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Alexandra Allard

Employment, Externalities, and Exploitation

Empirical Essays on Maritime Sectors and Renewable Resource Management

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Abstract

This thesis addresses empirically understudied and politically significant issues. Specifically, it examines the blue economy and renewable energy, both of which are central to the European Union's economic and environmental strategies.

Essay I examine employment dynamics in the Swedish blue economy, i.e., maritime and maritime-related sectors. By utilizing a novel firm-level dataset covering 1998–2020, the analysis finds that firms within the blue economy generally exhibit higher employment growth and lower job destruction than their counterparts in other sectors.

Essays II and III examine EU fisheries governance. Essay II examines the policy preferences of EU member states, as indicated by bargaining outcomes on Total Allowable Catches (TACs). The findings suggest that the United Kingdom, Ireland, Portugal, Lithuania, and Poland advocate for TACs above scientific advice, while Germany supports lower TACs. Essay III assesses interest group lobbying within the Baltic Sea Advisory Council, demonstrating that fisheries achieve greater lobbying success when scientific advice is more than 20 percent below the status quo or the level of conflict is high. In contrast, other interest groups are more successful when the level of conflict is low and scientific advice is closer to or above the status quo.

Finally, Essay IV presents a meta-analysis of 252 estimates from 21 studies on the impact of wind turbines on property values. The results indicate a negative and significant effect on properties located within 4 km of a wind turbine, with stronger effects at closer distances and in more densely populated areas.

Keywords: European Union; Blue Economy; Employment Dynamics; Fisheries Management; Policy Position; Informational Lobbying; Interest Groups; Political Economy; Wind Turbines; Property Values

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Stockholm, September 2025

Alexandra Allard

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List of papers

This thesis is based on the following studies, referred to in the text by their Roman numerals.

I. Blue employment dynamics: Are maritime sectors different?

II. Fishing quotas and decision-making in the EU: Estimating policy positions from bargaining outcomes. Co-authored with Mats A. Bergman.

III. Lobbying for depletion? Examining lobbying success in fishing quota negotiations in the Baltic Sea area

IV. The effect of wind turbines on property values: A meta-regression analysis. Co-authored with Mats A. Nilsson.

Introduction

Within the European Union (EU), there is political momentum for both the blue economy and the shift to renewable energy sources. The blue economy, which encompasses a range of maritime and maritime related sectors, including fisheries, focuses on the sustainable utilization of maritime resources (Kathijotes, 2013). As a result, it has become a central concept in EU and international policy, aiming to drive growth, improve livelihoods, and create jobs while maintaining the health of the ocean ecosystem (European Commission, 2021; OECD, 2016). Meanwhile, expanding renewable energy is seen as a necessity to reduce greenhouse gas emissions (Directive 2023/2413). Among renewable energy sources, wind power has become a significant contributor, meeting 18 percent of the EU's final energy consumption in 2023 (Eurostat, 2025).

The blue economy and renewable energy are accompanied by political and societal debates about resource allocation, distribution of costs and benefits, and how policy should balance competing goals. This thesis adds to these debates by examining questions at the intersection of economic outcomes, political decision-making, and interest group representation. While the essays address distinct questions, they share a focus on issues that are empirically understudied, politically relevant, and located between the spheres of policymaking and business.

Essay I investigate whether the employment potential often attributed to the blue economy has materialized. The blue economy is expected to generate innovation, increase cash flow, and create work opportunities while promoting sustainable use of our maritime resources (European Commission, 2021; Kathijotes, 2013). Yet, systematic empirical evidence on whether these expectations have materialized remains scarce. By analyzing employment developments of the blue economy, relative to other firms, the essay offers insights into the extent to which policy ambitions have translated into tangible labor market outcomes.

Essays II and III examine the governance of EU fisheries, a policy area characterized by complex institutions and high political stakes. More specifically, Essay II examines the policy positions of EU member states

in the context of total allowable catches (TACs), i.e., fishing quotas, comparing political decisions with the scientific advice provided by the International Council for the Exploration of the Sea (ICES). Systematic departures from the scientific advice illustrate how governments balance economic, ecological, and political priorities during EU-level negotiations.

Essay III extends the analysis of EU fisheries policy by shifting the focus from intergovernmental bargaining to interest group representation, specifically the role of the Baltic Sea Advisory Council (BSAC). Advisory councils were introduced into the Common Fisheries Policy (CFP) to enhance stakeholder participation and benefit from their expertise (Council Regulation 2371/2002). Nonetheless, questions remain about which actors are most successful in shaping outcomes within these forums. By examining patterns of lobbying success in BSAC, this essay contributes to the broader discussion on how influence is distributed between industry and other interests in EU decision-making.

Essay IV shifts the focus to the energy sector, analyzing the local impacts of wind power development. Wind power is a cornerstone of Europe's energy strategy. Its expansion, however, has led to increasing opposition at the local level (Niskanen et al., 2024; Reusswig et al., 2016). One approach to measuring the external effects of wind turbines is to examine the effect of their announcement and construction on adjacent property values. This analysis contributes to ongoing policy discussions about how external effects of wind energy should be addressed and whether compensation schemes for affected households are warranted.

Each essay utilizes its individual dataset and method. The analysis for Essay I relies on firm-level data from financial statements, combined with member firms in business associations, electricity certificate applications, and geographic location, to identify firms within the Swedish blue economy. A basic Ordinary Least Squares (OLS) estimation is first applied to estimate whether employment growth, job creation, and job destruction differ between blue, i.e., firms operating within the blue economy, and non-blue firms. To increase comparability between the

two groups, the OLS regression is re-estimated after matching blue and non-blue observations using Coarsened Exact Matching (CEM).

Essay II employs a dataset provided by Griffin Carpenter, previously at the New Economics Foundation (a British think tank). The dataset matches final TACs to ICES headline advice. To estimate EU members non-disclosed policy positions from bargaining outcomes, our models build on the compromise model, a cooperative bargaining framework, with species- and time-fixed effects. Furthermore, to address the compositional properties of the data, the relative-shift regression framework (proposed by Li et al., 2023) is applied.

Similar to Essay II, the dataset for Essay III is based on ICES headline advice and final TACs. However, the collected dataset also includes interest group recommendations from BSAC and TAC proposals from the European Commission. Using this dataset, the preference attainment is calculated for each interest group recommendation, followed by the application of fixed-effects models.

Lastly, a meta-analysis based on data collected from 21 studies is employed in Essay IV. A mixed-effects multilevel model is used to test for publication bias within the sample. As no publication bias is identified, a fixed-effects model is applied in the main specification.

Summary of each Essay

Essay I: Blue employment dynamics: Are maritime sectors different?

The essay examines employment dynamics within the Swedish blue economy, which encompasses firms in maritime and maritime-related sectors, relative to non-blue firms. Despite the political prominence of the blue economy as a driver of growth, innovation, and job creation (Kathijotes, 2013; OECD, 2016), empirical evidence on labor market outcomes remains limited. Using firm-level data, 892,132 Swedish companies are examined between 1998 and 2020. To identify blue firms, data based on financial statements, member firms in relevant business associations, electricity certificate applications, and geographic location are combined, creating a unique dataset.

The contribution of this essay is twofold. Firstly, the study aims to address the research gap by analyzing employment dynamics in the Swedish blue economy relative to non-blue sectors. Secondly, this essay shows how sector codes can be complemented with other data sources to identify blue firms.

The analysis employs OLS regressions and Coarsened Exact Matching. The findings suggest that, when industry effects are controlled for, blue firms exhibit significantly higher employment growth and lower job destruction. Furthermore, young firms (0–1 years) exhibit the strongest employment growth. Yet, young blue firms have significantly higher job destruction as well as significantly lower job creation and employment growth than non-blue firms of similar age.

In terms of firm size, the results indicate that firms with fewer than 10 employees have a significantly higher job creation, compared to firms with 500 employees or more. Furthermore, there are significantly higher job destruction and lower employment growth for firms with fewer than 500 employees. When interaction terms are included, blue firms with fewer than 10 employees have a significantly higher job creation and employment growth, compared to non-blue firms of the same size.

