and re-entering global markets. This results in a 'beachhead effect' (a term originally coined by Baldwin (1988)); once entry into a particular country has been established, the incentives to remain in the market through times of distress become stronger if exporters believe the losses are transitory. Not only can it be costly to withdraw, but even after a macroeconomic shock such as a sudden currency devaluation makes it less profitable to remain in the short run, the fact that the shock is transitory combined with expected future revenue streams still implies that the net benefit of staying is positive.

The fixed cost component is frequently shown to be a significant determinant of international trade. An empirical study by Bernard and Jensen (2004) finds that the probability of exporting in any given period increases by 39 percent if the exporter already shipped to that market in previous periods, while Maurseth and Medin (2017) place that same estimate as high as 180 percent in the seafood sector – the experience gained from exporting in the past increasing the probability of exporting today from 3.9 to 11 percent. Moreover, exporting experience appears to deteriorate rapidly. One of main findings of Roberts and Tybout (1997) is that after only two years outside, the cost of re-entry for a firm which exported in the past is about the same as that faced by a new exporter. According to Gullstrand (2011), fixed costs seem to play a larger role for smaller, less productive firms.

In our case, we need to think of the macro shock as a 'Peace Prize shock', making trade with China suddenly less profitable for some Norwegian exporters. Assume now that China increases d_2 just enough to result in a change of supplier of Atlantic salmon from Norway to either Chile or the United States. This could be because there are many suppliers of salmon who are relatively efficient, but perhaps more realistically because China specifically chooses to target seafood for symbolic effects. Norwegian exporters, however, expecting that the restrictions are transitory, do not exit the Chinese market. Instead, they – or their Chinese counterparts, depending on bargaining power – pay to find alternative solutions to bypass these restrictions such as re-exporting through Vietnam. This is consistent with the previously-discussed findings of Chen and Garcia (2016) on which we elaborate in section 5.2. If we believe their informants, the costs of that burden was mostly carried by the Chinese.

Notice that avoiding trade barriers by re-exporting through third-party countries is strictly speaking a violation of EK's no-triangular-arbitrage condition, even if this result is only true after taking multiple periods into account. In the static environment of EK, direct exports are always assumed to be the cheapest option, and by perfect competition the cheapest provider of a good to a given country is the sole supplier.

4 Data & Econometrics

4.1 Data

We use data on bilateral trade flows from the BACI database provided by the French research agency CEPII. BACI contains over 150 million HS six-digit disaggregated type-pair-year observations from more than 200 trading partners between 1995 and 2018, measured in thousands of nominal USD. The raw data for BACI is taken from the UN Comtrade database to which each country directly reports their individual trade flows. An issue with Comtrade and most other providers of trade statistics is that reported exports from one country typically do not match with imports reported by the receiving country[15]. BACI solves this through a process of reconciliation where trade flows are harmonized so that the reported value of good h from country i to j always matches the reported value of good h to j from i[16].

Country-specific macro data is provided by the World Bank WDI database and merged with BACI. We include each country's gross domestic product, population size and relative exchange rates, where output is denominated in nominal USD. Key variables are not deflated; as we have seen, gravity is an expenditures model in which multilateral resistance terms are designed to capture effects of unobserved price indices. Since a country's aggregate sales and spending are not comprehensively recorded, we follow the convention of assuming GDP to be an adequate proxy in some of our models, as is common among many empiricists (Head & Mayer, 2014). We also provide alternative solutions (see the next subsection).

Observations from Belgium and Luxembourg, France and Monaco, and Switzerland and Liechtenstein are merged in pairs since these regions are defined differently by the two sources. The same is done for South Africa, Botswana, Eswatini, Lesotho

[15]The discrepancy is known as 'bilateral asymmetries', and arises primarily because 1) exporters report value using Free-on-Board whereas importers report Cost, Insurance and Freight, 2) countries use different applications of measurement and trade systems in data compilation, and 3) shipping time-lags, customs delays and re-exports through third party nations create disturbances (United Nations Statistics Division, 2019). It is also possible that bilateral asymmetries are a result of intentional underreporting by one or more parties due to tax/tariff evasion efforts.

[16]The harmonization process follows two steps. First, CIF expenditures are estimated and removed so that all values are reported in FOB. Second, each reporter's reliability is assessed according to how far their average measurements differ from those of all other nations. The reconciled trade flows are then calculated as the average of the two reported, where more weight is assigned to the more reliable reporter (Gaulier & Zignago, 2010).

and Namibia since CEPII reports trade flows to and from these countries under the heading of the South African Customs Union. To calculate the Euro-equivalent of eurozone countries' currencies before the implementation of the Euro (1999 for most countries, but with some exceptions) we rely on the OECD's irrevocable conversion rates[17]. The country-pair relative exchange rate is then calculated as an implied quote using the USD as an intermediary:

$$r^*_{ijt} = \frac{r_{ijt}}{r_{ij0}} = \frac{LCU_{it}/USD_t}{LCU_{jt}/USD_t}/r_{ij0} = \frac{LCU_{it}}{LCU_{jt}}/r_{ij0}, \tag{13}$$

where LCU stands for the Local Currency Unit of countries i and j and we normalize to base year for each pair so that $r^*_{ijt} = 1$ for all i and j in 1995.

Geographical variables are provided by CEPII's own gravity dataset, which includes proxies for trade costs such as distance[18] and indicators for contiguity and common language. We also add a separate indicator for sea access. Note that since all geographical variables are time-invariant, their impact can only be assessed using random effects regression.

For the main analysis, we restrict our sample to the 36 OECD member countries plus their key partners China, India, Indonesia, Brazil and South Africa (i.e. the South African Customs Union). Hong Kong and Vietnam are also included, the reasons for which are discussed in the next section. While it would arguably be better from a statistical point of view to include as many countries as possible, this is also problematic as what constitutes the baseline in our model becomes more and more influenced by marginal exporters whose trade flows are small, nonexistent and/or highly volatile. The decision to limit the sample thus improves the model fit considerably and virtually eliminates the need to deal with zero observations since practically all partners trade with each other in every period. After restricting

[17] The irrevocable conversion rates are listed, among other places, in Schreyer and Suyker (2002).

[18] Distance is denominated in kilometers between the two partners' most populous cities, calculated using the formula for great-circle distance as reported by Head (2003):

$$d_{ij} = 3962.6 \arccos\left([\sin(la_i) \cdot \sin(la_j)] + [\cos(la_i) \cdot \cos(la_j) \cdot \cos(lo_i - lo_j)]\right),$$

where d_{ij} is the distance in km between countries i and j, lo is longitudinal position in degrees divided by 57.3 to convert it to radians and la is latitudinal position in degrees divided by -57.3 or 57.3 depending on whether the position is reported in degrees west or east.

Table 3: Descriptive Statistics of Main Variables

Panel A: Descriptive Statistics

	Observations	Mean	Median	Std. Dev.	Min	Max
lntrade	41 304	19.20	20.13	2.33	7.12	26.94
lnGDP	41 304	26.53	26.50	1.63	22.23	30.65
lnPOP	41 304	16.82	16.48	1.75	12.50	21.05
fx^{norm}	41 304	1.76	1.00	5.55	0.01	144.09
lndist	41 304	8.32	8.79	1.11	4.09	9.88
contig	41 304	0.05	0	0.21	0	1
comlang	41 304	0.07	0	0.26	0	1
seaaccess	41 304	0.77	1	0.42	0	1

Panel B: Simple Correlation Matrix

	lntrade	$lnGDP_i$	$lnGDP_j$	$lnPOP_i$	$lnPOP_j$	fx^{norm}	lndist	contig	comlang	seaaccess
lntrade	1									
$lnGDP_i$	0.59	1								
$lnGDP_j$	0.55	0.04	1							
$lnPOP_i$	0.39	0.76	-0.01	1						
$lnPOP_j$	0.33	-0.01	0.76	-0.02	1					
fx^{norm}	0.02	0.05	0.02	0.11	-0.02	1				
lndist	-0.28	0.13	0.13	0.24	0.24	-0.02	1			
contig	0.27	0.03	0.03	0.00	0.00	-0.02	-0.42	1		
comlang	0.18	0.10	0.10	0.05	0.05	-0.03	0.04	0.19	1	
seaaccess	0.05	0.11	0.11	0.13	0.13	0.03	0.25	-0.09	0.07	1

Notes: lntrade is log of trade flow, lnGDP is log of Gross Domestic Product, lnPOP is log of population, fx_norm is the normalized relative exchange rate, lndist is the log distance (most populated cities, in km), contig, comlang and seaaccess are indicators for whether or not the exporter and importer share borders, have at least one common official language and both have sea access, respectively. Since GDP and population are included twice in the regressions, their correlations need to be considered separately.

our sample, the 'OECD plus' dataset[19] contains 41 304 pair-year observations from 42 countries, 1 722 country-pairs and 24 years between 1995 and 2018. Over 99 percent of these groups have no missing observations, making the panel almost fully balanced. The lowest trade observation is of Estonian exports to New Zealand in 1997 with a value of USD 1 237, and the highest is of American imports from China in 2018 with a value of USD 499 billion. Summary statistics for the main variables are shown in Panel A of Table 3, complemented by a simple correlation matrix in Panel B. As we see, multicollinearity is not a problem for any of the main variables. In Appendix B, we provide scatter plots of all observations of bilateral trade flows against the traditional gravity variables. When logged, these relations seem almost perfectly linear on average but, as in Eaton and Kortum (2002), the variance for distance is heteroscedastic.

[19]Full links to all data sources are found in the reference list under CEPII (2020), The World Bank (2020) and CEPII (2015). The compiled dataset as well as do-files are available upon request.

4.2 Empirical Approach

Recall that the log-linearized standard gravity equation is given by:

$$\ln x_{ij} = \ln \alpha + \beta_1 \ln y_i + \beta_2 \ln y_j + \beta_3 \ln d_{ij}, \tag{14}$$

where x_{ij}, y_i, y_j and d_{ij} have the same interpretation as before. To investigate what happened to Norwegian exports in the years after the Peace Prize, we employ a diff-in-diff[20] type approach where the gravity equation serves as a baseline for our counterfactual. The model is extended to compensate for our inability to fully incorporate structural gravity. In the following, $G'_{ijt} = (\ln y_{it}, \ln y_{jt}, \ln p_{it}, \ln p_{jt}, r^*_{ijt})$ is a vector containing the time-varying variables of either country's gross domestic products at time t, y_{it} and y_{jt}, population sizes, p_{it} and p_{jt}, and their normalized mean annual relative exchange rate, r^*_{ijt}. Furthermore, $D'_{ij} = (\ln d_{ij}, b_{ij}, l_{ij}, o_{ij})$ contains the time-invariant variables, i.e. the log of great-circle distance in kilometers between trading partners, $\ln d_{ij}$, as well as indicators for common borders, b_{ij}, common language, l_{ij}, and both countries having sea access, o_{ij}.

We also include treatment indicators which will be discussed in turn below. A novel feature of our research design is the inclusion of indicators for other East-Asian importers in close proximity to China, on the suspicion that these countries were used as intermediaries to bypass Chinese restrictions. Let j' denote each of these importers of interest (in addition to China, we focus on Vietnam, Japan, Hong Kong and South Korea), and let i' denote the exporter of interest (set to Norway initially, but will vary in later iterations).

4.2.1 Random Model

To estimate the coefficients, we first specify a random effects regression model which takes into account the full set of variables[21]. While contemporary gravity literature suggests distance is not a sufficient proxy for trade resistance, we nevertheless provide

[20] A standard diff-in-diff setup would be to let exports from one country serve as a counterfactual for Norwegian exports to China, under the critical assumption that these times series follow *parallel trends* before (and in the absence of) the administration of treatment. Since finding such a credible exporter is hard, our counterfactual is constructed using the gravity relationship with indicators estimated from every country in the sample.

[21] We provide a technical review of the estimation procedures and required assumptions for panel data regression in Appendix D.

these results for consistency. The random model uses FGLS to estimate the following equation:

$$\ln x_{ijt} = G'_{ijt}\beta + D'_{ij}\delta + \tau_t + \sum_{j'} [\gamma_{1j'}(c_{i'}s_t c_{j'}) + \gamma_{2j'}(c_{j'}s_t)] + \gamma_3(c_{i'}s_t) + \upsilon_{ijt}, \quad (15)$$

where x_{ijt} is the nominal USD value of exports from country i to country j in year t; β and δ are vectors of coefficients; τ_t is shorthand for $\sum_t \tau_t k_t$ where k_t indicates each year in the sample (first year omitted) to capture global time-fixed effects, $c_{i'}$ is an indicator for the single exporter of interest; $c_{j'}$ is an indicator for each of the five importers of interest; s_t is a treatment indicator equal to one for all years assumed to be affected by treatment and zero otherwise, interacted with $c_{i'}$ and $c_{j'}$ both separately and together; and $\upsilon_{ijt} = \alpha_{ij} + \varepsilon_{ijt}$ is the composite error term assumed to be uncorrelated with all other regressors since both the time-invariant component α_{ij} and the idiosyncratic error ε_{ijt} are supposedly random. The coefficients of interest are $\gamma_{1j'}$ which capture any disruption in trade flows from country i' to country j' in the treatment years after controlling for exporter and importer treatment-period effects. Results are reported with τ_t switched on and off; when off, the main effect of the treatment variable, $\gamma_4 s_t$, is included in its place.

Two important things to note regarding the equation above. The first is that we estimate the effects of treatment on all suspected channels in the same regression. We do this to reduce the risk of interference; as discussed in Kolstad (2019), if we believe the Peace Prize had an effect on Norwegian exports to two or more countries simultaneously, failing to control for this possibility will lead to an over/underestimation of the individual effects since the control group would also be receiving treatment. It is econometrically impossible to consider every potential channel at the same time, of course, so we must necessarily assume that the interference would predominantly come from one of these countries. The second thing to note is the terms where the treatment variable is separately interacted with the exporter and importers of interest. We call these the first-order interaction effects. Including them is not a universal requirement, however, the implication of not doing so is that we assume there are no systematic factors other than those prescribed by gravity affecting treatment. The benefit of having them in the system is that the we are specifically filtering out global effects of Norwegian exports and Chinese imports during the treatment period *before* we estimate the coefficient of interest. As we will see this has important implications for the results. It is also possible to include main effects of all the interacted coefficients by themselves, but for now these are purposely left out since their inclusion would violate the philosophy of the random model by making these effects fixed for the countries of interest.

4.2.2 Fixed Model

Next, we specify a fixed effects regression model which uses country-pair fixed effects to measure trade resistance directly. The benefits of this approach are many; not only is it the single appropriate specification suggested by formal tests (see below), it also raises the explained variance significantly and brings us closer to the theoretically-founded model by avoiding the assumption that distance is good proxy for trade costs. The fixed model uses within estimation to estimate the following equation:

$$\ln x_{ijt} = G'_{ijt}\beta + \alpha_{ij} + \tau_t + \sum_{j'} [\gamma_{1j'}(c_{i'}s_t c_{j'}) + \gamma_{2j'}(c_{j'}s_t)] + \gamma_3(c_{i'}s_t) + \varepsilon_{ijt}, \quad (16)$$

where the main distinction from the random model is that $D'_{ij}\delta$ is now captured entirely by the fixed effects. The new country-pair component, α_{ij}, is really shorthand for $\sum_i \sum_j \alpha_{ij} c_i c_j$, where c_i and c_j are indicators for each importer and exporter in the sample; and ε_{ijt} is the idiosyncratic error term, assumed to be uncorrelated with all other regressors. As in the random model, when the time-specific component is switched off, the main effect of the treatment variable, $\gamma_4 s_t$, is included in its place, and we will report results both with and without the first-order interactions. Now that all fixed effects are accounted for (observe that the main effects from the interacted variables are captured by α_{ij} and τ_t), we can think of this as our complete diff-in-diff model, conditional on the gravity equation. Finally, we introduce source-year and destination-year fixed effects to make the estimation self-contained. This 'unconditional' model takes the following form:

$$\ln x_{ijt} = \beta_{it} + \beta_{jt} + \alpha_{ij} + \sum_{j'} \gamma_{1j'}(c_{i'}s_t c_{j'}) + \varepsilon_{ijt}, \quad (17)$$

where β_{it} is shorthand for $\sum_i \sum_t \beta_{it} c_i k_t$; β_{jt} is shorthand for $\sum_j \sum_t \beta_{jt} c_j k_t$; and the rest is the same as before. Corresponding to what Anderson and Van Wincoop (2003) refer to as outward and inward multilateral resistance respectively, the two terms β_{it} and β_{jt} allow us to circumvent the problem of using GDP to proxy gross output so long as we have access to panel data for estimation. Note that time-specific components as well as all first-order interactions are now captured by the fixed effects. This model is also the only specification which is directly compatible with EK[22].

For statistical inference, the standard assumption in the fixed effects model is that ε_{ijt} is i.i.d., conditional on α_{ij}. We relax this assumption by using cluster-robust standard errors, requiring only that ε_{ijt} is independent across country pairs, but not *within* pairs[23]. This requires in turn that $N \to \infty$, which is arguably met with $N = 1722$. As discussed in Cameron and Miller (2015), failure to use clustering when appropriate leads to unreasonably small standard errors and a potential increase in type I errors.

In Appendix B, we provide the output from three tests confirming the appropriateness of the fixed effects model. The first is a Breusch and Pagan Lagrangian Multiplier test for random effects which checks whether the variance of the time-fixed components α_{ij} is non-zero against the null hypothesis that it is zero. The next is an F-test which checks for the presence of fixed effects against the null hypothesis that all α_{ij} coefficients are zero. Specifically, the F-test asks whether the goodness-of-fit measure improves when fixed effects are included in the model. The implication of a rejected null hypothesis in either of these two tests implies that population-averaged[24] OLS is unsuitable. Lastly, we run a Hausman test which checks the alternative hypothesis that estimates from the random and fixed effects models significantly differ against the null hypothesis that they are equal. If the

[22]Some manipulation of equation (8) gives us: $X_{ij} = T_i c_i^{-\theta} X_j \phi_j^{-1} d_{ij}^{-\theta}$, which, by taking natural logarithms on both sides, becomes:

$$\ln[X_{ij}] = \beta_i + \beta_j - \alpha_{ij},$$

where $\beta_i = \ln[T_i c_i^{-\theta}]$, $\beta_j = \ln[X_j \phi_j^{-1}]$ and $\alpha_{ij} = \theta \ln[d_{ij}]$, the estimates of which respectively capture exporter, importer and country-pair fixed effects.

[23]Specifically, instead of requiring that $Cov(\varepsilon_{ijt}, \varepsilon_{skl}) = 0$ for all $ij \neq sk$ and $t \neq l$, we require that $Cov(\varepsilon_{ijt}, \varepsilon_{skt}) = 0$ for all $ij \neq sk$, regardless of t.

[24]While not used in this paper, we briefly explain the PA model in Appendix D.

time-invariant components are random, then estimates from both models should be similar since both are consistent; if on the other hand the estimates diverge, this suggests that α_{ij} is systematically correlated with other regressors and that the random model is biased. All three null hypotheses from the LM, F- and Hausman tests are rejected, in favor of the fixed effects specification.

We also run a test for autocorrelation between the residuals υ_{ijt} using the population-averaged model. The results indicate a strong presence of autocorrelation, averaging 0.84 for all possible lags. This should not be surprising; even if the idiosyncratic error term ε_{ijt} is i.i.d, the presence of time-invariant effects α_{ij} induces autocorrelation since these effects by definition are perfectly correlated across time (Cameron & Trivedi, 2010, p. 253). We regard this as further evidence against the population-averaged model. Indeed, the 'intraclass correlation coefficient', measuring α_{ij}'s share of υ_{ijt}'s variation is almost 0.99.

5 Results

5.1 Direct Effects of the Peace Prize

We begin this section by presenting the results from our gravity analysis where the exporter of interest is set to Norway in every model. Next, we allow the exporter of interest to rotate between other countries to assess the uniqueness of the results. In every regression, the dependent variable is the annual aggregate trade flow between each country in our main sample (in logs of nominal USD) and the independent variables are as defined in the previous section.

5.1.1 Gravity Results

The results for Norway are shown in Table 4, where we only report the estimated $\gamma_{1j'}$ coefficients described in section 4.2. Effects of all other regressors are diverted to Table A.3 in the appendix, where it is encouraging to see that the important ones have the expected signs. The first three columns show results from the random models, whereas the last four show results from the fixed models. Consider first the top row coefficient estimates in columns (a) and (d) of Panel A, where the treatment period is defined as lasting from 2011 to 2016 and the first-order interaction terms for the treatment indicator are not included. These models are the only ones to produce significantly negative coefficients in the top row, suggesting that Norwegian exports to China were at least 23 percent, or around USD 1 billion *per year*, lower than the gravity counterfactual[25]. This is comparable with Mathisrud (2018), whose more modest gravity setup predicts exports to China were USD 5.5 billion lower in total over six years. When controlling for main exporter and importer treatment-period effects, however, the estimates come in much lower at around 10 percent, or less than USD 400 million per year, while standard errors increase enough to eliminate any statistical significance. The reason for this is as shown in Table A.3; the first-order effect for Norway is also negative, implying that Norwegian exports to *all other countries* fell, by 24 and 19 percent in the random and fixed models respectively, and the additional effect on exports to China was insignificant. These results are robust to either the random or fixed specification, regardless of whether we include time-specific effects or use the self-contained model in column (g). More in line with Kolstad (2019), who estimates the overall drop to be between USD 780 and USD 1 300 million in total over three years, our results imply that Mathisrud (2018) may be overestimating these effects slightly.

In the second row from the top, the comparable effects for Vietnam are reported. Regardless of which model we consider, every coefficient is strongly positive, suggesting that Norwegian exports to Vietnam were at least 222 percent, or around USD 200 million *per year*, above the counterfactual between 2011 and 2016. It is immediately clear that this amount matches to a large degree the fall in Norwegian exports to China. We know from Chen and Garcia (2016) that large volumes of salmon were redirected through Vietnam, but the magnitude seen here could indicate that this was also the case for other commodities. Focusing now on the bottom row, a similar result is found for South Korea. Here, most models agree that the abnormal increase in exports from Norway was around 68 percent, or USD 1.5 billion per year, an amount even more substantial than in Vietnam's case. The combined overshoot of almost USD 2 billion per year to Vietnam and South Korea is in strong support of the re-export hypothesis and could hint at how high exports to China would have been without the Peace Prize incident. As we will see shortly,

[25] Recall that since the dependent variable is in logs and our coefficient of interest is regressed on an indicator variable, the treatment effect in percent is given by the formula $e^x - 1$ where x is the coefficient estimate.

Table 4: Results for Norwegian Aggregate Exports

Panel A: Treatment active from 2011 to 2016: $s_t = 1$ if $2011 \leq t \leq 2016$, 0 otherwise

	Random Effects			Fixed Effects			
Dependent Variable: Log of Trade Flow	(a)	(b)	(c)	d)	(e)	(f)	(g)
Exporter Norway × s_t × Importer China	-0.28***	-0.10	-0.11	-0.26***	-0.10	-0.11	-0.10
	(0.02)	(0.08)	(0.08)	(0.03)	(0.08)	(0.08)	(0.07)
Exporter Norway × s_t × Importer Vietnam	1.22***	1.18***	1.17***	1.27***	1.19***	1.19***	1.17***
	(0.02)	(0.10)	(0.10)	(0.02)	(0.10)	(0.10)	(0.10)
Exporter Norway × s_t × Importer Japan	-0.19***	0.03	0.04	-0.07***	0.03	0.03	0.04
	(0.01)	(0.07)	(0.07)	(0.02)	(0.07)	(0.07)	(0.07)
Exporter Norway × s_t × Importer Hong Kong	-0.36***	-0.27***	-0.27***	-0.27***	-0.27***	-0.27***	-0.25***
	(0.01)	(0.09)	(0.09)	(0.01)	(0.09)	(0.09)	(0.08)
Exporter Norway × s_t × Importer South Korea	0.35***	0.52***	0.52***	0.42***	0.52***	0.52***	0.52***
	(0.01)	(0.08)	(0.08)	(0.01)	(0.08)	(0.08)	(0.07)
Pair Fixed Effects				YES	YES	YES	YES
First-order Interaction Effects		YES	YES		YES	YES	
Year Fixed Effects			YES			YES	
Source- & Destination-year Effects							YES
R^2	0.83	0.83	0.83	0.96	0.96	0.97	0.98
Observations	41 304	41 304	41 304	41 304	41 304	41 304	41 304

Panel B: Treatment active from 2011 to 2017: $s_t = 1$ if $2011 \leq t \leq 2017$, 0 otherwise

	Random Effects			Fixed Effects			
Dependent Variable: Log of Trade Flow	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Exporter Norway × s_t × Importer China	-0.33***	-0.12	-0.13	-0.31***	-0.12	-0.13	-0.12
	(0.03)	(0.08)	(0.08)	(0.03)	(0.08)	(0.08)	(0.08)
Exporter Norway × s_t × Importer Vietnam	1.36***	1.29***	1.29***	1.43***	1.31***	1.31***	1.29***
	(0.02)	(0.11)	(0.11)	(0.02)	(0.11)	(0.11)	(0.11)
Exporter Norway × s_t × Importer Japan	-0.19***	0.05	0.05	-0.06***	0.05	0.05	0.06
	(0.01)	(0.08)	(0.08)	(0.02)	(0.07)	(0.07)	(0.07)
Exporter Norway × s_t × Importer Hong Kong	-0.44***	-0.30***	-0.30***	-0.34***	-0.29***	-0.29***	-0.27***
	(0.01)	(0.10)	(0.10)	(0.01)	(0.10)	(0.10)	(0.09)
Exporter Norway × s_t × Importer South Korea	0.21***	0.42***	0.42***	0.30***	0.41***	0.41***	0.42***
	(0.01)	(0.09)	(0.09)	(0.01)	(0.09)	(0.09)	(0.07)
Pair Fixed Effects				YES	YES	YES	YES
First-order Interaction Effects		YES	YES		YES	YES	
Year Fixed Effects			YES			YES	
Source- & Destination-year Effects							YES
R^2	0.83	0.83	0.83	0.96	0.96	0.97	0.98
Observations	41 304	41 304	41 304	41 304	41 304	41 304	41 304

Notes: Each column represents a separate regression of equations specified in section 4.2; (a)-(c) is equation (15) with first-order interaction terms and time indicators omitted or included as specified, (d)-(f) is equation (16) with first-order interaction terms and time indicators omitted or included as specified, and (g) is equation (17). The exporter of interest is set to Norway in all regressions. The difference between Panels A and B is that the latter extends the treatment period by one year. Only estimates of the coefficients of interest are reported, the rest are contained in Table A.3 in the appendix. Country-pair clustered standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

however, there are also other forces behind these results. Nothing similar is found for the cases of Japan and Hong Kong, where the coefficients are either negative or statistically insignificant. We should keep in mind that Norwegian exports to some of these countries are low, making large fluctuations more prominent.

To take into account the possibility of treatment lasting longer than December 2016, we provide results from repeating the analysis with the treatment period extended by one additional year in Panel B. Practically all of the results from Panel A carry over to this panel, with changes only affecting the magnitudes of coefficient estimates, but not the signs. Most prominently, the Vietnam effect increases even further to around 271 percent and South Korea decreases slightly to 51 percent. If we assume the Peace Prize incident is the main driver of these results, it appears the effect lingered a little longer in Vietnam. Lastly, we note how the explained variance as measured by R^2 improves as we move farther to the right in Table 4. An R^2 of 0.98 is remarkably high. Combined with the results from the Hausman test and our discussion in section 4.2, we argue that our most reliable findings are contained within columns (e)-(g).

5.1.2 Counterfactuals

Panel A of Figure 3 plots the counterfactuals for Norwegian exports to China, as estimated by the last three regressions above[26]. The solid line indicates the realized outcomes. We see that the three counterfactuals are similar to each other and resemble those in Kolstad (2019), predicting that exports to China should have been higher in 2012 and 2013 in particular, but notably also in 2016, 2017 and 2018. Overall, the deviations are small and statistically insignificant as we have seen, and one of the counterfactuals even predicts that exports were abnormally high in 2014 and 2015.

A closer inspection of similar counterfactuals for Vietnam and South Korea in Panels B and C make us a little less confident regarding the role played by these countries as intermediaries following the Peace Prize incident. On the one hand, it is clear that realized exports to both Vietnam and South Korea were much higher than predicted in the treatment period and both converge back to normal towards the end of the sample. On the other hand, a large portion of these effects became prominent well before the announcement of the Peace Prize in October 2010. It is possible that China decided to implement measures very early on. As discussed in section 2.1, rumors of the award were already beginning to surface in the summer of 2010, and the increase for Vietnam is not prominent before then. However, if we rule out the possibility of accounting errors, the notion that Norwegian exporters would have been able to find new partners and reestablish trade deals before the end of the year seems to imply at least some degree of foresight. In the case of South Korea, there is

[26]We produce these counterfactuals by plotting the fitted values from the regressions in Table 4 net of the treatment effects.

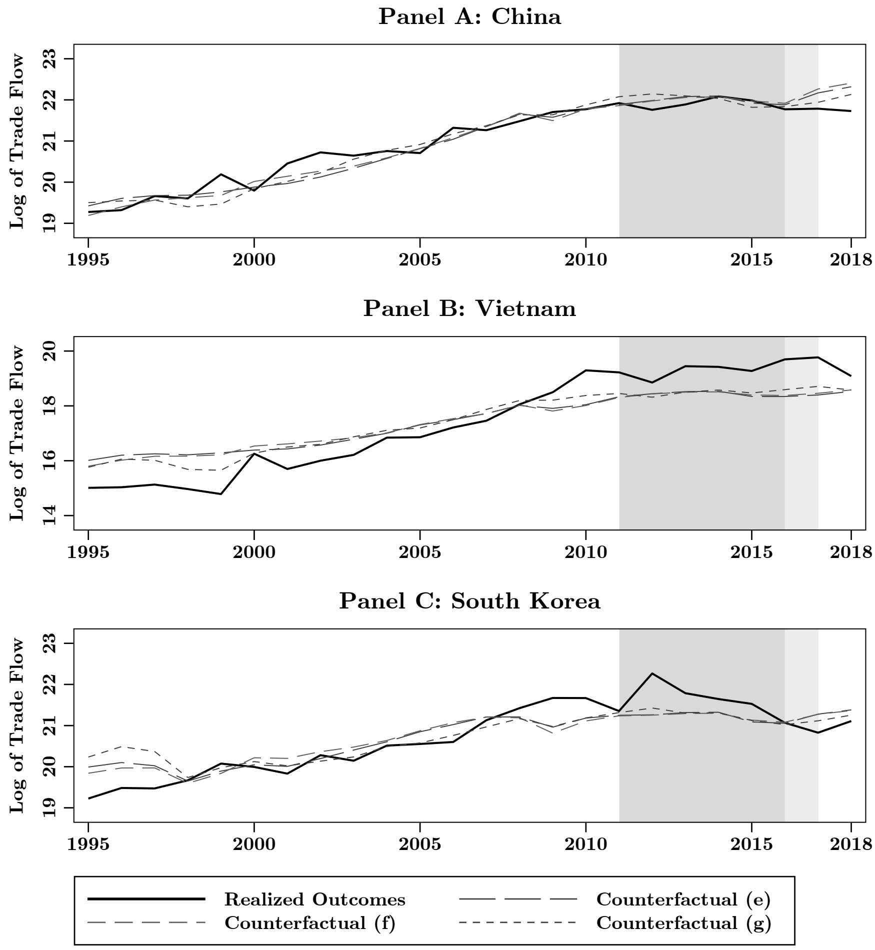

Figure 3: Exports to China, Vietnam and South Korea with Counterfactuals

another factor possibly confounding the results. Notice how the abnormal increase in trade initially appears to have started already in 2007. This coincides with the signing of the Free Trade Agreement Between The EFTA States and The Republic of South Korea on December 15, 2005, making it probable that the impact of this agreement is at least in part what is captured by the treatment coefficient.