Essay II: Fishing quotas and decision-making in the EU: Estimating policy positions from bargaining outcomes

Overfishing remains a persistent challenge in Europe, with 40–70 percent of stocks overexploited despite the EU's commitment to sustainable fisheries (e.g., Froese et al., 2018, 2021). A key instrument of the Common Fisheries Policy (CFP) is total allowable catches (TACs), i.e., fishing quotas. However, these quotas often exceed scientific advice (Cardinale & Svedäng, 2008; O'Leary et al., 2011). In this paper, we propose a statistical method for estimating non-disclosed policy positions from bargaining outcomes. This method can shed light on which EU member states that seems to prefer TACs above, or below, the scientific advice.

Previous literature that uses collective bargaining models typically establish policy positions through document studies or expert surveys. Thus, our study contributes to this literature by proposing how unobserved policy positions can be inferred directly from bargaining outcomes, rather than evaluated qualitatively. To do so, we rely on three identifying assumptions: (i) TAC shares are constant, according to EU's principle of relative stability; (ii) a country's influence in each negotiation is proportional to its share of the TAC; and (iii) countries' relative policy positions are stable over time and across species and fishing zones.

We employ panel data on TACs and scientific advice from the International Council for the Exploration of the Sea (ICES), encompassing 162 zone–species combinations over the period 2005–2020. Our empirical model builds on the compromise model, a cooperative bargaining framework, and integrates the relative-shift regression framework (introduced by Li et al. 2023) to address compositional properties of the data. The empirical model also includes species- and time-fixed effects. The findings reveal systematic cross-country differences. The United Kingdom, Ireland, Portugal, and the pairing of Lithuania and Poland tend to support TACs significantly above ICES advice, suggesting a preference for higher quotas. In contrast, Germany appears to favor TACs below scientific recommendations.

Essay III: Lobbying for depletion? Examining lobbying success in fishing quota negotiations in the Baltic Sea area

This essay examines the role of informational lobbying in shaping EU fisheries management, with a focus on total allowable catch (TAC), i.e., fishing quota, negotiations in the Baltic Sea. Despite the EU's commitment to achieving sustainable fisheries by 2020, fish stocks in the Baltic Sea continue to deteriorate (Altmayer, 2025; ICES, 2022). Lobbying is a potential but unexplored aspect, with informational lobbying being the most prevalent form of lobbying in the EU (Chalmers, 2013). Within the EU, interest groups have been granted formal consultative roles through advisory councils. For the Baltic Sea, the interest group advisory council is the Baltic Sea Advisory Council (BSAC).

The study makes two key contributions. First, it introduces a novel dataset that links interest group recommendations from BSAC, scientific advice from the International Council for the Exploration of the Sea (ICES), TACs proposed by the European Commission, and the final TACs for 2015–2025. Unlike prior work that relies on expert interviews and surveys (e.g., Bocse, 2021; Chalmers, 2013) or adopts binary indicators or three-value scores to estimate preference attainment (e.g., Junk & Rasmussen, 2019; Sebők & Kozák, 2021), this dataset enables precise, continuous measurement of preference attainment. Second, the study situates fisheries lobbying within a broader long-standing debate on interest group influence and lobbying success of different interest groups.

The results suggest that fisheries generally have higher lobbying success than other interest groups (OIGs). This occurs when the ICES advice is more than 20 percent below the status quo, which is the case in just over half of the observations, or when the level of conflict between BSAC members' recommendations is high. In contrast, when the level of conflict is low and the ICES advice deviates by less than 20 percent or exceeds the status quo, OIGs and interest groups supporting minority positions have higher lobbying success than fisheries.

Essay IV: The effect of wind turbines on property values: A meta-regression analysis

This essay examines the impact of proximity to wind turbines on property values of adjacent properties, a pressing issue given the expansion of wind power for climate mitigation (Barthelmie & Pryor, 2021) and the growing local opposition (Niskanen et al., 2024; Reusswig et al., 2016). Previous literature presents mixed findings, with North American studies often showing inconclusive results (e.g., Hoen et al., 2011, 2015; Lang et al., 2014), and European studies tending toward negative effects (e.g., Gibbons, 2015; Sunak & Madlener, 2016; Westlund & Wilhelmsson, 2021). Thus, to synthesize existing evidence, this essay conducts a meta-regression analysis of 252 property value estimates from 21 studies between 2011 and 2024.

Methodologically, the study uses a fixed-effects model to account for within-study correlation. It compares estimated changes in property values for properties within sequential 1 km distance bands, up to 4 km from a wind turbine, and compares them to estimates for properties located more than 4 km away. Additionally, the analysis controls for the average year of announcement or construction, depending on which effect being measured, and population density.

The results indicate a more negative effect size of 5–6 percentage points for properties within 1 km from a wind turbine, decreasing to 4.1–5.4 percentage points at 1–2 km, 3.3–4.1 percentage points at 2–3 km, and 3–4.1 percentage points at 3–4 km. Furthermore, when different distance bands are employed in the sensitivity analysis, no distance bands exceeding 4 km from a wind turbine are significant, indicating that property values decline up to 4 km from wind turbines. Moreover, our findings suggest that a more negative effect size of 0.01 percentage points is observed in study areas with an additional inhabitant per km^2.

In conclusion, the study provides evidence that proximity to wind turbines is associated with reduced property values within a 4 km range, with stronger impacts observed in densely populated areas. These findings have direct implications for compensation policies, suggesting that they should consider both the distance to wind turbines and area characteristics, such as population density.

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ESSAY I

Blue employment dynamics

Are maritime sectors different?

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Abstract

The blue economy has become a strategic priority within the EU, as it is predicted to drive innovation, stimulate economic growth, and create employment opportunities, all while promoting sustainable use of maritime resources. However, the economic impact of the blue economy remains underexplored in empirical research. This paper examines employment dynamics in the Swedish blue economy, defined as the maritime and maritime-related sectors. The analysis is based on firm-level data from 1998 to 2020. Using a unique dataset that integrates financial statements, business association memberships, electricity certificate applications, and geographic location, firms within the Swedish blue economy were identified. OLS regressions and coarsened exact matching are used to estimate the effect on job flow variables. The results suggest that blue firms – i.e., firms in a maritime or maritime-related sector – exhibit higher employment growth and lower job destruction than other firms.

Keywords: Blue economy; Employment dynamics; Job creation; Job destruction

JEL-codes: D22, E24, R11

1 Introduction

The blue economy is expected to generate innovation, increase cash flow, and create work opportunities while promoting sustainable use of our maritime resources (Kathijotes, 2013). Such expectations have fueled an increasing interest in the blue economy concept in both academia and policy (Mulazzani & Malorgio, 2017). Two decades ago, the first EU communication associated with the blue economy was published.[1] Several communications have been published since then, emphasizing the importance of the blue economy due to its rapid technological progress and the increased awareness of finite resources in maritime sectors, having the potential to increase employment (e.g., European Commission, 2012, 2014, 2021). Today, the blue economy is one of the EU's strategic objectives (European Commission, n.d.). However, the question remains whether this strategic objective has yielded the intended outcomes. Has there been an increase in employment growth in blue firms, relative to non-blue firms, during the last two decades? Despite growing interest in the blue economy, there is an absence of literature addressing how firms in this sector contribute to job creation. Against this backdrop, this study aims to analyze employment dynamics in the Swedish blue economy in comparison to non-blue Swedish sectors.

The blue economy concept has been defined and used in various ways (Lee et al., 2020). When defining the blue economy, it is common to either focus on activities which utilize maritime resources in a sustainable manner (e.g., Kathijotes, 2013; Potgieter, 2018) or include all marine and maritime-related sectors – sustainable or not. The European Commission et al. (2022a) states that "[t]he EU's Blue Economy encompasses all sectoral and cross-sectoral economic activities related to the oceans, seas and coasts" (p. 2). In this paper, I will use EU's definition,

[1] Among other things, the communication asserted the need "for an all-embracing maritime policy aimed at developing a thriving maritime economy and the full potential of sea-based activity in an environmentally sustainable manner." (European Commission, 2005, p. 9).

as this study focuses on comparing employment dynamics in different sectors, rather than investigating the sustainability of these sectors.