5.1.3 Placebo Tests for Other Exporters

We now turn to the results of our extended analysis where we compare the regressions for Norway to placebo treatments of other countries. The purpose of this procedure is to investigate the uniqueness of Norwegian results, the abnormal increase in exports to Vietnam and South Korea in particular. In this section, we repeat the fixed effects regressions from columns (e)-(g) in Table 4 but allow the exporter of interest to rotate, first between the other Nordic countries, and later between all countries in the sample. Since the differences between Panels A and B above were minor, we only consider the case where treatment is switched on for 2011 to 2016. As before, each column represents a separate regression, so the analysis is restricted to only one exporter of interest at a time.

The first three columns in Table 5 simply repeat the results from Table 4. The remainder of columns show the result for Sweden, Finland, Iceland and Denmark respectively. Consider first the top row, which indicates how exports to China between 2011 and 2016 from each of these countries compare to their respective counterfactuals. While the coefficients for Norway and Denmark are small and statistically insignificant, exports from Sweden, Finland and Iceland are all strongly negative, suggesting a reduction in exports by an order of 24 to 34 percent. Such results are surprising. Indeed, we would have expected the coefficients for these countries to be close to zero as well – if not positive, since Iceland became the second European country to sign a FTA with China in the same period.

It is possible that the effects of Chinese restrictions reached further than Norwegian borders, making at least a part of the unexpected treatment effects a result of 'misguided' restrictions or spillover effects. While this cannot be ruled out, we still find it unlikely considering that their primary target was so scarcely affected, no such signal has been publicly communicated from Beijing and exports from these countries to China's neighbors do not follow the same pattern as Norway's (see below). The 2015 disappearance of Swedish book-seller Gui Minhai[27] which rocked Sino-Swedish diplomatic relations in a manner strikingly similar to the Peace Prize event was also too late to have influenced results.

[27] Part of an incident later referred to as the Causeway Bay Books disappearances, Chinese-born Swedish bookseller Gui Minhai was apprehended in late 2015 by Chinese law enforcement in Thailand and secretly held in custody for three months. Still under arrest, in 2019 Gui was awarded the Tucholsky Prize by writer's association PEN International, after which the Chinese embassy in Sweden reportedly warned of 'bad consequences' (Elmer, 2019).

TABLE 5: Results for Nordic Countries' Aggregate Exports

	Exporter i' = Norway			Exporter i' = Sweden			Exporter i' = Finland			Exporter i' = Iceland			Exporter i' = Denmark		
Dependent Variable: Log of Trade Flow	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Exporter $i' \times s_t \times$ Importer China	-0.10	-0.11	-0.10	-0.37***	-0.37***	-0.37***	-0.40***	-0.41***	-0.40***	-0.28**	-0.29**	-0.28**	0.05	0.05	0.05
	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)	(0.06)	(0.12)	(0.12)	(0.11)	(0.07)	(0.07)	(0.06)
Exporter $i' \times s_t \times$ Importer Vietnam	1.19***	1.19***	1.17***	-0.79***	-0.79***	-0.81***	0.05	0.04	0.03	-0.10	-0.05	0.08	-0.16	-0.17*	-0.18*
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.14)	(0.14)	(0.11)	(0.10)	(0.10)	(0.10)
Exporter $i' \times s_t \times$ Importer Japan	0.03	0.03	0.04	-0.12**	-0.12**	-0.11**	0.19***	0.19***	0.20***	-0.45***	-0.45***	-0.44***	-0.16***	-0.16***	-0.15***
	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)	(0.11)	(0.11)	(0.10)	(0.06)	(0.06)	(0.05)
Exporter $i' \times s_t \times$ Importer Hong Kong	-0.27***	-0.27***	-0.25***	-0.36***	-0.36***	-0.34***	-0.48***	-0.48***	-0.47***	0.62***	0.62***	0.63***	0.21**	0.22**	0.23***
	(0.09)	(0.09)	(0.08)	(0.08)	(0.09)	(0.07)	(0.09)	(0.09)	(0.07)	(0.13)	(0.13)	(0.12)	(0.09)	(0.09)	(0.07)
Exporter $i' \times s_t \times$ Importer South Korea	0.52***	0.52***	0.52***	0.03	0.03	0.04	0.21***	0.21***	0.22***	-0.11	-0.10	-0.10	-0.11	-0.11	-0.10*
	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)	(0.06)	(0.12)	(0.12)	(0.11)	(0.07)	(0.07)	(0.06)
Pair Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
First-order Interaction Effects	YES	YES		YES	YES		YES	YES		YES	YES		YES	YES	
Year Fixed Effects		YES			YES			YES			YES			YES	
Source- & Destination-year Effects			YES			YES			YES			YES			YES
R^2	0.96	0.97	0.98	0.96	0.97	0.98	0.96	0.97	0.98	0.96	0.97	0.98	0.96	0.97	0.98
Observations	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304

Notes: Each column represents a separate regression of the last three equations specified in section 4.2. Columns (a) and (b), (d) and (e), (g) and (h), (j) and (k), and (m) and (n), are equation (16) without and with time indicators respectively; (c), (f), (i), (l) and (o) are equation (17). The exporter of interest rotates under each heading, starting with Norway and ending with Denmark. Columns (a), (b) and (c) thus correspond to columns (e), (f) and (g) in Panel A of Table 4. Only estimates of the coefficients of interest are reported, the rest are contained in Table A.4 in the appendix. Country-pair clustered standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Next, consider the coefficients for the other five East-Asian importers, and recall that the treatment period coincided with an enormous spike in Norwegian exports to Vietnam and South Korea. From Table 5, it is evident that no such effects are present for any other Nordic country, perhaps with the exception of Finland which has smaller, significant coefficients on exports to South Korea. These findings are more in line with our expectations, however, there are some disturbances in the data as well; for instance, Swedish exports to Vietnam appear to have dropped markedly during the treatment years, and we would ideally have less significant coefficients for Japan and Hong Kong. Under each heading, the three models produce very similar results, with the same level of explained variance as before.

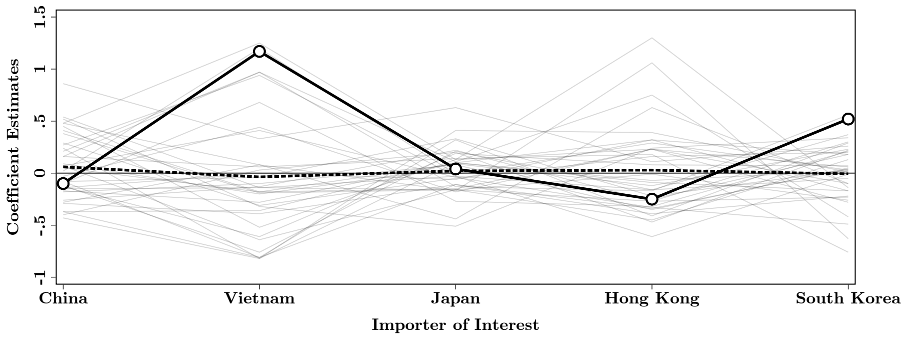

FIGURE 4: Coefficient Plot for All Countries

In Figure 4, we plot the estimated $\gamma_{1j'}$-coefficients from equation (17), this time using all exporters in the sample (except those specified on the horizontal axis). The treatment period remains as before. Results for Norway are highlighted by the black circles with white centers connected by a solid black line, and the average of all other countries are illustrated by the dotted black line. While the placebo effects for some countries are stronger than we would have hoped for, the majority of coefficients are close to zero, and practically zero on average. Norway continues to stand out. In particular, the treatment effect for Norwegian exports to South Korea is the second highest in the entire sample (surpassed only by Greece), and third-highest for exports to Vietnam (surpassed by Slovenia and Brazil). Excluding imports to China, Norway is the only exporter to have two top-three ranking coefficients. We regard this as further support for the re-export hypothesis. In the next section, we bring these claims under further scrutiny.

5.2 Evidence of Re-exported Commodities

We now turn our attention to disaggregated trade flows, searching for evidence of specific commodities which may have been re-exported through Vietnam or South Korea. From Figure 5, constructed in a similar manner to Figure 2, it is clear that the enormous increase in Norwegian exports to both countries is driven almost exclusively by two or three commodity groups. In Panel A, the largest Section by far is HS 1 (Animal Products), which takes up 79 percent of all exports to Vietnam in 2017. Consisting mostly of seafood, we see that this group fell dramatically again in 2018. The second largest Section is HS 16 (Machinery and Mechanical Appliances), rising sharply already from 2009. We know from Table 1 that this group contains some of the most valuable of China's imports from Norway, but the fact that the increase happens so early casts doubts on the Nobel Prize's influence on this growth. Falling again in 2016, 2017 and 2018, machinery exports nevertheless deserves our attention, and we will keep this in mind for the discussion below. The sizeable spike in HS 17 in 2010 comes from a USD 70 million export of transportation vessels that year.

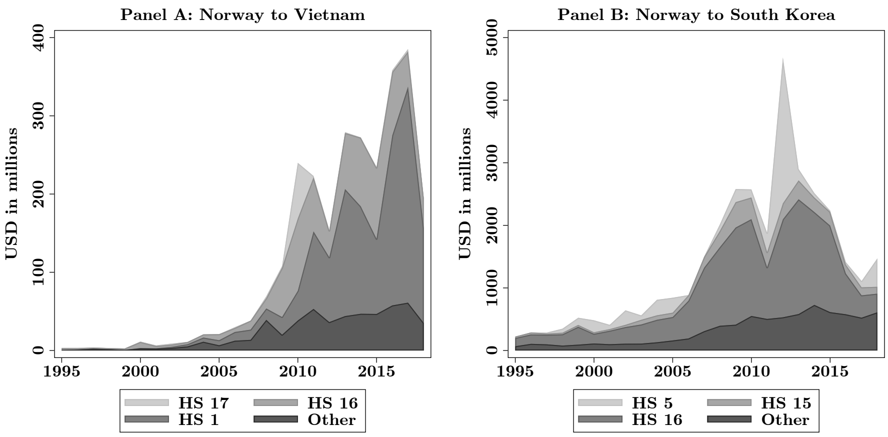

FIGURE 5: Norwegian Exports to Vietnam and South Korea, by HS Section

HS 16 is also prominent in Panel B, taking up around 60 percent of all exports to South Korea in the years after 2006. As we have seen, the value of trade increase dramatically in at least two stages, reaching a peak of USD 5 billion in 2012, before falling again to just over USD 1 billion in 2017. The entire growth period succeeds the signing of the free trade agreement which came into effect in 2006, quite evidently explaining a large part of this increase – at least in the short term. The second stage of growth fits better with the timing of the Peace Prize. In addition to machinery, the large spike in 2012 is driven by an abnormal shipment of petroleum products, the magnitude of which is over six times greater than South Korea's HS 5 imports in any other given year. We turn our attention to these findings below. The third-largest Section is HS 15 (Base Metals). Much smaller than the other two groups, HS 15 seems to be of less interest.

5.2.1 Vietnam

The fact that Norwegian salmon was exported from Norway to Vietnam and then either smuggled or re-exported into Mainland China has been well documented by Chen and Garcia (2016). In their paper, seven interviewed stakeholders admit to having taken part in this operation, which was motivated by the sudden difficulty of importing Norwegian salmon through legal channels[28]. We begin this section by reproducing the now-famous results, while also showing what happened to salmon exports after relations were normalized in late 2016. This is provided in Panel A of Figure 6. The solid line shows exports of whole (i.e. not filleted or otherwise processed) fresh or chilled Atlantic salmon from Norway to China up to the year 2019[29]. Exports to Vietnam and from Vietnam to China of the same product are shown in short and long dashes respectively. In 2009, one year before the announcement of the Peace Prize, Vietnam purchased fresh Norwegian salmon for a little less than USD 3 million. China's purchases that year was around USD 40 million – well over 10 times greater. Over the next eight years, according to the official figures, growth in the Chinese market was at best sluggish, never exceeding the 2010 level and falling as low as USD 23 million in 2016. At the same time, exports to Vietnam soared, peaking in 2017 at USD 192 million – 64 times greater than in 2009. After normalization of relations between Norway and China, the two time series invert

[28]For years the shipment of exotic food and other commodities across unofficial border crossings in North Vietnam has been a serious concern for international institutions and NGOs. Typically, contraband will arrive at the Vietnamese port of Haiphong, before being transported to Mong Cai at the Chinese border where facilitators pay $10-20 in bribes to cross the Ka Long river into China's Guanxi province. As many as 1 500 illegal vehicles reportedly pass through here every day (Bland, 2012). In early spring 2018, whatever remained of the smuggling operation of Norwegian salmon was effectively shut down after Chinese customs officials launched several raids on suspected smugglers. A Norwegian citizen with ties to the company SalMar was arrested in China, facing charges of illegally importing salmon worth up to USD 98.4 million. The CEO of SalMar stepped down the same week, officially due to unrelated causes (Kynge, 2018).

[29]Since seafood is not reported on sufficiently refined levels in HS 1992 (see footnote 2) some figures in this section are constructed using data from Statistics Norway (2020). In such cases, reported values are converted to current USD using the annual average exchange rate from Norges Bank (2020).