The European Commission (2012) argues that there is significant potential for growth and job creation in the blue economy, which can be further utilized through research and investment. To encourage marine and maritime research, the Commission contributed approximately €350 million per year on average between 2007 and 2013, under the 7th Framework Programme for Research (European Commission, 2014). To further amplify marine research, blue growth was included as a focus area within EU's research and innovation funding program Horizon 2020, with a budget of €145 million for the years 2014–2015 (European Commission, 2014). Following the conclusion of Horizon 2020, it has been noted that the area receiving the highest funding was the blue economy (European Commission, n.d.).[2] However, funding for the sustainability transition of the blue economy has not come solely through Horizon 2020 projects. For example, with a budget of €389.5 million, the European Maritime, Fisheries and Aquaculture Fund (EMFAF) and its precursor European Maritime and Fisheries Fund (EMFF) sponsored more than 500 actions and reached more than 8,000 stakeholders between 2014 and 2024 (European Climate, Infrastructure and Environment Executive Agency, 2024).[3]

With these continuous investments and the rapid innovation and technological growth in the blue economy (OECD, 2016), it is expected to see changes in job creation and destruction. The OECD (2016) argues that there is a cross-fertilization of knowledge within the blue economy, with many innovations in maritime sectors stemming from one

[2] Specifically, within ocean observation, blue growth, blue bioeconomy, and biotechnology. Horizon 2020 funding was available from 2014 to 2020 and had a budget of nearly €80 billion (European Commission & Directorate-General for Research and Innovation, n.d.).

[3] Further funding opportunities within the blue economy have been provided by, for example, Programme for the Environment and Climate Action (LIFE2027), Interreg Europe, and Connecting Europe Facility (CEF) (European Commission, n.d.).

another, in a cycle that triggers further technological change.[4] With the development of new technologies, jobs will be simultaneously created and destroyed (Mortensen & Pissarides, 1998). Mortensen and Pissarides (1998) argue that creative destruction is one of two mechanisms through which technological progress affects employment. Creative destruction, coined by Schumpeter (1942), is an evolutionary process of the economic structure from within, characterized by the emergence of new markets, goods, production methods, transportation systems, and forms of industrial organization. This process continually creates new structures while destroying the old ones.

With technological progress, some existing occupations become unprofitable and are replaced by new, more profitable, ones. Except for the destruction of specific occupations, this process may also lead to a relative or absolute deterioration of some sectors. However, other sectors will simultaneously expand or emerge. There is also a related process involving renovation and updating work equipment. In this process, technological progress does not induce the same degree of structural change. Instead of the creation and destruction of some occupations, staff must be trained and companies might be reorganized (Mortensen & Pissarides, 1998). One of the most frequently noted challenges in the blue economy is the skills gap, which reflects the inability of the current workforce to meet the demands of the ongoing technological progress.[5]

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[4] For example, companies in gas, oil, and seabed mining explore maritime robotics for subsea operations; biotechnology focusing on fish welfare and health is the foundation for aquaculture; and strides in maritime navigation and remote sensing improve several maritime fields, such as maritime safety, fisheries, and ocean observation (OECD, 2016).

[5] To increase the attractiveness and awareness of blue occupations, initiatives such as the "Blue careers in Europe" program have emerged. The fourth round of funding started in September 2023, and to date, the initiative has supported 26 projects with a budget of €18.5 million (Directorate-General for Maritime Affairs and Fisheries, n.d.).

Previous studies have often focused on conceptualizing the blue economy (Bhattacharya & Dash, 2020). Graziano et al. (2022) extend this discussion by analyzing the socioeconomic scope of the blue economy in Michigan and Scotland, based on different definitions, and find that the socioeconomic extent varies depending on the definition applied. Another part of the blue economy literature discusses success stories in the blue economy at the company (e.g., Frisk, 2012), sector, and country level (e.g., Lu et al., 2019; UNEP, 2015; Xie, 2022) or emphasizes the potential of the blue economy to boost economic development and job creation in developing countries (e.g., Hasan et al., 2018; Sarker et al., 2018).

Regarding national employment in blue sectors, Colgan (2004) examines the ocean economy between 1990 and 2000 and finds that tourism and recreation are the only sectors experiencing significant employment growth.[6] Three reasons for job losses in other ocean sectors are mentioned: (i) decreases in ship building and manufacturing of navigation equipment because of a shift away from the military; (ii) productivity increases in maritime production, transportation, and oil and gas exploration; and (iii) overfishing pressures leading to a decline in US fisheries. In some of the European Commission's annual blue economy reports (e.g., European Commission et al., 2022b), the total employment in the blue economy sectors is presented at the country level, but employment dynamics are omitted. Due to the scarcity of data, a comprehensive analysis of the blue economy can be challenging (European Commission et al., 2025).

The contribution of this study is twofold. Firstly, the study aims to address the mentioned gap in the literature by analyzing employment dynamics in the Swedish blue economy relative to non-blue sectors, by examining 892,132 companies between 1998 and 2020, corresponding to 8,763,606 observations. The analysis is based on firm-level data provided by Dun & Bradstreet via the Research Institute of Industrial Economics (IFN). However, information such as the sector is not sufficient

[6] The other sectors of the ocean economy include marine-related construction, living resources, minerals, ship and boat building, and maritime transportation (Colgan, 2004).

to identify some blue firms. Instead, for some sectors, further division is required. Thus, the firm-level data is combined with data from the Research Institutes of Sweden (RISE) and the Swedish Energy Agency, as well as data collected from member firms in business associations and geographic information. Consequently, the second contribution of this study is to show how sector codes can be complemented with other data types to identify blue firms.

Initial results from OLS models indicate that blue firms have a significantly higher job creation, before controlling for industry. When industry is controlled for, blue firms have significantly lower job destruction and significantly higher employment growth. To increase comparability between blue and non-blue firms, I re-estimate the OLS models after matching blue and non-blue firms, using Coarsened Exact Matching (CEM). The findings after matching firms based on year, starting year, industry, firm ownership, and municipality, are similar to the OLS results when industry dummies are included, but with marginally higher and more significant employment growth.

Furthermore, this study finds that young firms generally exhibit lower job destruction and higher job creation and employment growth. However, relative to non-blue firms, blue firms have significantly lower employment growth and job creation, as well as significantly higher job destruction, particularly among firms that are one year old or younger. The effect of firm size varies somewhat by model specifications; however, firms with fewer than 500 employees generally exhibit significantly higher job destruction and job creation, as well as significantly lower employment growth, compared to larger firms.

This paper proceeds as follows. Section 2 provides an overview of the Swedish blue economy and its sectors. The relevant literature on job creation and destruction is provided in Section 3. Section 4 presents the data and relevant measurements. The methodology is presented in Section 5. Section 6 presents and discusses the results of the regressions, and Section 7 provides concluding remarks.

2 The Swedish Blue Economy

In 2015, the Swedish government adopted a strategy to promote maritime sectors, focusing on ensuring competitive maritime industries, attractive coastal areas, and a balanced marine environment (Government Offices of Sweden, 2015). The strategy also discussed promoting innovation, simplifying the process for maritime sectors to receive EU funding, and the role of an integrated marine policy in contributing to the overall goal of achieving the lowest unemployment rate in the EU by 2020. Even though the general unemployment trend has been the opposite, it is interesting to examine whether the blue economy has played a role in this development.

The Swedish maritime strategy was later investigated by the Swedish Agency for Marine and Water Management (2020), which argued that the strategy is presented as a vision and the desired direction to work, without quantitative goals. When examining the competitiveness of maritime industries, the authors find that the added value has increased relatively more in maritime sectors between 2014 and 2018, compared to comparable sectors, while there was a relative decrease in employment in three out of five maritime sectors. The Swedish Agency for Marine and Water Management (2020) also develops a maritime innovation index, finding that innovation has more than doubled between 2016 and 2018.[7] It is further stated that this index should be interpreted with caution, but that an increasing innovation for these sectors could be explained by several important initiatives within recent years, such as maritime clusters and local innovation arenas. Furthermore, aggregated employment in the Swedish blue economy has been presented and briefly analyzed at the sector level between 2007 and 2011 by Hanning et al. (2013), for 2010–2015 by Svensson et al. (2017), and for 2013 and 2014 by Statistics Sweden (2016).

[7] The innovation index is based on the innovation investments and degree of renewal in maritime sectors, specifically the share of firms younger than three years, as well as engagement in entrepreneurial activities in the coastal area (Swedish Agency for Marine and Water Management, 2020).