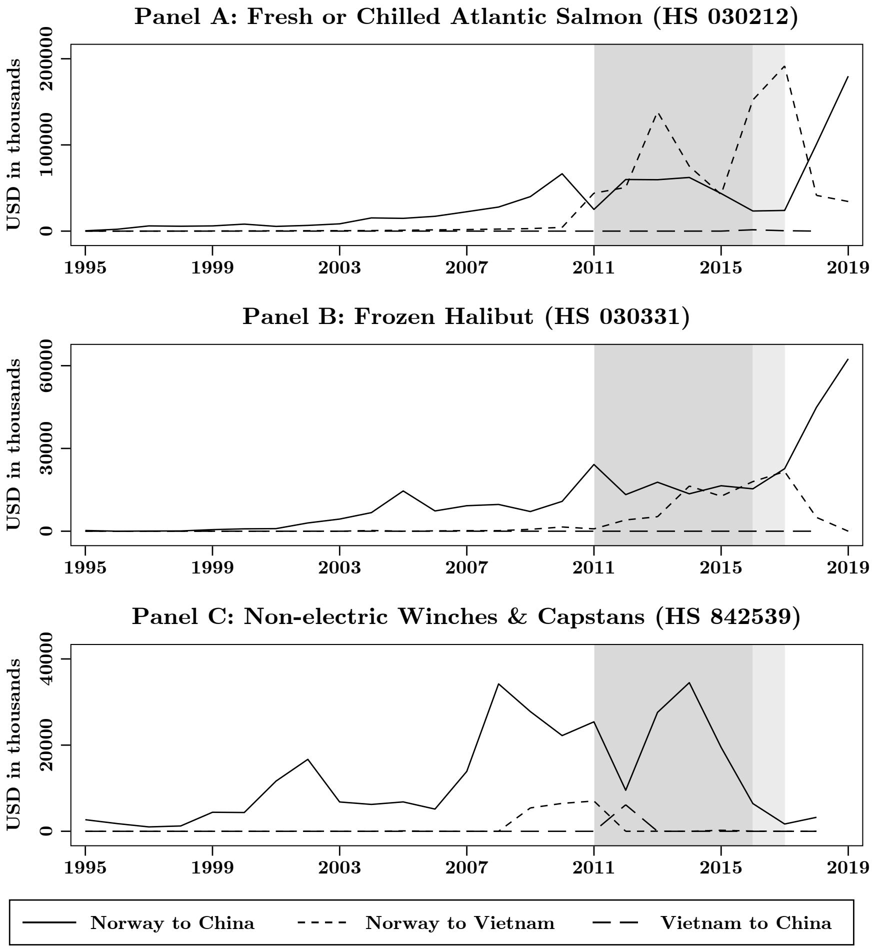

Figure 6: Exports of Selected Products between Norway, China and Vietnam

almost perfectly, settling in 2019 at a level more coherent with the demand and rate of growth observed before 2011. Any effect of treatment does not appear to have ended until after 2017, consistent with our findings in the main analysis.

The resulting pattern is perhaps more easily observed in Table 6. Here, we report coefficients from a linear regression of annual export values on a trend polynomial

Table 6: Effects of Treatment Between Norway, China and Vietnam

	Norway to China		Norway to Vietnam		Vietnam to China	
Dep. Var: Trade Flow in thousands of USD	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
Fresh or Chilled Atlantic Salmon (HS 030212)	-30744** (14324)	-40968*** (11388)	80037*** (16836)	71953*** (15867)	254 (176)	138 (194)
Frozen Halibut (HS 030331)	-8582 (5078)	-12928*** (3319)	9341*** (2186)	8405*** (2109)	0	0
Non-electric Winches & Capstans (HS 842539)	-882 (5933)	6173 (5847)	-528 (1232)	-4 (1386)	998 (700)	1286 (788)

Notes: Coefficients from a linear regression of annual exports between the given partners on a treatment indicator (2011-2017) and either a linear or quadratic trend polynomial. Each coefficient is a separate regression, and only the effect of treatment is shown. Standard errors in parenthesis.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(linear and quadratic) and simple treatment indicator for the years 2011 to 2017. This crude fit suggests that Chinas imports of Norwegian salmon were USD 30-40 million lower than normal in every year of treatment, while Vietnam's imports were USD 70-80 million higher. In sum over seven years this amounts to at most USD 560 millions worth of salmon, roughly one third of all exports from Norway to Vietnam in the same period. Official exports of Atlantic salmon from Vietnam to China were zero, or very close to zero at all times. This is notably also the case for processed variants such as frozen salmon or salmon fillets (not shown). We regard this as strongly supportive of earlier findings that salmon was smuggled into China via Vietnam. The entire increment of up to USD 560 million thus serve as a crude estimate of the total value of potentially-smuggled salmon, a figure which is made more easily identifiable by having access to post-normalization data. From China's point of view, however, that same estimate is roughly halved.

We believe that the exclusive focus on salmon in Chen and Garcia (2016), as well as in many news reports at the time, do not capture the entire picture of the Norwegian seafood smuggling operation. In Panel B of Figure 6, we provide evidence suggesting that a similar scheme was being used for imports of Norwegian frozen halibut. While much smaller in value, the trade pattern between the three countries is remarkably similar to that of salmon in Panel A. This time the coefficient estimates in Table 6 almost unanimously agree that the annual effect of treatment was around USD 10 million, implying a crude estimate of the total value of halibut smuggling in the range of USD 70 million. As before, official figures of processed variants of halibut between Vietnam and China are negligible. It is also possible that other types of seafood were smuggled, however, our search does not reveal any such effects for other sizeable products.

The second most important commodity Section for Norwegian exports to Vietnam was HS 16, covering machinery and mechanical appliances under headings 8400 to 8599 of the nomenclature. Unlike seafood, these products are durable, mostly used as industrial inputs and likely connected to individual plants or construction projects. Exports thus become much more irregular, making it harder to observe a smooth trend pattern of the type we find for non-durable consumer goods like food. Within HS 16, very little stands out in any particular way, and it is clear that the large increase in Vietnam's purchases after 2008 is made up of a multitude of products, the three largest of which are Centrifugal Pumps (HS 841370), Diesel Engines for Marine Propulsion (HS 840810) and Electric Conductors (HS 854460). Centrifugal Pumps is also one of China's largest imports from Norway, but with exports to Vietnam not starting to pick up before 2014, it is an unlikely candidate for this analysis. One possible case of re-exports is nevertheless highlighted in Panel C of Figure 6. Here, a 2012 fall in exports of non-electric winches and capstans from Norway to China are shown to be matched by a sizeable shipment – this time officially registered – of the same product from Vietnam to China, succeeding a brief period of Vietnamese imports from Norway which ended in 2011. To see such fluctuations in themselves is not unusual, and the combined effect is statistically insignificant (see Table 6). But the timing of China's purchases is suspicious, substantiated by the facts that Vietnam's exports of winches and capstans to China were zero in all other years and Norway was by far Vietnam's largest supplier in 2009 to 2011. Nor is Vietnam an otherwise large exporter of this product, the second largest recipient in 2012 being Japan with a mere USD 426 thousand. Perhaps more likely a result of excess supply than Peace Prize restrictions, it is at least probable that Norwegian exports of winches and capstans found their way into China this way.

5.2.2 South Korea

Unlike Vietnam, we do not find compelling evidence that exports of Norwegian salmon or other kinds of seafood entered China through South Korea. From Panel B of Figure 5 it is clear that the abnormal growth in exports to South Korea during the treatment period predominantly comes from one of only two HS Sections, 5 and 16, the latter of which was also the case for Vietnam. We view this in connection with findings from a series of industry reports by Rystad Energy (2014, 2017), suggesting that South Korea was a particularly important market for Norwegian oilfield services companies up until around 2015, when revenues started to fall. Three interesting examples which may suggest potential re-exporting activity are nevertheless highlighted in Figure 7. In all panels we see how a treatment-period drop in Chinese imports from Norway coincides with an increase in exports of the same product from South Korea to China, around the same time as South Korea imported more of the products from Norway. Hardly any of the effects are statistically significant,

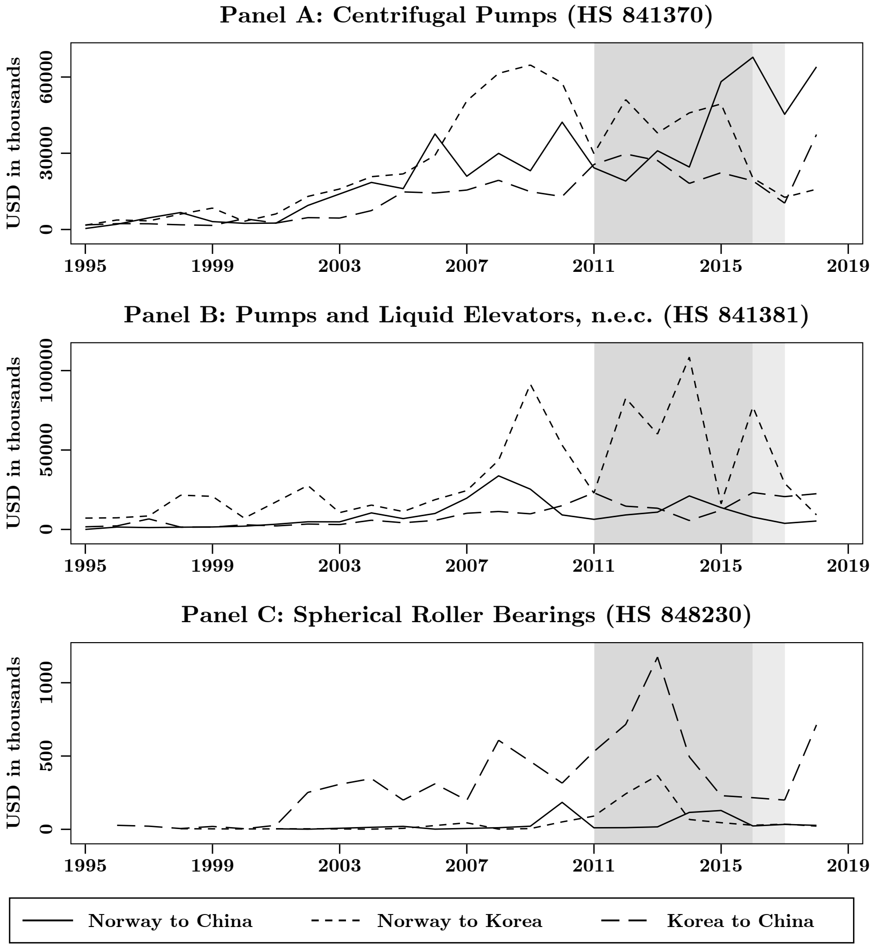

Figure 7: Exports of Selected Products between Norway, China and Korea

as reported in Table 7, and there is a substantial chance that the observations are strictly coincidental.

A perhaps more convincing result is found in Figure 8. Here, exports of crude oil from Norway to China and from Norway to South Korea are measured along the left axis, while exports from South Korea to China of refined oil are measured along the right

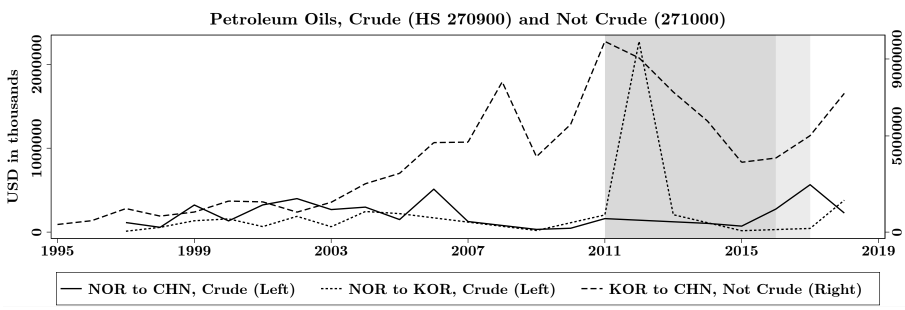

Figure 8: Exports of Petroleum between Norway, China and Korea

Table 7: Effects of Treatment Between Norway, China and South Korea

	Norway to China		Norway to S. Korea		S. Korea to China	
Dep. Var: Trade Flow in thousands of USD	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
Centrifugal Pumps (HS 841370)	-3961 (5883)	-7681 (5330)	-41 (9837)	6360 (8815)	4569 (3072)	4465 (3249)
Pumps and Liquid Elevators, n.e.c. (HS 841381)	-2813 (4380)	-441 (4156)	21642 (13722)	26988* (13762)	565 (2337)	-411 (2324)
Spherical Roller Bearings (HS 848230)	3 (32)	3 (33)	120** (44)	125** (46)	132 (125)	162 (130)
Petroleum Oils, Crude (HS 270900)	-204238* (109906)	-161297 (109382)	494609 (336803)	500849 (346200)		
Petroleum Oils, Not Crude (HS 271000)					967005 (1021953)	1344980 (1030609)

Notes: Coefficients from a linear regression of annual exports between the given partners on a treatment indicator (2011-2016) and either a linear or quadratic trend polynomial. Each coefficient is a separate regression, and only the effect of treatment is shown. Standard errors in parenthesis.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

axis[30]. Historically, neither China nor South Korea have been particularly important markets for Norwegian direct petroleum exports, instead primarily finding its way to European destinations. In 2012, however, South Korea received an enormous shipment of Norwegian crude oil, valued at well over USD 2 billion (almost 18 million barrels, or the equivalent of approximately ten fully-loaded supertankers, at then-current prices). At no point in the entire sample period were Norwegian petroleum exports to other Asian partners anywhere near this level. The closest was China, as seen in the graph peaking in 2017 at USD 564 million. Exports of the same kind of unrefined oil from South Korea to China have always been negligible, but exports of refined oil are formidable and peaked around the same time at almost USD 10 billion. In the absence of interviewed stakeholders, a conclusive link between this observation and the Peace Prize event cannot be firmly established. However, we view it as very likely that North Sea oil contributed to Chinese petroleum imports that year.

5.2.3 Fish Meal

In January 2011, three months after the announcement date of the Peace Prize, Norway lost its approval from the Chinese General Administration of Quality Supervision, Inspection and Quarantine required for the export of processed flours, meals and pellets of seafood (colloquially known as ‘fish meal’) to China. The official rea-

[30] A country with no proven oil reserves, South Korea is nevertheless one of the world’s largest exporters of refined petroleum, having recently surpassed Japan as the country with the fifth largest refining capacity (Han & Minu, 2019). China’s capacity is much larger but, in contrast to Korea, they also consume more. According to our data, South Korean total exports of refined petroleum amounted to USD 51 billion in 2012.

son for the sudden lockout was that Norway no longer satisfied the requirements for 'traditional trade' (Norwegian Seafood Council, 2018). Following interviews with the Norwegian Food Safety Authority and two anonymous stakeholders, Johansen et al. (2018) conclude that this product was subjectively targeted by Chinese authorities in a manner similar to salmon. While official statistics suggest the restrictions were highly effective, one Norwegian producer of processed fish foods admitted that they had indeed been able to export the product in the entire period. The anonymous informant stated that having an office in Shanghai likely helped facilitate this, but did not specify whether exports were rerouted or how else they were able to avoid restrictions.

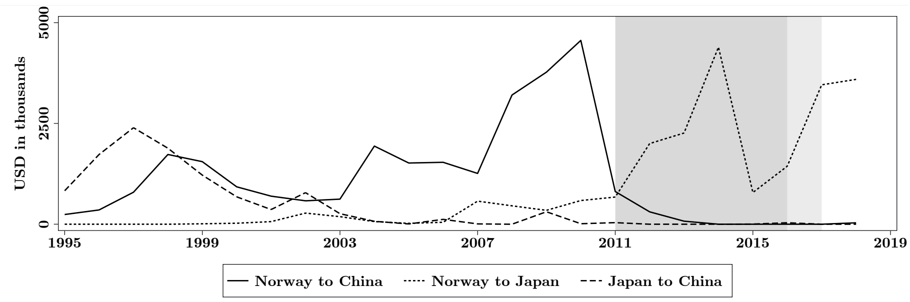

Figure 9: Exports of Fish Meal (HS230120) between Norway, China and Japan

In our analysis of potential channels through Vietnam and South Korea, we are unable to find any evidence suggesting that fish meal followed these routes. In Japan, however, imports of Norwegian fish meal does appear to have grown markedly starting from 2012, as seen from Figure 9. What goes against the idea of Japan being used as an intermediary is that exports were high even after the end of the treatment period, and nor were there any official exports of this product from Japan to China. It is still possible that fish meal was redirected through entirely different countries, or that other methods of circumventing restrictions such as smuggling or falsified country of origin reports were employed.

5.3 Lost Opportunities

We have previously seen how negotiations for the Sino-Norwegian Free Trade Agreement were seriously delayed by the Peace Prize incident in the fall of 2010. In the meantime, China has established a network of such treaties with countries spanning from Chile in the Americas to New Zealand in the Pacific. Iceland became the first European nation to complete their FTA negotiations in April 2013, with Switzerland following suit a few months later. In this section, we employ our gravity framework to investigate what happened in the aftermath to those countries which did sign a FTA with China. We hope this can be suggestive of whether or not Norwegian exporters would have sold more to Chinese buyers had negotiations not been stalled.

5.3.1 Gravity Results

As of March 2020, China has implemented 16 free trade agreements and have an additional 24 in development (MOFCOM, 2020). Within our main sample of 'OECD plus' countries, this includes the agreements with Vietnam and Indonesia through the establishment of the ASEAN-China Free Trade Area signed in 2002; Hong Kong in 2003; Chile in 2005; New Zealand in 2008; Iceland and Switzerland in 2013; and Australia and South Korea in 2015. In most cases, actual implementation did not occur until at least one year later. To investigate whether any of these FTAs actually lead to an increase in exports, we substitute the exporters' treatment indicators in equations (16) and (17) with a FTA indicator equal to one if there exists a free trade agreement between exporter i and China at time t. We include the first-order interaction effects discussed in section 4.2, so that the estimated coefficients are the average annual increase in exports to China from the indicated country/countries after controlling for both exporter and importer treatment-period effects. Individual effects are included in the same regression to reduce interference, but it serves to mention that this has little implications for the results.

The coefficient estimates are reported in Table 8, using the same three specifications as in Table 5. Columns (a), (d) and (g) show results from the pooled models, columns (b), (e) and (h) split the effects into Asian and non-Asian exporters and columns (c), (f) and (i) show results for individual countries. Each of the pooled effects can thus be thought of as a weighted average of the individual coefficients listed below in the columns to their right. The first thing to note is that regardless of specification, all three coefficients in the top row agree that the combined effect on exports from all countries is statistically insignificant. When broken down on individual exporters, however, there are large differences; Chile, New Zealand, Switzerland and Australia all have positive coefficients, suggesting that each country's exports to China increase

Table 8: Effects on Aggregate Exports of Having an Active FTA with China

Dep. Var: Log of Trade Flow	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Pooled	-0.07 (0.18)			-0.14 (0.18)			-0.01 (0.18)		
Non-Asian Exporters		0.39** (0.16)			0.32* (0.16)			0.44*** (0.13)	
Chile			0.56*** (0.12)			0.52*** (0.12)			0.52*** (0.10)
New Zealand			0.41*** (0.09)			0.37*** (0.09)			0.36*** (0.08)
Iceland			-0.13 (0.14)			-0.12 (0.14)			-0.12 (0.12)
Switzerland			0.82*** (0.09)			0.84*** (0.09)			0.83*** (0.08)
Australia			0.62*** (0.11)			0.65*** (0.11)			0.65*** (0.09)
Asian Exporters		-0.52** (0.21)			-0.56*** (0.20)			-0.52*** (0.13)	
South Korea			-0.31*** (0.11)			-0.28*** (0.11)			-0.29*** (0.09)
Vietnam			-0.70*** (0.13)			-0.73*** (0.13)			-0.75*** (0.11)
Indonesia			-0.27** (0.12)			-0.31*** (0.12)			-0.30*** (0.10)
Hong Kong			-0.63*** (0.14)			-0.64*** (0.14)			-0.66*** (0.12)
Pair Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
First-order Interaction Effects	YES	YES	YES	YES	YES	YES			
Year Fixed Effects				YES	YES	YES			
Source- & Destination-year Effects							YES	YES	YES
R^2	0.96	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98
Observations	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304

Notes: Each column represents a separate regression of equations specified in section 4.2, where treatment is substituted with an indicator for exports to China from the specified country/countries coded as one starting with the year the FTA came into effect and all years thereafter. Columns (a) – (f) use equation (16) without and with time indicators, and columns (g) – (i) use equation (17). For notational simplicity, the names displayed in the first column denote only country/countries, but they are actually a full interaction between the specified exporter, the respective FTA-indicator and an indicator for Chinese imports in a manner similar to the main analysis. Only estimates of the coefficients of interest are reported, the rest are contained in Table A.5 in the appendix. Country-pair clustered standard errors in parenthesis.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

relative to their respective counterfactuals, ranging from around 43 percent in the case of New Zealand to a remarkable 132 percent in the case of Switzerland[31], after the implementation of a FTA with China. Meanwhile, the coefficients for South Korea, Vietnam, Indonesia and Hong Kong are negative, ranging from -24 to -53 percent.

The negative estimates for some exporters are puzzling. If taken literally these findings suggest signing a FTA with China may have a trade-*reducing* effect on aggregate exports. Since the number of observations in the treatment groups in

[31] We remind the reader that since the dependent variable is in logs and our coefficient of interest is regressed on an indicator variable, the treatment effect in percent is given by the formula $e^x - 1$ where x is the coefficient estimate.

columns (b), (e) and (h) are as many as 48, there is little reason to suspect that these effects are a result of noise. But notice how there appears to be a divide between how treatment is affecting Asian and non-Asian exporters; in particular, Western countries seem to gain from the agreements at the expense of Asian partners (the only exception is Iceland whose effect is not significantly different from zero).

We propose that the explanation is a case of confounding variables. When China entered the WTO in 2001, market access was improved dramatically, not only for Chinese exporters, but also for its importers. It is possible that this affected foreign partners' sales disproportionately, leading to an overall increase in imports from Western countries which was larger than the comparable effects for Asia. Using the analogy from our extension of EK, our suggestion is that d_{2ij} has been lowered relatively more against Western partners in recent years. The denominator in α_{ij} from equation (12) has thus increased more than the numerator when j indicates an Asian partner (vice versa for Western), making many far-away countries cheaper suppliers of goods formerly accessible to China only from itself or its closest neighbors. Our treatment indicators for Asia capture this overall loss and fails to net out the fact that those with an active FTA would have been even lower without the agreement. The effect is exacerbated by the low number of Asian exporters included in 'OECD plus', making the counterfactuals for Asia constructed using an overweight of Western partners.

5.3.2 Placebo Test for Other Exporters

The measurements shown in Table 8 are divergent, but nevertheless suggestive of an export-increasing effect of signing a FTA with China for Western countries. How likely is it that these observations are merely a result of chance? We proceed in the same manner as before by repeating the analysis for all other countries in the sample, creating false FTA indicators *as if* they also had established such agreements with China. The results are shown in Figure 10, where we plot the estimated coefficients from three iterations of the self-contained model used in column (f) in Table 8, assuming the placebo treaties were implemented in 2008, 2010 and 2012 respectively. Each plot point comes from a separate regression for that country – including them as a tenth exporter in the regressions above would not make any difference. The effects of the true FTAs from column (f) are superimposed in all three panels.

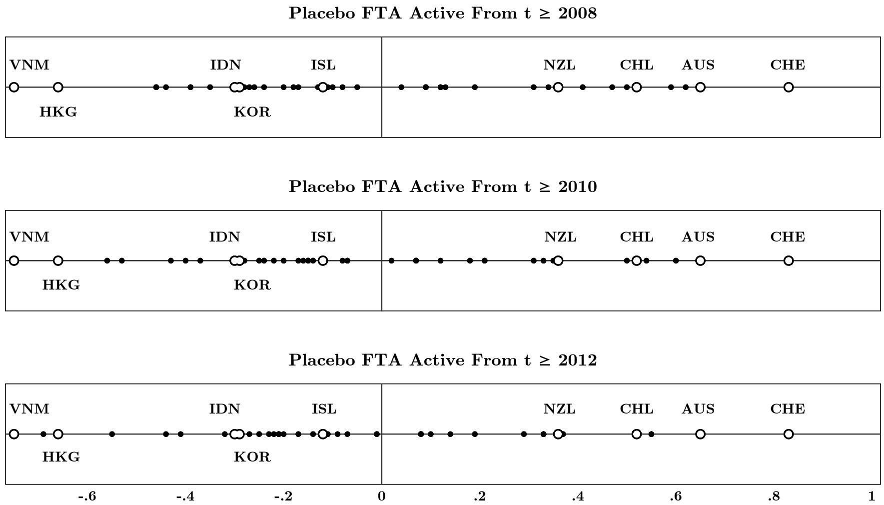

FIGURE 10: Coefficient Plot for All Countries

The results in this section are quite robust. While not entirely noise-free, most of the black points appear to be clustered around zero, while the white circles representing actual treatment effects on Western countries stretch out towards the left of each panel. In particular, the effects for Australia and Switzerland are the highest regardless of model, with Chile alternating between fourth or fifth place. The average of the black points is close to zero, ranging from -0.02 to -0.03, and the average of the true Western FTAs is markedly higher at 0.45. We regard this as evidence suggesting that signing a FTA with China is likely to have an export-increasing effect for non-Asian countries. At the very least, we cannot rule out that the delay in negotiations of the Sino-Norwegian FTA in 2010 might have caused significant losses of opportunities for Norwegian exporters.

6 Discussion

6.1 Econometric Considerations

As we discuss in Appendix D, the key assumption for consistency in the FE model is that after conditioning on G_{ijt} and α_{ij}, the idiosyncratic error ε_{ijt} is independent (for statistical inference, it suffices that the independence is across country pairs only since we use clustered standard errors). Is this assumption reasonably met in our model? Imagine a case where one of our regressors, GDP, is correlated with one or more unobserved variables such as FDI inflows. This is quite likely to be the case – in fact, studies by Liu, Burridge, and Sinclair (2002) and Liu, Wang, and Wei

(2001) find that not only are trade and investments causally linked; economic growth, trade and investment in China are triangularly complementary, having bi-directional causal effects on each other. Since FDI inflows are not constant over time, they are not sufficiently captured by α_{ij}. Nor are they necessarily proxied by any other covariate in the system, making investments an omitted variable and the estimated effect of GDP on trade in our model biased. But we are not particularly interested in this effect. Instead, the variable of interest in our study, s_t, simply captures all unobserved factors left in the specific treatment years after conditioning on the set of covariates, and the omitted variable poses a problem for us if, and only if, FDI inflows are also correlated with treatment. What is perhaps much more probable, however, is that the Nobel Prize event also affected investments. Controlling for FDI inflows in that case would introduce reverse-causality bias, underestimating the effect of treatment on trade since much of this is incorrectly captured by investments. Even if we had reliable FDI data for every country and every year in the sample, we find it best to stick to the conventional gravity framework and leave this variable out.

What about voluntary trade restrictions like import and export tariffs? Certainly influencing to a large degree firms' importing and exporting decisions, their explanatory power on bilateral trade flows seem unquestionable. At the same time, including this in our model poses several problems. The first is the complicated structure of tariffs. Considering a single country, its restrictions on trade can vary significantly both across goods and between partners, posing problems not only from a data collection point of view, but also on the assessment of impact when trade flows are aggregated[32]. It is possible to use average trade tariffs provided by The World Bank's WDI database as an approximate measure. While this would probably improve the model fit slightly, the downside is a more unbalanced sample due to missing data on individual years for several countries. We rely instead on the time- and country-pair fixed components to capture these effects.

[32]Consider Japan, which, until the early 90s, was known for maintaining its 'not a single grain of foreign rice' import policy, allowing only for the consumption of domestically-produced rice on Japanese dinner tables. It is very likely that these restrictions had a stronger effect on trade with Southeast Asian partners whose rice exporting sectors account for a significant part of the national economy than with Norway. Since there is heterogeneity of impact, average tariffs are at best insufficiently able to capture the individual effects of voluntary trade restrictions on aggregate exports, and arguably no better in our case than simply using pair-fixed effects.

Another potential source of bias comes from the choice of using panel data to estimate the gravity equation. While enabling us to study developments over time in the first place and greatly expanding the number of available observations, the inclusion of time series give rise to potential issues with co-integration and non-stationarity of variables, as discussed in Zwinkels and Beugelsdijk (2010). This is problematic because developments in variables like GDP and trade flows are likely driven by a similar, underlying, trend component which largely explains the observed correlation and confounds the estimated coefficients. After correcting for this, GDP and other covariates in Zwinkels and Beugelsdijk (2010) are shown to have a markedly smaller effect on both trade and investment flows. We have not attempted any such correction in our study, despite the apparent non-stationarity observed in many of the time series (see for instance the realized outcomes in Figure 3). However, in our model this is a global concern, and our conclusions are not drawn on the basis of the magnitude of the treatment effects alone, but rather the fact that the size of the effect is large relative to other nations.

Up until this point, we have been very careful not to identify any measured effects as *causal*. Assuming there are no measurement errors so that we have correctly identified an abnormal increase in Norwegian exports to Vietnam and South Korea, what remains in order to credibly infer that these are *caused* by the Peace Prize is either: 1) having sufficiently controlled for all factors affecting Norwegian exports in the years 2011 to 2016/17, 2) parallel trends between realized outcomes and the Norwegian counterfactual in the absence of treatment, or 3) the strict exogeneity of the Peace Prize event in combination with enough observations in treatment and control groups. The first can be ruled out immediately on the basis of common sense. The second is guaranteed by construction if the third holds, but must nevertheless be dismissed due to the many statistically significant results for treatment in placebo countries. While the decision to award the Peace Prize to Liu Xiaobo in 2010 was arguably unanticipated and the Norwegian Parliament insists that the Nobel Committee operates independently of itself (thus ruling out endogeneity between the award decision and Sino-Norwegian commercial ties of the type discussed in Fuchs and Klann (2013)), claims of causality on the aggregate level are ultimately rejected on the basis of having too few observations for which treatment is indicated. If we had, say, 30 years of treatment instead of just six or seven, then we expect many more placebo coefficients to be insignificant and we would be less concerned that the effects measured on Norway were a result of noise or confounders. A potential suggestion for future research could be to use monthly data, increasing the number of observations in the treatment group by the twelvefold, but possibly requiring some form of seasonal adjustment. On disaggregated levels, however, there are stronger evidence of causality, in particular on exports of fresh salmon and frozen halibut to Vietnam and the fish meal restrictions. This substantiates of course the claim on aggregate levels. Other goods like Vietnamese and South Korean imports of machinery and petroleum are also suspected, but further research is required for any causal links to be confirmed.

6.2 Broader Implications

On December 19, 2016, after years of diplomatic efforts, the Norwegian Ministry of Foreign Affairs sent out a press release declaring the full normalization of Sino-Norwegian relations. Accompanying the announcement was a joint statement from the governments of both China and Norway where the latter promised, among other things, to "fully [respect] China's sovereignty and territorial integrity, [attach] high importance to China's core interests[33] and major concerns, will not support actions that undermine them, and will do its best to avoid any future damage to the bilateral relations." (Norwegian MFA, 2016). The explicit wording of this excerpt caught the attention of many scholars and interest groups; a few days later, Professor Emeritus at the University of Oxford Stein Ringen remarked to the online magazine ChinaFile that Norway had indeed 'kowtowed' to Beijing, and Senior Researcher Maya Wang at the Human Rights Watch wrote: "That an established democracy should parrot the line of an authoritarian power is both absurd and deeply troubling." (Ringen, 2016; Wang, 2017).