Table 1: The Swedish blue economy

Sector	Nr of firms			Total employees		
	1998	2005	2020	1998	2005	2020
Marine living resources						
Fishing	125	137	307	327	268	483
Aquaculture	120	103	119	157	151	297
Processing of seafood products	142	147	115	1,456	1,669	1,401
Distribution/retail of seafood products and support services	137	128	278	325	440	1,037
Maritime transport						
Freight transport, cargo, and warehousing	12	19	365	5	105	5,429
Passenger transport	640	802	586	11,851	12,911	5,860
Support services, maritime transport	140	165	208	1,050	1,850	2,232
Coastal tourism						
Accommodation	354	452	1,144	2,094	2,892	5,323
Conference facility	47	74	124	662	719	939
Restaurants	1,443	1957	4,279	7,214	9,128	20,879
Rental and leasing of ships and boats and others	33	45	74	69	77	170
Maritime renewable energy						
Generation of electricity	82	86	174	559	258	1,167
Maritime technology						
Shipbuilding and repair	634	693	976	6,900	8,516	4,280
Distribution/retail of ships	392	451	549	745	977	1,127
Other relevant distribution/retail	31	67	174	715	983	1,874
Water construction	68	64	94	343	524	299
Other relevant construction	8	12	48	56	77	285
Manufacturing and repairs	33	48	179	634	1,105	4,040
Support services and education	16	27	273	73	222	1,829
Total	4,457	5,477	10,112	35,229	42,872	58,947

Note: The numbers in the table are based on financial statements of Swedish companies from the Swedish Company Registration Office. Thus, sole proprietorships are excluded, as are firms with missing data on the number of employees or the five-digit SNI code. This, as well as other data restrictions, is further explained in Section 4.

Frameworks and definitions presented by the European Commission et al. (2021), Statistics Sweden (2016), the Government Offices of Sweden (2015), and the Swedish Agency for Marine and Water Management (2017) are utilized to define the sectors included in the Swedish blue economy. Characterizations of maritime transport and maritime technology are further based on the Swedish Maritime Technology Forum (2020, 2021).[8] Based on these classifications, I divide the Swedish blue economy into five sectors: living resources, maritime freight transport, coastal tourism, maritime renewable energy, and maritime technology. Table 1 lists the sub-categories of each sector, along with the number of firms and total number of employees in each sub-sector, for the years 1998, 2005, and 2020. In Sections 2.1–2.5, each sector is discussed in more detail.

2.1 Marine living resources

Marine living resources consist of five parts: fishing, aquaculture, processing of seafood products, distribution and retail of seafood products, and support services. However, as very few firms that provide support services for marine living resources were identified, they were merged with distribution and retail of seafood products in Table 1. Support services include activities such as consultation, staff leasing, research, and business organizations.

Among the blue economy living resource sectors, aquaculture has been expected to expand the most. Between 2007 and 2012, food fish production in Swedish aquaculture increased from around 5,000 to approximately 12,500 tonnes (Swedish Board of Agriculture, 2015). Further, prior to 2015, aquaculture – encompassing fish, shellfish, and algae – was the fastest-growing segment of the food industry (Government Offices of Sweden, 2015). However, the Swedish aquaculture production has since then stagnated. The number of firms within aquaculture was approximately the same in 1998 and 2020, while the total number of employees increased by about 90 percent during the period (Table 1). However, aquaculture is the next-to-smallest part of maritime living

[8]Since autumn 2017, Swedish Maritime Technology Forum has been part of RISE.

resources in terms of the number of firms and the smallest in terms of employees in 2020.

According to Table 1, the number of firms and total employment have increased in the fishing industry, as well as in distribution and retail of seafood products and support services. However, according to reports from the Swedish Agency for Marine and Water Management (2016, 2022), the number of firms within the fishing industry decreased each year from 2008 to 2020. Similarly, there has been a continuous decrease in the number of employees (Swedish Agency for Marine and Water Management, 2016). There are two possible reasons why the data used in this study differ from official aggregated statistics. Firstly, many fisheries are sole proprietorships (Blomquist et al., 2021), which are not included in the data.[9] Secondly, the SNI code for some small firms, such as small fisheries, was missing for earlier years and has gradually improved over time (Statistics Sweden, 2014), indicates an increase in total number of firms and employees in fishing, while opposite trend is true.[10]

2.2 Maritime Transport

Maritime freight transport can be divided into four main components: freight transport, cargo and warehousing, passenger transport, and support services. However, as very few companies within cargo and warehousing were identified for 1998 and 2005, cargo and warehousing are merged with freight transport in Table 1. Between 2010 and 2015, the total number of employees in Swedish maritime transport decreased, while value-added increased simultaneously (Svensson et al., 2017). Svensson et al. (2017) argue that this decrease in employment is a result of rationalization and flagging out, which aims to increase companies'

[9] In 2019, 74 percent of firms in the fishing industry were sole proprietorships. However, 97,7 percent of these firms did not have any employees (Blomquist et al., 2021). Thus, even though the data may give a skewed picture of how the sector has developed in Table 1, it should not have a significant impact on the firm-level employment growth.

[10] However, it is worth noting that approximately 93 percent of firms without an SNI code in 2013 had no employees (Statistics Sweden, 2014).

competitiveness.[11] This is further supported by the Swedish Agency for Marine and Water Management (2020), which finds that between 2014 and 2017, there was a continuous decrease in the number of Swedish registered ships. However, this trend was reversed in 2018, and by 2019, the number of Swedish registered ships had returned to roughly the same level as in 2014 (Swedish Agency for Marine and Water Management, 2020).

Table 1 displays a similar pattern to that observed by Svensson et al. (2017) for the number of employees in passenger transport, which has decreased by more than half between 2005 and 2020. However, for freight transport, cargo, and warehousing, the number of employees increased fiftyfold between 2005 and 2020, with approximately 60 percent of the increase attributed to cargo and warehousing, and the other 40 percent to freight transport. There have been political attempts to increase maritime freight transport and the size of the Swedish fleet over the years. One example is the EU's strategic interest in short-sea shipping, which started in 2004 (European Commission, 2004). Part of this strategic interest has been the development of motorways of sea projects (Debyser, 2022). Another example is the introduction of the tonnage tax in 2017 in Sweden (Swedish Agency for Marine and Water Management, 2020).

2.3 Coastal Tourism

The majority of firms and employment within the blue economy, as shown in Table 1, can be found in coastal tourism, particularly in the sectors of accommodation and restaurants. The Swedish Agency for Marine and Water Management (2020) also notes a positive trend in maritime tourism, attributing it to a general positive trend within the tourism industry. Within the blue economy, there has also been a push for the sustainable development of coastal tourist destinations, which has been supported by policies, strategies, and directed projects. For example, between 2012 and 2015, the Stockholm Archipelago and

[11] Flagging out means that a ship is registered in a country other than its home country, for example, because the regulations, taxes, or labor laws in that country are more favorable.

Bohuslän received resources and monetary funding to enhance competitiveness in tourism, particularly coastal tourism, through a project focused on developing and strengthening sustainable tourist destinateions (Swedish Agency for Economic and Regional Growth, 2017).

2.4 Maritime Renewable Energy

Maritime renewable energy includes electricity generated from water, waves, and offshore wind. This sector is described as one of the developing sectors within the blue economy, particularly offshore wind. However, between 2014 and 2019, the installed effect in offshore wind has remained essentially unchanged, which can be attributed to high construction costs relative to onshore wind, hindrances in the permit process, and costs associated with connecting to the electricity grid (Swedish Agency for Marine and Water Management, 2020). The growth of offshore renewable energy is further disadvantaged by an existing skills shortage within the EU (European Commission et al., 2021).

Table 1 shows an increase in the number of firms during the period, especially between 2005 and 2020. Total employment decreased between 1998 and 2005 but increased until 2020, approximately doubling compared to 1998. The table does not distinguish between different types of maritime renewable energy. Furthermore, it is worth noting that only firms solely engaged in maritime renewable energy are classified as blue firms (see Section 4.1). Thus, the figures in Table 1 understate the size of the Swedish maritime renewable energy sector.

2.5 Maritime Technology

The maritime technology sector is diverse (Statistics Sweden, 2016) and can be found in different blue and non-blue sectors. It can, therefore, be challenging to capture these companies as one sector. The Swedish Maritime Technology Forum (2019, 2021) identified Swedish firms in the maritime technology sector and mapped the sector for the years 2017 and 2019. The reports find that most firms are small, longstanding businesses, with approximately 80 percent having fewer than 10 employees and about 60 percent having been active for more than 10 years.

In this study, I categorize maritime technology into eight sub-sectors: shipbuilding and repair, distribution and retail of ships, other relevant distribution and retail activities, water construction, other relevant construction, manufacturing and repairs, support services, and education. Education and support services are combined in Table 1, as very few firms specializing in maritime education were identified. Other relevant distribution and retail activities include those related to maritime technology, which are not included in the distribution and retail of ships, such as the wholesale of machinery, electronic components, and measuring and precision instruments. Similarly, other relevant constructions include those other than water construction, such as electrical installations, the construction of bridges and tunnels, and the installation of ventilation equipment.

3 Previous Literature

This study is part of the literature investigating job creation and destruction. As discussed in the introduction, there is a lack of literature investigating job creation and employment growth in the blue economy. Thus, in this section, a more general literature on job creation, job destruction, and employment growth is presented.

Job creation and destruction research often focuses on firm size and firm age as key explanatory variables. Studies consistently show that small firms contribute disproportionately to employment growth (e.g., Ayyagari et al., 2011; Hijzen et al., 2010; Lawless, 2014). Davis and Haltiwanger (1992) find that smaller firms experience higher job creation and destruction rates in the US manufacturing sector, leading to increased job reallocation. Similar patterns emerge in Sweden, for example, Heyman et al. (2018) observe that small and medium-sized firms account for the majority of net job creation, particularly among young firms aged three years or less.

Other examples include the cross-country analysis by Criscuolo et al. (2014), which finds that firms aged five years or younger drive employment growth. This trend is supported by Ayyagari et al. (2011), Haltiwanger et al. (2013), and Lawless (2014). Haltiwanger et al. (2013) further emphasize that start-ups have a critical role in employment

growth dynamics and that young firms exhibit more volatile behavior. This volatile behavior occurs as surviving young firms grow more rapidly than more mature firms. At the same time, young firms are more likely to exit, leading to a higher degree of job destruction (Haltiwanger et al., 2013). Studies have also shown that small firms are more affected by financial and monetary policy shocks (e.g., Gertler & Gilchrist, 1994; Sharpe, 1994). Sharpe (1994) argues that smaller, and more highly leveraged firms, have higher opportunity costs of capital during cyclical downturns and are therefore less likely to keep on staff in the hope of better days. Instead, their labor force is to a higher degree adjusted to temporary fluctuations in demand, relative to more mature firms.

In Sweden, Heyman et al. (2019) document a rise in start-up activity and job destruction among one- and two-year-old firms from 1990 to 2013, with job destruction surpassing job creation after 2005. Similarly, Eriksson and Hane-Weijman (2017) and Persson (2004) find that Swedish entrant firms face survival challenges, leading to higher job destruction rates. Persson (2004) argues that the chance of survival increases as a firm age, increases in size, or has greater access to resources, e.g., by being part of a multi-unit firm. Eriksson and Hane-Weijman (2017) further argue that stable job creation originates from incumbent firms rather than new entrants and is more pronounced in large, diversified regions. While some studies debate whether firm age is more influential than firm size (e.g., Lawless, 2014), this discussion will not be the focus of this analysis.

Sectoral comparisons indicate higher job creation in the service sectors. Hijzen et al. (2010) find that job destruction rates are similar across manufacturing and services. Nevertheless, job creation rates are higher in the service sector, resulting in greater net job creation. Heyman et al. (2018) confirm similar trends in Sweden, where the service sector outperforms manufacturing in net job creation, with small and young firms playing a central role.

Previous research has explored other factors influencing job creation and destruction beyond firm size, age, and sector. For example, Lawless (2014) examines the role of firm ownership and finds that foreign-

owned firms experience slightly higher job creation. Similarly, Esaku (2020) analyzes firm ownership along with productivity, capital intensity, and wage rates, and finds that capital intensity and labor productivity sometimes have a significant negative impact on both employment growth and job destruction.

4 Data and Specifications

The analysis is based on company data from 1998 to 2020, sourced from the Serrano database, which is provided by Dun & Bradstreet through the Research Institute of Industrial Economics (IFN). The Serrano database is based on the financial statements of Swedish companies from the Swedish Company Registration Office. Thus, one important limitation with this dataset is that sole proprietorships are excluded

4.1 The Swedish Blue Economy

Several steps are being taken to identify firms in the blue economy. In the first step, I use SNI 2007 to identify blue sectors.[12] The SNI code represents the company's primary industry and serves as the standard for Swedish industry classifications. The SNI codes are based on NACE Rev. 2, the industry standard classification system used by the EU. The identified SNI codes for the blue economy are presented in Table 1.

For some sectors, the initial division between blue and non-blue firms can be easily determined from sector codes, such as fishing or freight transport. However, in other sectors, there is a mix of blue and non-blue companies within the same five-digit SNI code, making it fruitless to separate the blue firms from the non-blue without additional information. This is the case for coastal tourism and maritime renewable energy, and, hence, other identifications had to be used.

For coastal tourism, I isolated accommodation establishments, conference facilities, and restaurants with postal codes that border the coastline or one of Sweden's three largest lakes: Vänern, Vättern, and

[12] SNI 2007 is used for all observations. For observations prior to 2007, SNI 2002 is converted to SNI 2007 to ensure consistency throughout the dataset.

Mälaren.[13] Postal codes with borders along the coastline were identified using data from sea areas provided by Lantmäteriet, and postal codes along the lakes were identified using data from Natural Earth (n.d.). Companies with a relevant SNI code and postal codes connected to the coast or a lake were identified as coastal tourism businesses.[14] There are two weaknesses of this method. Firstly, postal codes vary in size. Thus, it is not only the distance to the coast that determines if the firm is considered part of coastal tourism, but also the size of the postcode. Secondly, unfortunately, the available data does not include the number of employees and postal codes for each workplace. Hence, whether a firm is defined as coastal tourism depends on the location of its headquarters. However, only 1.2 percent of coastal tourism observations have more than one workplace. Therefore, this is unlikely to have a significant impact on the results.

To identify companies within the maritime energy sector, I followed the same strategy as Statistics Sweden (2022) and utilized electricity certificate applications. The Swedish Energy Agency registers all applications for electricity certificates, which are certificates for renewable electricity production. These applications include information on energy sources and organization numbers. Organizations solely applying for certificates in maritime renewable energy – specifically, water, wave, and offshore wind – were identified and further assessed.[15]

However, maritime-related firm outside the blue SNI-codes for marine living resources, maritime freight transport, and maritime technology

[13] 1,923 out of 10,481 postal codes have a border along the coastline or one of Sweden's three largest lakes.

[14] Relevant SNI codes for coastal tourism: 55101, 55102, 55103, 55201, 55202, 55300, 55900, 56100, and 56300.

[15] Thus, firms engaging in maritime renewable energy and other forms of electricity generation are not identified as blue firms, as it is not possible to separate employees working with maritime renewable energy from those working with other energy forms within the same company. Firms with SNI codes other than 35110, which is the relevant SNI codes for maritime renewable energy, were removed.

also exists. For example, insurance companies focusing on maritime transport are registered under a sector code for other support services. To identify these companies, I gathered data on member companies in business associations within the marine sector, namely the Swedish Shipowners' Association, Maritimt Forum, the Swedish Confederation of Transport Enterprises, Sweboat, Föreningen Sveriges Varv (shipyards), Svenska Fiskhandelsförbundet (fish trade), Fiskbranschens riksförbund (sea-food), and Matfiskodlarna (fish farmers).[16] The data gathered on member companies in the Maritimt Forum includes members from 2010, while the other business associations include members from 2022.[17] Data on organization numbers have also been received from RISE for active companies within maritime transport in 2017 and within maritime technology in 2019.[18] To ensure the exclusion of non-blue firms in these lists, I reviewed the five-digit SNI code for all included companies. If a SNI code was likely to include non-blue firms, all firms from either of the lists within that SNI code were checked.

Table 2 presents the industry division for the identified blue firms. The sector codes are presented both at the least detailed SNI code (letter) and the five-digit SNI. The classification of firms based on the SNI codes implies a different categorization compared to the blue sectors listed in Table 1.

[16] As the Swedish Confederation of Transport Enterprises also includes companies from non-blue sectors, I have only included member companies within shipping and ports.