China's human rights issues have for decades been a major dilemma for Western democracies. On the one hand, the rapid growth and new-found position of China as the world's second largest economy (number one, by some measures) has created vast opportunities for the west in areas of trade and finance – resulting in increased

[33] According to Sverdrup-Thygeson (2016, p. 5), China's core interests are to "[uphold] political stability and the Chinese party-state, [protect] national sovereignty and territorial integrity, and [promote] economic and social progress".

cooperation, but consequently also commitment and interdependence. At the same time, China's community-oriented society stand in stark contrast to Western values like freedom of speech, freedom of the press, and religious and political freedom. Some of the more recent international objections include concerns over internet and media censorship; harassment and detention of anyone publicly opposing the Communist Party or the Central Government as well as those appointed to defend them; complete lack of an independent judicial branch; wrongful executions; and the persecution, containment and possible torture of religious minorities in 'reeducation' camps in the Xinjiang province. The situation has arguably taken a turn for the worse since the appointment of President Xi Jinping in 2013, whose grand strategy for China in 2050 is not to be influenced by criticism of its domestic affairs from abroad (Piccone, 2018).

One of the earliest nations to officially recognize the People's Republic of China, Norway is perhaps facing the human rights dilemma to an even greater extent than many other countries. Since China started liberalizing its economy in the late 20th century, Sino-Norwegian interdependence has developed, not only in trade and investments, but also in educational and cultural exchanges – signalled by the increasing number of Chinese students in Norwegian universities, the supporting of arts and cultural exhibitions by Norwegian diplomatic stations in China, and the opening of a Chinese Confucius Institute in Bergen in 2008 (Sverdrup-Thygeson, 2016). At the same time, the promotion of democratic principles have for decades been important hallmarks for Norwegian foreign policy (Norwegian MFA, 2013). To legitimize China's central government, then, is problematic as it puts Norway's integrity as an internationally-recognized advocate for human rights at stake. While the decision by the Norwegian Government to apologize was probably more an example of pragmatism rather than a renouncement of this position, the cost is the public betrayal of a Nobel Laureate who remained incarcerated until his death in July 2017. In Chinese state-owned media Norway was ridiculed, as echoed in the sentiments from the Communist Party's English-language trumpet Global Times (2016):

> Awarding Liu the Nobel Peace Prize was one of the rudest interferences in Chinese internal affairs by the West over the past years. (...) Norway has a population of merely 4 million, but it tried to teach China, a

> country with 1.4 billion people, a lesson in 2010. It was a ridiculous story. (...) The Norwegian government has stepped out of the radical and naive state of six years ago.

With regard to Norwegian legitimacy, historian Stein Tønneson stated to NY Times that he did not believe the Joint Statement would impair Norway's reputation, however, Sverdrup-Thygeson added that it will be exciting to see what happens the next time Dalai Lama pays a visit (Chan, 2016).

Our study fits in a category of research of the type 'how to deal with the new China'. Contrasting to some degree with Mathisrud (2018), we find that the direct effects of Chinese restrictions on Norwegian exports were small or negligible, especially when taking into account the amount of re-exports through neighboring countries. In line with Sverdrup-Thygeson (2015), we argue that the strong economic complementary of Sino-Norwegian trade relations driven by Ricardian principles are the reason for this. We are not convinced, however, that this was also the case for *indirect* effects. Having reached the eighth round of negotiations before contact ceased in October 2010, the delegates working on the Sino-Norwegian FTA had already completed about as many talks as were ever held in the cases of both Switzerland and Iceland and were reportedly nearing completion. The results in Table 8 suggest annual Norwegian exports to China could have increased by 38 to 55 percent, had negotiations been finalized and trade progressed in a similar manner to the other Western FTA-countries. But one thing not discussed is how these countries' exports to all other nations developed in the meantime. Table A.5 in the appendix shows how Western exporters' overall first-order interaction effects are slightly negative, which could imply some degree of cannibalism as firms shift their attention to meet growing demand from the East. The net effect on total exports, and not least any welfare gains, of signing the FTAs are thus far from clear.

China's incentives for creating stronger ties with the West are debated, and it is often speculated that free trade agreements are used as a tool to gain geostrategic leverage. In the case of the Sino-Icelandic FTA, scholars point out that the small size of Iceland's market should not warrant much interest unless China plans to use the agreement to promote its influence over Arctic policy[34] or natural resources (Skoba, 2013; Isachsen, 2020). Concerns have also been raised over the specific content of the agreements. While on the surface each FTA seems to follow a similar template[35], they are negotiated individually and tailored to the bilateral relation in question. Most agreements include measures that go beyond the facilitation of trade in goods, and are often controversial. For instance, the Sino-Australian FTA (ChAFTA) contains provisions on the 'movement of natural persons' which exempts certain Chinese companies operating in Australia from submitting their migrant workers to Australian employment laws[36]. ChAFTA has also been criticized for its inclusion of an Investor-State Dispute Settlement clause which could potentially undermine the existing Australian legal system in disputes with Chinese investors. Another agreement which focuses explicitly on investment promotion is the Sino-Swiss FTA. In August 2018, members of the Swiss Parliament called for the implementation of investment controls, amid fears of Chinese investors targeting 'strategically sensitive' companies after the acquisition of agrochemical plant Syngenta in 2016 became the largest-ever Chinese takeover of a foreign company. The Swiss Government rejected the proposition in early 2019, but added that they would conduct a monitoring procedure to consider whether any actions would be required in the future (Swissinfo, 2019). Concerns have also been raised over the market-distortive effects of inviting tenders for the construction of large-scale infrastructure projects from a nation which is renowned for its governmental involvement in even wholly-privately-owned enterprises.

Since Xi Jinping came to power, China has markedly increased its global ambi-

[34]In 2010, Chinese Rear Admiral Yin Zhuo announced: "The Arctic belongs to all the people around the world as no nation has sovereignty over it. (...) China must play an indispensable role in Arctic exploration as we have one-fifth of the world's population" (Chang, 2010). Since then, China has become increasingly active in Arctic questions, becoming an observer of the Arctic Council in 2013 and declaring itself a 'Near-Arctic State' in its 2018 Arctic policy report. China's official plans for the polar region is to conduct research projects; protect, develop and participate in the governance of the Arctic; all the while promoting "respect, cooperation, win-win result and sustainability". A particularly important goal is the establishment of a new Polar Silk Route, the shorter northern journey lowering transit times between Asian and European ports by as much as two weeks while avoiding the risk of piracy in the Gulf of Aden (Xinhua, 2018).

[35]In addition to reducing tariffs on goods, the agreements always include sections on trade facilitation such as rules of origin measures and custom procedures, trade remedies, actions in case of disputes, sanitary and phytosanitary measures (food and plant safety) and to a varying degree intellectual property rights.

[36]Specifically, Article 10.4, paragraph 3 of the agreement proper states that "(...) neither [Australia nor China] shall require labour market testing, economic needs testing or other procedures of similar effect as a condition for temporary entry (Australian DFAT, 2015).

tions. The comprehensive Belt and Road Initiative[37] has sparked controversy over China's alleged neocolonialism and 'debt-trap diplomacy' over developing nations. Meanwhile in Europe, some governments have started taking action against foreign takeovers after a string of buyouts, one of the most publicized of which was when China's Midea Group acquired German robotics manufacturer Kuka in the summer of 2016 (Grimm & Kowsmann, 2018). The concern is that China is harvesting Western technology instead of cultivating it. A study by Jungbluth (2018) found that almost two-thirds of Chinese purchases of shares in German companies between 2014 and 2017 fit in either of the 10 sectors targeted by the Made in China 2025[38] strategic vision, calling for increased demands for reciprocity in economic relations with China from European authorities. According to Gåsemyr and Sverdrup-Thygeson (2017), the Norwegian story is in many ways no different; despite political strains, Chinese investors made several large purchases of Norwegian industrial firms after the Peace Prize event, including chemicals manufacturer Elkem in 2011, energy company REC Solar in 2015, and the consumer division of IT developer Opera Software in 2016. They also acquired furniture manufacturer Ekornes in 2018. Most if not all of these acquisitions are compatible with Made in China 2025.

Following the normalization of relations between Oslo and Beijing, FTA negotiations were promptly resumed in the fall of 2017, and are reportedly in the finishing stages again at present. We agree with Isachsen (2020) that Norway needs to proceed cautiously with this agreement. While our findings suggest implementing FTAs with China can have trade-increasing effects, we have also seen how China's ambitions likely reach further than dealing with imports and exports only. The specific content of the Sino-Norwegian agreement under negotiation is classified, but according to

[37] Launched in 2013, the Belt and Road Initiative, a collective term for the Silk Road Economic Belt and the 21st Century Maritime Silk Road, is likely the single largest international infrastructure project undertaken in Chinese history. The initiative aims at establishing treaties and constructing new trade routes spanning the entire Eurasian continent, both by land and sea. At the heart of the controversy is the case of the Magampura Mahinda Rajapaksa Port in Hambantota, Sri Lanka; when it became clear that the Sri Lankan Government would default on the Chinese loans used to finance its construction, an agreement was reached to lease the port back to the Chinese holding company for 99 years, causing both local and international protests (Henderson, 2019). Officially, however, China's purpose with BRI is to "promote regional economic development, through creation of win-win cooperation and joint prosperity." (Huang, 2016).

[38] Made in China 2025 is China's ten-year strategic plan for upgrading its industry from 'big to powerful'. The plan focuses on improving Chinese efficiency in high-tech fields such as robotics; new energy vehicles; aerospace and aeronautical equipment; and biopharma and advanced medical products. The official goal is to make "[Chinese manufacturing] efficient and integrated so that it can occupy the highest parts of global production chains"(Kennedy, 2015).

a recent statement it will include provisions on trade in goods, trade in services, investments and public procurement (MTIF, 2019). Improved market access for seafood is naturally one of the most important items on the agenda for the Norwegians, but with tariffs already at a low point, exactly what the Chinese are after remains ambiguous.

7 Conclusion

The awarding of the 2010 Nobel Peace Prize to Chinese dissident Liu Xiaobo resulted in a unilateral suspension of diplomatic relations between China and Norway which lasted from October 2010 to December 2016. For their perceived affiliation with the Nobel Committee, Norwegian officials and business representatives were routinely denied entry to China or lost contact with their Chinese counterparts. The free trade agreement which was nearing completion at the time was shelved. While some studies have found significant negative effects on Norwegian exports, the overall economic consequences for Norway appear to have been smaller than initially feared. Our study complements earlier literature regarding the Peace Prize event – challenging China's incentives for restricting Norwegian imports in the first place and disputing some earlier findings that the direct effects on trade were significant.

Our first result is that the USD value of Norwegian exports to China in aggregates were about 10 percent – or up to USD 2.4 billion in total – lower than our 'OECD plus'-estimated gravity counterfactual between 2011 and 2016. While substantial in value, the deviation is neither statistically significant nor a particularly unusual occurrence compared to many placebo countries. The result is robust to several key model specifications, but hinges on the inclusion of first-order interaction terms in the equation. At the same time, the USD value of Norwegian exports to South Korea and Vietnam were 68 and 222 percent higher than their respective counterfactuals between 2011 and 2016, an overshoot amounting to a combined total of well over USD 10 billion. For Vietnam, the estimate increases to 271 percent if we assume treatment lasted for one additional year. While these effects remain high compared to a series of placebo tests, we suspect they are at least in part influenced by entirely different factors than the Peace Prize.

Our second result confirms the findings by Chen and Garcia (2016) that exports of fresh Norwegian salmon found their way into China through Vietnam. Additionally, we find evidence that this was also the case for frozen halibut and possibly certain mechanical appliances like non-electric winches and capstans. The total value of potentially-smuggled salmon is estimated at up to USD 560 million and the value of halibut at USD 70 million. Adding these figures to the accounts of their most-likely destination would bring the treatment effects for both Vietnam and China closer to zero. In the case of South Korea, our qualitative search is only able to uncover circumstantial evidence that exports of Norwegian petroleum, and to a lesser degree machinery like centrifugal pumps and liquid elevators, ended up in China or were otherwise tied to Chinese demand. As was initially discovered by Johansen et al. (2018), Norwegian exports of fish meal are reconfirmed to have been affected by treatment, but official reports of Vietnamese and South Korean imports rule them out as potential intermediaries.

Lastly, our third result is that the USD value of exports to China from Chile, New Zealand, Iceland, Switzerland and Australia on average increased by an order of 38 to 55 percent compared to their respective counterfactuals after the implementation of a bilateral free trade agreement with China. Under strong assumptions, this can be indicative of Norway's indirect losses following the discontinuation of negotiations in 2010. These findings ignore the possibility of cannibalization, of which there is also some evidence.

In sum, our study finds that severed diplomatic relations did not seem to have much of an effect on Norway's exports to China in the period 2010 to 2016/17. An important implication of our results is that the Norwegian Government need not be excessively accommodative to Beijing in order to maintain healthy trade flows, and we believe central issues of Norwegian foreign policy should have a higher priority than the voice of individual exporters. In particular, the rerouting of certain products through third-party countries is not evidence of Chinese restrictions working – rather, this is evidence of restrictions failing to work.

It is quite likely, however, that the incident led to an at least temporary loss of opportunities in China, especially through the delayed FTA negotiations. But if so, the price of getting these opportunities is the increased commitment to an autocracy which has a multitude of well-documented human rights violations and the potential undermining of Norwegian interests. Our message is not one of anti-globalization; nor is it against China per se. We are simply suggesting that we should keep nations which we do not yet know exactly how to deal with at an arm's length distance. In one view, China is a friendly giant, whose economic achievements will serve as an example for developing nations for years to come. In another view, China is a bully, whose lack of respect for foreign interests is surpassed only by the way she treats the population of her own.

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Appendices

A Derivations from EK

A.1 Country i's Contribution to Country j's Price Parameter

We have defined π_{ij} to be the probability that the lowest price offered for a good is that provided by country i to j:

$$\pi_{ij} = \Pr[p_{ij}(h) \leq \min p_{kj}(h)],$$

for all $k \neq i$. By the law of large numbers, this probability also equals the share of j's purchases from i. Following the steps outlined by Allen and Arkolakis (2016), this can be expressed as:

$$\pi_{ij} = \int_0^\infty \Pr[\min p_{kj}(h) \geq p] dG_{ij}(p)$$
$$\pi_{ij} = \int_0^\infty \prod_{\substack{k=1 \\ k\neq i}}^{N} [1 - G_{kj}(p)] dG_{ij}(p)$$

where we integrate over the distribution of prices offered by i to j, using the facts that prices are positive and vary between zero and infinity and that all goods have the same distribution[39]. Inserting for the distributions of prices from equation (5), we have[40]:

$$\pi_{ij} = \int_0^\infty \prod_{\substack{k=1 \\ k\neq i}}^{N} [e^{-[T_k(c_k d_{kj})^{-\theta}]p^\theta}] \frac{d}{dp}[1 - e^{-[T_i(c_i d_{ij})^{-\theta}]p^\theta}] dp$$
$$\pi_{ij} = \int_0^\infty \prod_{k=1}^{N} [e^{-[T_k(c_k d_{kj})^{-\theta}]p^\theta}][T_i(c_i d_{ij})^{-\theta} \theta p^{\theta-1}] dp$$
$$\pi_{ij} = T_i(c_i d_{ij})^{-\theta} \int_0^\infty [e^{-\phi_j p^\theta}] \theta p^{\theta-1} dp,$$

where the second line follows from combining the outer core from the differentiation with the product of the sequence, and the third follows from our definition of ϕ_j

[39] The second line follows from the applying the same order statistics rule for the cumulative distribution function of the minimum as in footnote 10, except that the expression is inverted.