[17] Enquiries have been made about historical member lists, which have not been provided, partly because they were not available, but also due to concerns related to GDPR.

[18] Members of business associations in 2022, or 2010 for member companies in Maritimt Forum, as well as active companies within maritime transport and maritime technology, provided RISE are classified as blue for earlier (and the following) years, as long as their primary five-digit SNI code has not changed.

Table 2: Industry division in the Swedish blue economy sectors

Blue economy sectors	Sector codes
Agriculture, forestry, and fishing	A
Fishing	03111, 03119, 03120
Aquaculture	03210, 03220
Mining and quarrying	B
Other mining and quarrying and support service activities	8110, 9100
Manufacturing	C
Processing of seafood products	10200, 10850
Shipbuilding and repair	30110, 30120, 33150
Other relevant manufacturing	E.g., 13922, 22290, 28290
Other relevant repairs	E.g., 33120, 33200
Electricity, gas, etc.	D
Generation of electricity	35110
Water supply, sewerage, waste management, and remediation activities	E
Waste management	38210
Construction	F
Water construction	42910
Other relevant construction	E.g., 43210, 43999
Wholesale, retail, and repair	G
Distribution/retail of seafood products	47230
Distribution/retail of ships	47643
Other distribution/retail	E.g., 46141, 46380, 46491, 46699
Service and repairs	E.g., 45201
Transportation and storage	H
Passenger transport	50101, 50102, 50301, 50302
Freight transport	50201, 50202, 50401, 50402
Cargo and warehousing	52100, 52241, 52249
Support services, maritime transport	52220
Other support services	E.g., 52290
Accommodation and food service	I
Accommodation	55101, 55103, 55201, 55202, 55300, 55900
Conference facility	55102
Restaurants	55101, 56100, 56300

Information and communication	J
Computer programming activities	E.g., 62010, 62020
Financial and insurance activities	K
Other credit-granting	E.g., 64202, 66220
Real estate activities	L
Renting and operating of own or leased other premises	E.g., 68203, 68209
Professional, scientific, and technical activities	M
Legal and accounting activities	E.g., 69201
Head offices and consultancy activities	E.g., 70100, 70220
Research and technical testing	E.g., 71200, 72190, 72190
Administrative and support service	N
Rental and leasing of ships and boats	77340
Renting and leasing of other machinery, equipment, and tangible goods	E.g., 77210, 77390
Travel agency and tour operator activities	E.g., 79110, 79120
Other relevant support services	E.g., 78200, 81221
Education	P
Different forms of education	E.g., 85599
Human health and social work activities	Q
Other general medical practice activities	86212
Arts, entertainment, and recreation	R
Museum activities	91020
Sports and other amusement and recreation activities	E.g., 93290
Other service activities	S
Activities of business membership organizations	94111
Washing and (dry-)cleaning for businesses and institutions	96011

Note: The table includes sector codes where the entire 5-digit SNI code is blue and SNI codes with only a few blue firms. The 5-digit SNI codes that only include blue firms are 03111, 03119, 03120, 03210, 03220, 10200, 30110, 30120, 33150, 42910, 47230, 47643, 50101, 50102, 50301, 50302, 50201, 50202, 50401, 50402, 52241, 52220, and 77340. For member companies and firms provided by RISE, it is not uncommon that only one blue firm is included in a 5-digit SNI code. Thus, to maintain legibility in the table, I will only present some of the relevant codes for these firms, which is why e.g., is included.

4.2 Measurements of Employment Dynamics

Following Davis and Haltiwanger (1992), commonly used in the literature, employment growth at the company level is calculated by dividing the employment change by the average employment of the two periods:

$$g_{it} = \frac{E_{it} - E_{i,t-1}}{0.5(E_{it} + E_{i,t-1})} \quad \textbf{(1)}$$

where E_{it} is total employment in firm i at time t.

By dividing by the average employment, the growth rate is symmetric around zero and constrained between -2 and 2. A firm enters (exits) the market when its employment growth equals 2 (-2).

The measurement of employment growth is also used to identify job creation and destruction at the firm level. Job creation and destruction for firm i at time t:

$$JC_{it} = \begin{cases} g_{it} & \text{if } g_{it} > 0 \\ 0 & \text{otherwise} \end{cases} \quad \textbf{(2)}$$

$$JD_{it} = \begin{cases} |g_{it}| & \text{if } g_{it} < 0 \\ 0 & \text{otherwise} \end{cases} \quad \textbf{(3)}$$

Thus, job creation at the firm level equals positive employment growth, and job destruction is the absolute value of negative employment growth.

5 Methodology

When estimating employment growth, job creation, and job destruction, the most common explanatory variables are size and age, which are usually captured by dummies (e.g., Esaku, 2020; Heyman et al., 2019), and in some papers, industry dummies are included as well (e.g., Ayyagari et al., 2011; Baldwin et al., 1998). In line with this approach,

I estimate the following OLS model, with clustered standard errors at the five-digit SNI level:

$$y_{it} = \beta_0 + \beta_1 Blue_{it} + \beta_2 Age_{it} + \beta_3 Size_{it} + \beta_4 Ind_{it} + \varepsilon_{it} \quad \textbf{(4)}$$

where y_{it} represents g_{it}, JC_{it}, or JD_{it} for firm i at time t.[19] Age, $Size$, Ind, and $Blue$ signify dummies for size, age, industry, and being blue, respectively. I have created five age groups and five size groups. The age groups are 0–1 year old, 2–5 years, 6–10 years, 11–20 years, and more than 20 years (reference category). The size groups are fewer than 10 employees, 10–49 employees, 50–199 employees, 200–499 employees, and 500 or more employees (reference category). If firm size is measured at year t, there is a risk of endogeneity issues, as job creation and destruction might lead to firms changing size group. To avoid this, firm size is defined as the average firm size of the two previous years, i.e., $t-1$ and $t-2$. This way, firm size is not affected by employment changes at year t. Furthermore, the data includes 21 industries. Thus, the model includes 20 industry dummies, and industry S – other service activities – is the reference category. Lastly, ε_{it} is the error term.

To increase comparability between blue and non-blue firms, the regression is re-estimate after matching blue and non-blue observations using Coarsened Exact Matching (CEM). CEM is a matching method that focuses on reducing imbalance between different types of observations (Blackwell et al., 2009; Iacus et al., 2012), in this case, between blue and non-blue firms. The observations are matched based on ex-ante user-determined variables **X**. From the matching, observations with the same coarsened values of **X** are paired in strata. Weights are assigned to observations in the strata based on the number of matched observations of each type.[20] Unmatched units receive a weight equal to

[19] Where g_{it} is the firm-level employment growth, explained in Eq. 1, JC_{it} is the firm-level job creation, explained in Eq. 2, and JD_{it} is the firm-level job destruction, explained in Eq. 3.

[20] Where the weight, w_i, is assigned using the following equation:
$w_i = \begin{cases} 1, & i \in T^s \\ \frac{m_C}{m_T}\frac{m_T^s}{m_C^s}, & i \in C^s \end{cases}$, where T^s are the treated units and C^s are the control

zero and are thus disregarded (Iacus et al., 2012). The coarsened values of **X** are only used for matching and creating the strata, not for the subsequent stages of the analysis (Blackwell et al., 2009). Thus, the OLS estimations are based on the original values for all variables. As I aim to match variables that influence entrepreneurs' decisions to start a blue business instead of a non-blue business, and the subsequent employment growth, I match on the starting year, sector, firm ownership, and municipality.[21] As the matching is made for the whole panel, and not at a specific year, I also include an exact match on year to account for time-related effects, such as economic downturns.

Estimates based on Eq. 4 indicate the average differences between blue and non-blue firms, as well as the general effects of firm age and size. To further examine whether employment growth, job creation, and job destruction in blue firms occur at other firm ages or sizes than in non-blue firms, interaction variables between being blue and age groups, as well as between being blue and size groups, are included after matching blue and non-blue observations using CEM. Resulting in the

units in stratum s, m_T is the number of matched units, such as $m_T = \cup_{s \in S} m_T^s$, and m_C is the number of control units, such as $m_C = \cup_{s \in S} m_C^s$.

[21] Industries are coarsened into 18 groups, based on the least detailed SNI code, as shown in Table 2. The municipality is coarsened into nine groups defined by the Swedish Association of Local Authorities and Regions (2016): larger cities, with at least 200,000 residents in the largest urban area; commuting municipalities near larger cities; medium-sized towns, with at least 50,000 residents in total and at least 40,000 residents in the largest urban area; commuting municipality near medium-sized towns; low-commuting municipality near medium-sized towns; small towns, with 15,000 to 40,000 residents in the largest urban area; commuting municipality near a small town; rural municipality, with less than 15,000 residents in the largest urban area; and rural municipality with a visitor industry.

following expansion of the OLS model in Eq. 4, with clustered standard errors at the five-digit SNI level:

$$y_{it} = \beta_0 + \beta_1 Blue_{it} + \beta_2 Age_{it} + \beta_3 (Blue_{it} * Age_{it}) + \beta_4 Size_{it} + \beta_5 (Blue_{it} * Size_{it}) + \varepsilon_{it} \quad \textbf{(5)}$$

where y_{it} represents g_{it}, JC_{it}, or JD_{it} for firm i at time t. Age, $Size$, Ind, and $Blue$ signify dummies for size, age, industry, and being blue, respectively. The same age and size groups are included as in Eq. 4. Eight interaction terms are included, four of which estimate the age effects in blue firms, relative to non-blue firms, while the remaining four estimate the size effects for blue firms.

6 Results

In this section, the results for the OLS estimations, before and after matching using CEM, are presented. Table 3 shows the results from the pooled OLS. Estimations in columns 2, 4, and 6 include industry dummies, while columns 1, 3, and 5 do not. The results for the industry dummies are presented in Table A1 (in Appendix A).

Table 3 indicates that there is no significant difference between employment growth and job destruction before controlling for industry. However, when the industry is controlled for, blue firms have significantly higher employment growth and significantly lower job destruction. Moreover, job creation is significantly higher for blue firms before controlling for industry, but negative and insignificant after. This suggests that blue firms tend to operate within sectors characterized by a higher degree of job creation, and within these sectors, blue firms exhibit lower job destruction and higher employment growth. Approximately half of the blue economy, both in terms of number of firms and the labor force, operated within accommodation and food services in 2020 (see Table 1). Accommodation and food services are one of five sectors with positive job creation, relative to other service activities, although the difference is not significant (see Table A1 in Appendix A).[22] Moreover, accommodation and food services exhibit significantly

[22] Only one of the sectors with positive job creation is significantly different from other service activities, while 10 sectors have a significantly lower job creation.

lower employment growth and significantly higher job destruction, relative to other service activities.

Table 3: Results from pooled OLS estimations

Explanatory variables	Employment Growth		Job Creation		Job Destruction	
	(1)	(2)	(3)	(4)	(5)	(6)
Blue	0.006	0.006*	0.021**	-0.003	0.015	-0.009***
	(0.005)	(0.003)	(0.010)	(0.003)	(0.013)	(0.003)
Age 0–1	0.631***	0.629***	0.538***	0.534***	-0.093***	-0.095***
	(0.030)	(0.031)	(0.028)	(0.029)	(0.003)	(0.003)
Age 2–5	0.061***	0.060***	0.080***	0.076***	0.019***	0.016***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)
Age 6–10	0.011***	0.011***	0.031***	0.028***	0.020***	0.018***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Age 11–20	0.005***	0.004**	0.014***	0.011***	0.009***	0.007***
	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.001)
Size <10	0.004	0.010	0.010***	0.021***	0.006	0.011
	(0.008)	(0.009)	(0.003)	(0.004)	(0.008)	(0.007)
Size 10–49	-0.012**	-0.011*	0.019***	0.017***	0.031***	0.028***
	(0.006)	(0.006)	(0.002)	(0.004)	(0.006)	(0.006)
Size 50–199	-0.011**	-0.010*	0.012***	0.014***	0.023***	0.024***
	(0.006)	(0.006)	(0.002)	(0.003)	(0.006)	(0.006)
Size 200–499	-0.011**	-0.009*	0.007***	0.010***	0.018***	0.019***
	(0.005)	(0.006)	(0.002)	(0.003)	(0.005)	(0.005)
Industry dummies	No	Yes	No	Yes	No	Yes
Constant	-0.061***	-0.044***	0.039***	0.059***	0.099***	0.103***
	(0.006)	(0.011)	(0.002)	(0.008)	(0.007)	(0.009)
Observations	8,763,606	8,763,606	8,763,606	8,763,606	8,763,606	8,763,606
Adjusted R^2	0.102	0.103	0.132	0.137	0.008	0.011

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses.

Regarding firm age, the youngest firms have the largest effect on employment growth, job creation, and job destruction. Firms aged 11–20 years have a positive effect on the three measurements compared to the reference group of firms aged 20 years or older. This pattern continues for employment growth and job creation, and as firm age decreases, the significantly positive impact on job creation and employment

growth increases. This is also true for job destruction. However, firms of one year or younger have significantly lower job destruction, compared to firms aged 20 years or older.

The effect of firm size on job creation and destruction is positive and increases as firm size decreases. This finding aligns with previous literature, which indicates that job creation and destruction are most prevalent in small firms (e.g., Davis & Haltiwanger, 1992; Lawless, 2014). One finding that is less consistent with previous literature is the fact that firms with 10–499 employees tend to have lower employment growth, compared to firms with more than 500 employees.

Table 4 shows the results for the pooled OLS after matching on year, starting year, industry, firm ownership, and municipality using CEM. The results after the CEM are similar to those before the CEM when industry dummies are included, as shown in Table 3. However, Table 4 shows a marginally higher and more significant employment growth. The general results for firm age are in line with the results before matching using CEM, with a significantly higher employment growth, job creation, and job destruction compared to the reference group of firms aged 20 years or older, except for firms of at least one year, which have a significantly lower job destruction.

Regarding company size, firms with fewer than 10 employees (hereafter referred to as micro firms) are now significant for all three employment dynamic measures, exhibiting significantly higher job creation and destruction, as well as significantly lower employment growth, compared to firms with 500 or more employees. Firms with 10–49 and 200–499 employees do not exhibit significantly different job creation compared to those with 500 or more employees; however, they do experience significantly higher job destruction and significantly lower employment growth.

To further examine the effect of employment age and size, Table 5 shows the results from the pooled OLS after CEM when interaction terms are included. Table 5 shows that for most age and size groups, there is no significant difference between blue and non-blue firms, for either employment dynamic measurement. However, for the youngest firm age group, firms 0–1 year, blue firms exhibit significantly higher

job destruction and significantly lower job creation and employment growth. However, relative to firms of more than 20 years, blue firms still exhibit higher job creation and employment growth, as well as lower job destruction. For the smallest firm size, blue firms have a significantly higher job creation and employment growth. Furthermore, blue firms have a significantly higher job creation for firms with 50–199 employees.

Table 4: Pooled OLS, after CEM

Explanatory variables	Employment Growth	Job Creation	Job Destruction
	(1)	(2)	(3)
Blue	0.008***	-0.001	-0.009**
	(0.003)	(0.004)	(0.004)
Age 0–1	0.771***	0.675***	-0.096***
	(0.040)	(0.038)	(0.003)
Age 2–5	0.040***	0.094***	0.054***
	(0.014)	(0.002)	(0.015)
Age 6–10	-0.011	0.033***	0.044***
	(0.011)	(0.001)	(0.011)
Age 11–20	-0.007	0.013***	0.021***
	(0.006)	(0.001)	(0.007)
Size <10	-0.032***	0.016***	0.048***
	(0.009)	(0.004)	(0.010)
Size 10–49	-0.042***	0.006	0.049***
	(0.012)	(0.005)	(0.009)
Size 50–199	-0.027***	0.007*	0.033***
	(0.009)	(0.004)	(0.009)
Size 200–499	-0.033***	0.005	0.039***
	(0.011)	(0.004)	(0.012)
Constant	-0.033***	0.036***	0.069***
	(0.008)	(0.003)	(0.008)
Observations	7,902,217	7,902,217	7,902,217
Adjusted R^2	0.136	0.188	0.012

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses.