[40] Here we use the rule that $\int_0^\infty z dx = \int_0^\infty z \frac{dx}{dy} dy$.

from equation (6). Next, we solve the integral to arrive at the solution[41]:

$$\pi_{ij} = \frac{T_i(c_i d_{ij})^{-\theta}}{\phi_j}[e^{-\phi_j p^\theta}|_0^\infty]$$
$$\pi_{ij} = \frac{T_i(c_i d_{ij})^{-\theta}}{\phi_j},$$

since the function evaluated at $p = \infty$ is zero and $p = 0$ is one.

A.2 Finding the Price Index for Country j

The consumer maximization problem is given by:

$$\arg\max_{Q_j(h)} \left\{ U = \left[\int_0^1 Q_j(h)^{(\sigma-1)/\sigma} dh\right]^{\sigma/(\sigma-1)} \right\} \quad s.t. \quad \int_0^1 P_j(h)Q_j(h)dh = X_j,$$

where everything is as in the text. We set up the Lagrangian (note that it is common to perform a monotonic transformation of the utility function to maximize $U^{\sigma-1/\sigma}$ instead of U because this makes the algebra a little easier):

$$\mathcal{L} = \int_0^1 Q_j(h)^{(\sigma-1)/\sigma} dh + \lambda \left[X_j - \int_0^1 P_j(h)Q_j(h)dh\right]. \tag{A.1}$$

The first order condition is:

$$\frac{\partial \mathcal{L}}{\partial Q_j(h)} = 0$$
$$\frac{\sigma-1}{\sigma} Q_j(h)^{-1/\sigma} - \lambda P_j(h) = 0$$
$$Q_j(h) = \lambda^{-\sigma}\left(\frac{\sigma-1}{\sigma}\frac{1}{P_j(h)}\right)^\sigma. \tag{A.2}$$

Inserting (A.2) into the budget constraint yields:

$$X_j = \int_0^1 P_j(h)\lambda^{-\sigma}\left(\frac{\sigma-1}{\sigma}\frac{1}{P_j(h)}\right)^\sigma dh$$
$$\lambda^\sigma = \left(\frac{\sigma-1}{\sigma}\right)^\sigma \frac{\int_0^1 P_j(h)^{1-\sigma}dh}{X_j}$$
$$\lambda = \frac{\sigma-1}{\sigma}\left(\frac{X_j}{\int_0^1 P_j(h)^{1-\sigma}dh}\right)^{-\frac{1}{\sigma}} \tag{A.3}$$

[41] Using the theorem that $\int_a^b f(x)dx = F(x)|_a^b = F(b) - F(a)$ for a continuous function f(x) which has the anti-derivative F(x).

Next, insert (A.3) into the first order condition to get an expression for demand:

$$Q_j(h) = \left[\frac{\sigma-1}{\sigma}\left(\frac{X_j}{\int_0^1 P_j(h)^{1-\sigma}dh}\right)^{-\frac{1}{\sigma}}\right]^{-\sigma}\left(\frac{\sigma-1}{\sigma}\frac{1}{P_j(h)}\right)^{\sigma}$$
$$Q_j(h) = \left(\frac{X_j}{\int_0^1 P_j(h)^{1-\sigma}dh}\right)\left(\frac{1}{P_j(h)}\right)^{\sigma},$$

which can be written as

$$Q_j(h) = X_j P_j(h)^{-\sigma} p_j^{\sigma-1}, \tag{A.4}$$

if we define $p_j = \left(\int_0^1 P_j(h)^{1-\sigma}dh\right)^{\frac{1}{1-\sigma}}$. Equation (A.4) is the well-known *Marshallian demand function*, which expresses consumption of good h (in our case, also in country j) as a function of its price $P_j(h)$, total income X_j and the price of all goods p_j, assuming that utility is perfectly maximized as above. The Marshallian demand function enables us to understand how much consumption of good h changes with its price, holding total income and the prices of all other goods constant. p_j – the so-called Dixit-Stiglitz Price Index – can then be thought of as a measure of the true cost of living in country j when consumer behaviour is optimized. It is easily shown that p_j is such that it satisfies $U_j^* = \frac{X_j}{p_j}$, where U_j^* denotes maximum utility[42].

The exact price index in Eaton and Kortum (2002) can now be derived from the expression of p_j. We rely on the derivations in Allen and Arkolakis (2016) to show this result:

$$p_j = \left(\int_0^1 P_j(h)^{1-\sigma}dh\right)^{\frac{1}{1-\sigma}}$$
$$p_j^{1-\sigma} = \int_0^\infty p^{1-\sigma}dG_j(h),$$

where we integrate over the distribution of prices instead of across goods. Like earlier, we use the facts that prices are positive and vary between zero and infinity and that all goods have the same distribution. Next, we rewrite the expression

[42] To see this, insert A.4 into the utility function. This relationship is also called the indirect utility function, defined as maximum utility for a given level of income and prices.

as[43]:

$$p_j^{1-\sigma} = \theta\phi_j \int_0^\infty p^{\theta-\sigma} e^{-p^\theta \phi_j} dp.$$

Now define $x \equiv p^\theta \phi_j$, so that $p = (\frac{x}{\phi_j})^{\frac{1}{\theta}}$, $\frac{dp}{dx} = \frac{1}{\theta} x^{\frac{1-\theta}{\theta}} \phi_j^{-\frac{1}{\theta}}$ and:

$$\begin{aligned} p_j^{1-\sigma} &= \int_0^\infty \left(\frac{x}{\phi_j}\right)^{\frac{1-\sigma}{\theta}} e^{-x} dx, \\ p_j &= \phi_j^{-\frac{1}{\theta}} \left(\int_0^\infty x^{\frac{1-\sigma}{\theta}} e^{-x} dx\right)^{\frac{1}{1-\sigma}}, \\ p_j &= \phi_j^{-\frac{1}{\theta}} \left[\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)\right]^{\frac{1}{1-\sigma}}, \end{aligned}$$

where $\Gamma(t) \equiv \int_0^\infty x^{t-1} e^{-x} dx$ is the Gamma function, with $t = \frac{\theta+1-\sigma}{\theta}$.

Finally, let $\gamma = \Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)^{\frac{1}{1-\sigma}}$. We then have:

$$p_j = \gamma \phi_j^{-1/\theta} \tag{A.5}$$

[43]Here, and in the next step, we repeat our use of the rule that $\int_0^\infty z dx = \int_0^\infty z \frac{dx}{dy} dy$.

B Data

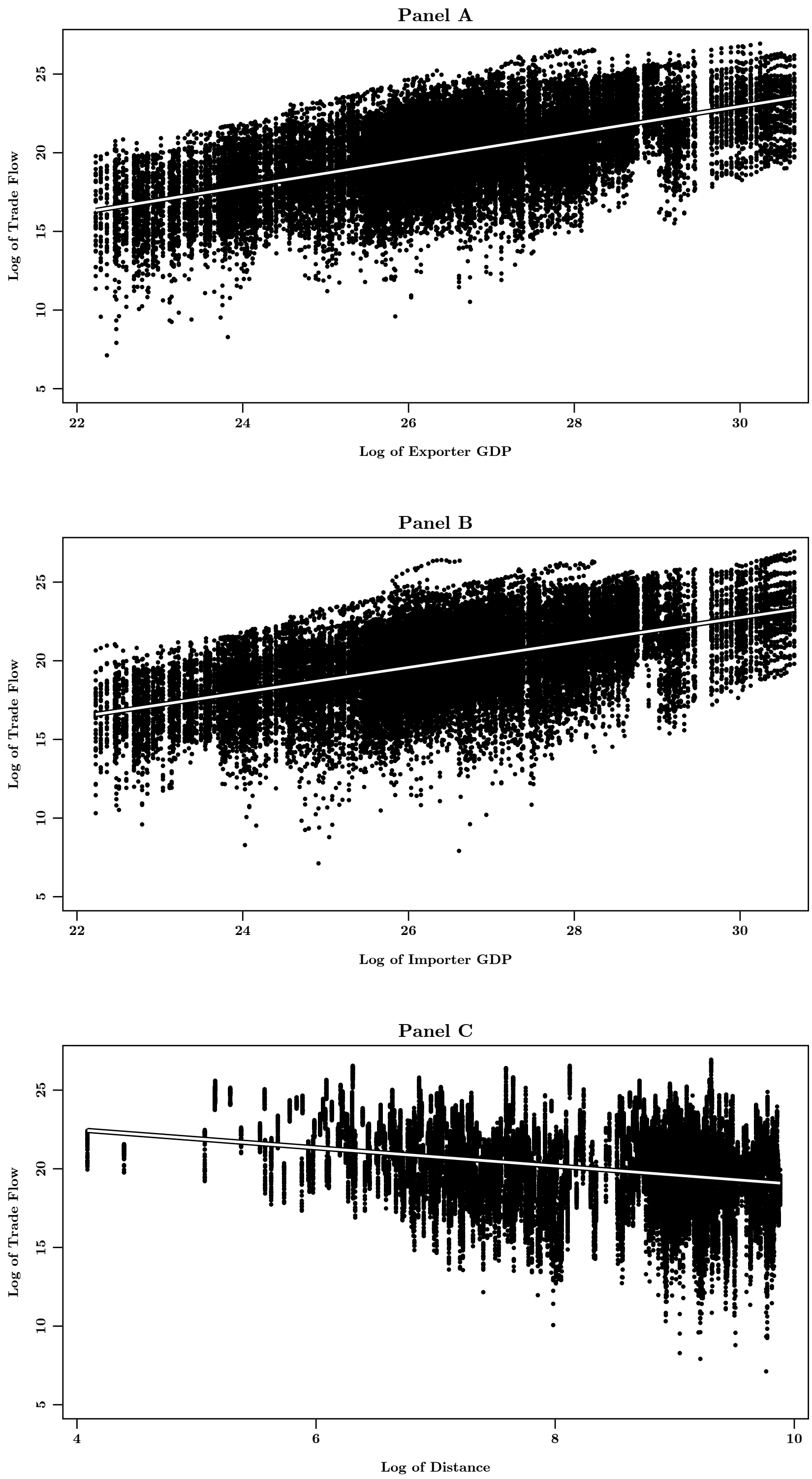

Figure A.1: Trade Flows Plotted Against Importer/Exporter GDP and Distance

Table A.1: Results From Panel Regression Hypothesis Tests

Panel A: Breusch and Pagan Lagrangian Multiplier test for Random Effects		
H_0: Var(α_{ij})=0	$\overline{\chi}^2$: 2.8e+0.5	P-value: 0.0000
Panel B: F-test for Fixed Effects		
H_0: $\alpha_{12} = \alpha_{13} = (...) = \alpha_{ij} = 0$	F-stat: 1610.25	P-value: 0.0000
Panel C: Hausman test between Random or Fixed Effects		
H_0: $\beta_{FE} = \beta_{RE}$	χ^2: 1438.40	P-value: 0.0000

Table A.2: Residual Autocorrelation in the Population-Averaged Model

Lag	Autocorr.	Lag	Autocorr.	Lag	Autocorr.
1	0.99	9	0.98	17	0.96
2	0.99	10	0.98	18	0.96
3	0.99	11	0.97	19	0.96
4	0.99	12	0.97	20	0.96
5	0.99	13	0.97	21	0.96
6	0.98	14	0.97	22	0.95
7	0.98	15	0.97	23	0.95
8	0.98	16	0.97		

C Additional Regression Outputs

Table A.3: Gravity Variables and First-order Effects from Table 4

Treatment Active from 2011 to 2016: $s_t = 1$ if if $2011 \leq t \leq 2016$, 0 otherwise	Random Effects			Fixed Effects			
Dependent Variable: Log of Trade Flow	(a)	(b)	(c)	(d)	(e)	(f)	(g)
$\ln GDP_i$	0.74*** (0.02)	0.76*** (0.02)	0.91*** (0.03)	0.79*** (0.03)	0.80*** (0.03)	0.89*** (0.03)	
$\ln GDP_j$	0.74*** (0.02)	0.74*** (0.02)	0.91*** (0.03)	0.82*** (0.02)	0.81*** (0.02)	0.91*** (0.03)	
$\ln POP_i$	0.01 (0.02)	0.00 (0.02)	-0.09*** (0.03)	-1.59*** (0.16)	-1.54*** (0.16)	-1.67*** (0.17)	
$\ln POP_j$	0.02 (0.02)	0.02 (0.02)	-0.08*** (0.03)	-0.08 (0.16)	-0.06 (0.16)	-0.19 (0.17)	
fx^{norm}	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	
lnDistance	-0.84*** (0.02)	-0.85*** (0.02)	-0.83*** (0.02)				
Contiguity	0.71*** (0.11)	0.69*** (0.11)	0.69*** (0.12)				
Common Language	0.65*** (0.07)	0.64*** (0.07)	0.50*** (0.08)				
Sea Access	0.21*** (0.05)	0.21*** (0.05)	0.17*** (0.05)				
s_t		-0.08*** (0.01)			-0.05*** (0.01)		
Exporter Norway × s_t		-0.27*** (0.05)	-0.27*** (0.05)		-0.21*** (0.05)	-0.21*** (0.05)	
Importer China × s_t		0.16*** (0.06)	0.01 (0.06)		0.09 (0.06)	-0.00 (0.06)	
Importer Vietnam × s_t		0.37*** (0.08)	0.27*** (0.08)		0.32*** (0.09)	0.27*** (0.09)	
Importer Japan × s_t		0.11** (0.05)	0.17*** (0.05)		0.14*** (0.04)	0.17*** (0.04)	
Importer Hong Kong × s_t		0.24*** (0.08)	0.27*** (0.08)		0.24*** (0.08)	0.25*** (0.08)	
Importer South Korea × s_t		0.16** (0.06)	0.15** (0.07)		0.15** (0.06)	0.15** (0.06)	
Pair Fixed Effects				YES	YES	YES	YES
First-order Interaction Effects		YES	YES			YES	
Year Fixed Effects			YES		YES	YES	
Source- & Destination-year Effects							YES
R^2	0.83	0.83	0.83	0.96	0.96	0.97	0.98
Observations	41 304	41 304	41 304	41 304	41 304	41 304	41 304

Notes: Each column contains the estimated coefficients for the gravity variables and the first-order interaction effects not reported in Panel A of Table 4. All comparable estimates from Panel B are similar. Year-specific effects and country-pair effects are not included. Country-pair clustered standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.4: Gravity Variables and First-order Effects from Table 5

	Exporter i' = Norway			Exporter i' = Sweden			Exporter i' = Finland			Exporter i' = Iceland			Exporter i' = Denmark		
Dependent Variable: Log of Trade Flow	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
$\ln GDP_i$	0.80***	0.89***		0.80***	0.88***		0.79***	0.88***		0.80***	0.89***		0.80***	0.89***	
	(0.03)	(0.03)		(0.03)	(0.03)		(0.03)	(0.03)		(0.03)	(0.03)		(0.03)	(0.03)	
$\ln GDP_j$	0.81***	0.91***		0.81***	0.91***		0.81***	0.91***		0.81***	0.91***		0.81***	0.91***	
	(0.02)	(0.03)		(0.02)	(0.03)		(0.02)	(0.03)		(0.02)	(0.03)		(0.02)	(0.03)	
$\ln POP_i$	-1.54***	-1.67***		-1.55***	-1.68***		-1.57***	-1.70***		-1.57***	-1.70***		-1.56***	-1.69***	
	(0.16)	(0.17)		(0.16)	(0.17)		(0.16)	(0.17)		(0.16)	(0.17)		(0.16)	(0.17)	
$\ln POP_j$	-0.06	-0.19		-0.05	-0.19		-0.05	-0.19		-0.05	-0.18		-0.05	-0.19	
	(0.16)	(0.17)		(0.16)	(0.17)		(0.16)	(0.17)		(0.16)	(0.17)		(0.16)	(0.17)	
fx^{norm}	0.01***	0.01***		0.01***	0.01***		0.01***	0.01***		0.01***	0.01***		0.01***	0.01***	
	(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)		(0.00)	(0.00)	
s_t	-0.05***			-0.04***			-0.04***			-0.06***			-0.05***		
	(0.01)			(0.01)			(0.01)			(0.01)			(0.01)		
Exporter $i' \times s_t$	-0.21***	-0.21***		-0.30***	-0.29***		-0.42***	-0.40***		0.16	0.18*		-0.16***	-0.14***	
	(0.05)	(0.05)		(0.04)	(0.04)		(0.04)	(0.04)		(0.10)	(0.10)		(0.04)	(0.04)	
Importer China $\times s_t$	0.09	-0.00		0.09*	0.00		0.09*	0.00		0.09	0.00		0.08	-0.01	
	(0.06)	(0.06)		(0.06)	(0.06)		(0.06)	(0.06)		(0.06)	(0.06)		(0.06)	(0.06)	
Importer Vietnam $\times s_t$	0.32***	0.27***		0.37***	0.31***		0.35***	0.29***		0.36***	0.30***		0.36***	0.30***	
	(0.09)	(0.09)		(0.09)	(0.09)		(0.09)	(0.09)		(0.09)	(0.09)		(0.09)	(0.09)	
Importer Japan $\times s_t$	0.14***	0.17***		0.14***	0.18***		0.13***	0.17***		0.15***	0.18***		0.14***	0.18***	
	(0.04)	(0.04)		(0.04)	(0.04)		(0.04)	(0.04)		(0.04)	(0.04)		(0.04)	(0.04)	
Importer Hong Kong $\times s_t$	0.24***	0.25***		0.24***	0.26***		0.24***	0.26***		0.22***	0.23***		0.23***	0.24***	
	(0.08)	(0.08)		(0.08)	(0.08)		(0.08)	(0.08)		(0.08)	(0.08)		(0.08)	(0.08)	
Importer South Korea $\times s_t$	0.15**	0.15**		0.16***	0.16***		0.16***	0.16**		0.17***	0.16***		0.17***	0.16***	
	(0.06)	(0.06)		(0.06)	(0.06)		(0.06)	(0.06)		(0.06)	(0.06)		(0.06)	(0.06)	
Pair Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
First-order Interaction Effects	YES	YES		YES	YES		YES	YES		YES	YES		YES	YES	
Year Fixed Effects		YES			YES			YES			YES			YES	
Source- & Destination-year Effects			YES			YES			YES			YES			YES
R^2	0.96	0.97	0.98	0.96	0.97	0.98	0.96	0.97	0.98	0.96	0.97	0.98	0.96	0.97	0.98
Observations	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304

Notes: Each column contains the estimated coefficients for the gravity variables and the first-order interaction effects not reported in Table 5. Year-specific effects and country-pair effects are not included. Country-pair clustered standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.5: Gravity Variables and First-order Effects from Table 8

Dep. Var: Log of Trade Flow	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
$\ln GDP_i$	0.80*** (0.03)	0.80*** (0.03)	0.76*** (0.02)	0.90*** (0.03)	0.90*** (0.03)	0.85*** (0.03)			
$\ln GDP_j$	0.79*** (0.03)	0.80*** (0.03)	0.82*** (0.03)	0.90*** (0.03)	0.91*** (0.03)	0.92*** (0.03)			
$\ln POP_i$	-1.50*** (0.16)	-1.48*** (0.17)	-1.43*** (0.17)	-1.61*** (0.17)	-1.60*** (0.17)	-1.57*** (0.17)			
$\ln POP_j$	-0.05 (0.16)	-0.05 (0.16)	-0.03 (0.16)	-0.18 (0.17)	-0.18 (0.17)	-0.19 (0.16)			
fx^{norm}	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)			
FTA Exporters Pooled × f_{it}^{POOLED}	-0.07* (0.04)			-0.06* (0.03)					
FTA Exporters Non-Asian × f_{it}^{N-ASN}		-0.12*** (0.04)			-0.11*** (0.04)				
Exporter Chile × f_t^{CHL}			0.04 (0.09)			0.05 (0.09)			
Exporter New Zealand × f_t^{NZL}			-0.33*** (0.06)			-0.29*** (0.06)			
Exporter Iceland × f_t^{ISL}			0.04 (0.12)			0.04 (0.12)			
Exporter Switzerland × f_t^{CHE}			-0.06 (0.05)			-0.07 (0.05)			
Exporter Australia × f_t^{AUS}			-0.27*** (0.08)			-0.30*** (0.08)			
FTA Exporters Asian × f_{it}^{ASN}		-0.01 (0.06)			-0.01 (0.06)				
Exporter South Korea × f_t^{KOR}			-0.12 (0.08)			-0.16** (0.08)			
Exporter Vietnam × f_t^{VNM}			0.75*** (0.10)			0.73*** (0.10)			
Exporter Indonesia × f_t^{IDN}			-0.41*** (0.09)			-0.41*** (0.09)			
Exporter Hong Kong × f_t^{HKG}			-0.29*** (0.11)			-0.24** (0.11)			
Importer China × $f_t^{POOLED'\,\ddagger}$	0.30*** (0.08)			0.23*** (0.08)					
Importer China × $f_t^{N-ASN'\,\ddagger}$		-0.16*** (0.06)			-0.20*** (0.06)				
Importer China × f_t^{CHL}			-0.03 (0.04)			-0.04 (0.04)			
Importer China × f_t^{NZL}			-0.11*** (0.04)			-0.11** (0.04)			
Importer China × f_t^{ISL}			-0.11*** (0.04)			-0.15*** (0.04)			
Importer China × $f_t^{CHE\,\dagger}$									
Importer China × f_t^{AUS}			-0.03 (0.05)			-0.12** (0.05)			
Importer China × $f_t^{ASN'\,\ddagger}$		0.44*** (0.06)			0.39*** (0.06)				
Importer China × $f_t^{KOR\,\dagger}$									
Importer China × f_t^{VNM}			-0.04 (0.04)			-0.00 (0.04)			
Importer China × $f_t^{IDN\,\dagger}$									
Importer China × f_t^{HKG}			0.45*** (0.06)			0.39*** (0.06)			
Pair Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
First-order Interaction Effects	YES	YES	YES	YES	YES	YES			
Year Fixed Effects				YES	YES	YES			
Source- & Destination-year Effects							YES	YES	YES
R^2	0.96	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98
Observations	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304	41 304

Notes: Each column contains the estimated coefficients for the gravity variables and the first-order interaction effects not reported in Table 8. Year-specific effects and country-pair effects are not included. Country-pair clustered standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. †Omitted because of collinearity, i.e. the FTA for this country became active in the same year as one or more of the others. ‡In the special cases where the first-order interaction effect on Chinese imports is pooled, the indicator variable is coded as one for all years starting with the year of implementation of the first agreement in the group of countries and all years thereafter.

D Estimation Methods: Panel Data Regression

Panel data is defined as multi-dimensional repeated measurements on the same individual units at different points in time. In our application, the unit of measurement is individual country-pairs (denoted by subscripts ij) and the unit of time is in years between 1995 and 2018 (denoted by subscript t). Panels can be either *short* (many units, few time periods), *long* (few units, many time periods) or both. Since we have $N = 1\,722$ pairs over $T = 24$ years, ours is *short.* Additionally, panels can be either balanced or to a varying degree unbalanced, depending on whether or not the number of observations is the same across country-pairs. With 1 707 pairs containing no missing observations, our data is almost fully balanced, as mentioned in section 4.1.

Linear panel data regression can be performed in at least three ways, using either a population-averaged (PA), fixed effects (FE) or random effects (RE) approach. All come with their share of benefits and costs, which will be discussed in turn below. Consider a simplified version of equations (15)-(16) which we reproduce without the interaction terms:

$$x_{ijt} = G'_{ijt}\beta + \upsilon_{ijt}, \tag{A.6}$$

where notation is as in section 4.2, except that x now represents the already-logged dependent variable for simplicity. As before, $\upsilon_{ijt} = \alpha_{ij} + \varepsilon_{ijt}$ is a composite error component assumed to consist of a time-invariant term α_{ij} and an idiosyncratic error term ε_{ijt}. A key distinction in panel data analysis lies in our treatment of this component. Firstly, in the PA model, the assumption is that α_{ij} does not vary between country-pairs, so that $\alpha_{ij} = \alpha$ for all i and j, thus taking the form of a regular constant in the regression equation. Secondly, in the FE model, α_{ij} are treated as a series of time-invariant constants as the subscripts suggest, permitting some correlation between this term and the regressors G'_{ijt}. Thirdly, in the RE model, it is assumed that α_{ij} is purely random (Cameron & Trivedi, 2010, pp. 237-238). It is important to keep in mind that ε_{ijt} remains by definition uncorrelated with all other regressors irrespective of model. In the following, we focus on the FE and RE models since the appropriateness of the PA model is strongly rejected by statistical tests and therefore not used (see section 4.2).

D.1 Fixed Effects Estimation

Most of the analyses performed in this paper relies on the FE model. The main benefits from this approach is the allowance of a limited form of endogeneity, making FE appropriate when the other models are not by controlling for time-invariant unobserved factors. Specifically, if $Cov(\alpha_{ij}, G'_{ijt}) \neq 0$, we assume $\mathbb{E}(\varepsilon_{ijt}|\alpha_{ij}, G'_{ijt}) = 0$, so that we can identify $\mathbb{E}(x_{ijt}|\alpha_{ij}, G'_{ijt})$. On the other hand, FE is in some sense considered a last resort in panel data analysis because estimation of α_{ij} renders estimates of all other time-invariant variables such as distance, common borders and having sea access unattainable. But nor is this a particular requirement in our application. If required assumptions for PA or RE are met, however, then FE should not be used. The reason is that in such cases coefficient estimates from these other models represent the true parameters of the underlying population, whereas FE is consistent but inefficient, since inference is only conditional on the fixed effects in the sample (Baum, 2006, p. 227). FE-estimation also results in larger standard errors, especially in cases where within-pair variation, conditional on the fixed effects, is low. In cases where we add a time-specific component τ_t, which varies with time but not country-pairs, the model is referred to as two-way FE.

Within Estimator

We estimate the FE models using Stata's inbuilt within estimator, which eliminates the fixed effects through a process of 'time-demeaning' before estimating β. Specifically, Stata fits the following model:

$$(x_{ijt} - \overline{x}_{ij} + \overline{\overline{x}}) = \alpha + (G_{ijt} - \overline{G}_{ij} + \overline{\overline{G}})'\beta + (\varepsilon_{ijt} - \overline{\varepsilon}_{ij} + \overline{\overline{\varepsilon}}), \qquad \text{(A.7)}$$

where one bar denotes the within-country-pair mean ($\overline{x}_{ij} = T_{ij}^{-1} \sum_{t=1}^{T_{ij}} x_{ijt}$) and two bars denote the 'grand mean' ($\overline{\overline{x}} = N^{-1} \sum_{ij=1}^{N} \overline{x}_{ij}$). The point of adding and subtracting these means from each variable is to eliminate all the α_{ij} without affecting the estimates of β[44] (Cameron & Trivedi, 2010, p. 257). Notice that since α_{ij} is a constant, $\alpha_{ij} = \overline{a}_{ij}$, and the two terms cancel out, so that we are left with $\overline{\overline{\alpha}} = \alpha$.

[44] Recall that the slope of the regression line does not change by adding or subtracting a constant to each variable.

D.2 Random Effects Estimation

The RE model is used in this paper mostly for consistency, and is not applied toward any of our main results. Compared to FE, the most prominent benefit offered is the ability of identifying $\mathbb{E}(x_{ijt}|G'_{ijt})$, i.e. without conditioning on the fixed effects in the sample. This is because α_{ij} is assumed to be random (or at the very least negligible), so that $Cov(\alpha_{ij}, G'_{ijt}) = 0$. It also allows us to control for time-invariant variables such as distance or border effects, now that α_{ij} does not require estimation. However, the violation of this critical assumption leads to inconsistent estimates, which is easily imaginable in our application as discussed in section 4.2.

FGLS Estimator

If indeed υ_{ijt} was fully random, we could use regular OLS to estimate the RE model. However, since the covariance between the errors is still positive[45] if $\alpha_{ij} > 0$, Stata instead uses Feasible Generalized Least Squares to estimate the following transformed system:

$$(x_{ijt} - \hat{\theta}_{ij}\overline{x}_{ij}) = (1 - \hat{\theta}_{ij})\alpha + (G_{ijt} - \hat{\theta}_{ij}\overline{G}_{ij})'\beta + [(1 - \hat{\theta}_{ij})\alpha_{ij} + (\varepsilon_{ij} - \hat{\theta}_{ij}\overline{\varepsilon}_{ij})], \quad \text{(A.8)}$$

where $\hat{\theta}_{ij}$ is estimated from

$$\theta_{ij} = 1 - \sqrt{\frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + T_{ij}\sigma_\alpha^2}}.$$

Observe first that the form of the system above is determined by the value of $\hat{\theta}_{ij}$, which by construction lies in the interval $0 < \hat{\theta}_{ij} < 1$ and consists of the variances of the two error terms respectively. In the extreme case when $\hat{\theta}_{ij} = 0$, the system collapses to a case of regular OLS. This happens when the variance of the time-invariant effects σ_α is equal to zero (in other words: $\alpha_{ij} = \alpha$ is a constant), and there is no possibility of serial correlation. In the other extreme case when $\hat{\theta}_{ij} = 1$, the FGLS estimator is identical to the within estimator except for the addition of the grand mean in equation (A.7) to report a constant. This happens when $\sigma_\alpha \to \infty$, so essentially because the variation of the fixed component is so large relative to the idiosyncratic variance, the estimator removes it altogether (Cameron & Trivedi,

[45] To see this, note that $Cov(\upsilon_{ijt}, \upsilon_{ijl}) = Cov(\alpha_{ij} + \varepsilon_{ijt}, \alpha_{ij} + \varepsilon_{ijl}) = Var(\alpha_{ij})$.

2010, p. 262). In most circumstances, however, $\hat{\theta}_{ij}$ lies somewhere in between. This is also the case in our application, where the median $\hat{\theta}_{ij}$ is 0.88, reflecting the large relative importance of σ_α and the inappropriateness of the RE model. Notice also the role of T_{ij}; if the panel is fully balanced, $T_{ij} = T$ and the system uses only one unique $\hat{\theta}$. In fact, $\hat{\theta}_{ij}$ is the same for all series with the same amount of periods, differing only in our case for those 15 (out of 1 722) with missing observations. As before, we use cluster-robust standard errors for the same reasons as in the FE model.