Table 5: Pooled OLS, after CEM with interaction terms

Explanatory variables	Employment Growth	Job Creation	Job Destruction
	(1)	(2)	(3)
Blue	-0.021	-0.011*	0.010
	(0.018)	(0.005)	(0.017)
Age 0–1	0.772***	0.676***	-0.097***
	(0.040)	(0.038)	(0.003)
Age 2–5	0.040***	0.094***	0.054***
	(0.014)	(0.002)	(0.015)
Age 6–10	-0.011	0.033***	0.044***
	(0.011)	(0.001)	(0.011)
Age 11–20	-0.007	0.013***	0.021***
	(0.006)	(0.001)	(0.007)
Blue and age 0–1	-0.081***	-0.073***	0.008*
	(0.026)	(0.022)	(0.005)
Blue and age 2–5	0.001	-0.003	-0.004
	(0.007)	(0.005)	(0.006)
Blue and age 6–10	-0.002	-0.004	-0.002
	(0.005)	(0.002)	(0.005)
Blue and age 11–20	0.003	-0.002	-0.004
	(0.005)	(0.002)	(0.005)
Size <10	-0.032***	0.016***	0.048***
	(0.009)	(0.004)	(0.010)
Size 10–49	-0.042***	0.006	0.049***
	(0.012)	(0.005)	(0.010)
Size 50–199	-0.027***	0.007*	0.033***
	(0.009)	(0.004)	(0.009)
Size 200–499	-0.034***	0.005	0.039***
	(0.011)	(0.005)	(0.012)
Blue and size <10	0.041**	0.021***	-0.020
	(0.019)	(0.006)	(0.017)
Blue and size 10–49	0.018	0.011	-0.007
	(0.019)	(0.007)	(0.015)
Blue and size 50–199	0.008	0.012*	0.004
	(0.021)	(0.007)	(0.018)
Blue and size 200–499	0.032	0.000	-0.032
	(0.026)	(0.007)	(0.024)
Constant	-0.032***	0.036***	0.069***
	(0.008)	(0.003)	(0.008)

Observations	7,902,217	7,902,217	7,902,217
Adjusted R^2	0.136	0.188	0.012

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses.

6.1 Sensitivity analysis

In this section, two sensitivity analyses are presented. As mentioned in Section 2.1, the data excludes sole proprietorships, the primary business type in the fishing industry (Blomquist et al., 2021). Small firms, such as small-scale fisheries, also lacked registered SNI codes to a greater extent in earlier years (Statistics Sweden, 2014), so their activity may not be entirely attributed to the data. As a result, updates to SNI code registration may appear as increases in the number of employees at the sector level. At the firm level, only an increase in the number of employees constitutes actual job creation. Still, if firms were not registered under the correct SNI code in earlier years, genuine job creation or destruction may not be accurately reflected in the data. However, most of the fisheries, which are sole proprietorships or firms that lack an SNI code, have no employees and should not significantly affect firm-level employment findings. Nevertheless, to test whether these data limitations affect the main results, firms within agriculture, forestry, and fishing are excluded in columns 1–3 in Tables 6 and 7.

Many studies examining job creation and destruction have a lower limit on the number of employees for firms included in the dataset (e.g., Ayyagari et al., 2011; Heyman et al., 2018; Hijzen et al., 2010; Lawless, 2014). The blue economy consists to a large degree of smaller firms. For example, 80 percent of firms within maritime technology have fewer than 10 employees (Swedish Maritime Technology Forum, 2019, 2021). Thus, excluding micro firms in the main regressions would exclude a large share of blue firms. Nevertheless, to examine how this

affects the main results, micro firms are excluded in columns 4–6 in Tables 6 and 7.[23]

Table 6 presents the sensitivity analysis results after CEM, excluding interaction terms. Columns 1–3 in show that after excluding firms in agriculture, forestry, and fishing, the results are practically the same as the main results, with the same degree of significance and the same or nearly the same coefficient. However, when micro firms are excluded (columns 4–6), there is no significant difference between blue and non-blue firms for the three employment dynamic measures, indicating that the difference between blue and non-blue firms is driven by employment changes in micro firms. Interestingly, the lowest size group, with fewer than 10 employees on average over the two previous years, became significantly positive for employment growth and significantly negative for job destruction. Thus, these results indicate a more positive employment growth for the smallest firm size, compared to when all firms are included. Table 7 presents the sensitivity analysis results after CEM when interaction terms are included. Columns 1–3 exclude firms within agriculture, forestry, and fishing. In columns 4–6, micro firms are excluded.

Table 7 reports the results from the sensitivity analysis results after CEM when interaction terms are included. Columns 1–3 in show that the results when firms within agriculture, forestry, and fishing are excluded are very similar to the main results. Columns 4–6 show that when micro firms are excluded, the employment dynamic measures are no longer significant. The general size effect for the smallest size group indicates a higher employment growth. Compared to the main results, there is no longer any significant difference in employment growth between blue and non-blue firms in the smallest size group, i.e., for firms with fewer than 10 employees on average the two previous

[23] To decrease the number of tables and focus on the most important results, the sensitivity analysis focuses on the OLS models after CEM. However, Table A2 (Appendix A) presents the results for the OLS before CEM when firms within agriculture, forestry, and fishing are excluded, and Table A3 (Appendix A) presents the results for the OLS before CEM when firms with fewer than 10 employees are excluded.

years. Furthermore, blue firms still exhibit significantly lower employment growth and job creation com-pared to firms of 0–1 years of age; however, job destruction is no longer significantly different.

Table 6: Sensitivity analysis, after CEM

Explanatory variables	Employment Growth	Job Creation	Job Destruction	Employment Growth	Job Creation	Job Destruction
	(1)	(2)	(3)	(4)	(5)	(6)
Blue	0.009***	-0.001	-0.010**	0.000	0.002	0.002
	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)	(0.002)
Age 0–1	0.775***	0.678***	-0.097***	1.007***	0.976***	-0.031***
	(0.040)	(0.038)	(0.003)	(0.004)	(0.005)	(0.001)
Age 2–5	0.038***	0.094***	0.056***	0.065***	0.073***	0.008***
	(0.013)	(0.002)	(0.014)	(0.007)	(0.007)	(0.001)
Age 6–10	-0.013	0.033***	0.046***	0.008**	0.013***	0.006***
	(0.011)	(0.001)	(0.010)	(0.003)	(0.002)	(0.002)
Age 11–20	-0.008	0.014***	0.022***	-0.000	0.003*	0.003**
	(0.006)	(0.001)	(0.006)	(0.002)	(0.002)	(0.001)
Size <10	-0.033***	0.017***	0.050***	0.386***	0.328***	-0.057***
	(0.009)	(0.004)	(0.010)	(0.015)	(0.015)	(0.004)
Size 10–49	-0.043***	0.006	0.049***	0.025***	0.011*	-0.014***
	(0.012)	(0.005)	(0.009)	(0.008)	(0.006)	(0.004)
Size 50–199	-0.027***	0.007*	0.034***	-0.002	0.011***	0.013***
	(0.009)	(0.004)	(0.009)	(0.007)	(0.004)	(0.005)
Size 200–499	-0.033***	0.005	0.039***	-0.008	0.007**	0.015**
	(0.011)	(0.004)	(0.012)	(0.008)	(0.003)	(0.008)
Constant	-0.032***	0.036***	0.069***	-0.024***	0.034***	0.058***
	(0.008)	(0.003)	(0.008)	(0.005)	(0.004)	(0.004)
Observations	7,721,178	7,721,178	7,721,178	582,241	582,241	582,241
Adjusted R^2	0.137	0.189	0.012	0.361	0.375	0.031

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses. Columns 1, 2, and 3 show the employment growth, job creation, and job destruction when agriculture, forestry, and fishing are excluded. Columns 4, 5, and 6 show the employment growth, job creation, and job destruction when firms with fewer than 10 employees are excluded.

Table 7: Sensitivity analysis, after CEM with interaction terms

Explanatory variables	Employment Growth	Job Creation	Job Destruction	Employment Growth	Job Creation	Job Destruction
	(1)	(2)	(3)	(4)	(5)	(6)
Blue	-0.021	-0.010*	0.011	-0.000	-0.004	-0.004
	(0.018)	(0.005)	(0.017)	(0.010)	(0.005)	(0.007)
Age 0–1	0.776***	0.679***	-0.097***	1.009***	0.978***	-0.031***
	(0.040)	(0.038)	(0.003)	(0.005)	(0.005)	(0.001)
Age 2–5	0.038***	0.094***	0.056***	0.065***	0.073***	0.008***
	(0.013)	(0.001)	(0.014)	(0.007)	(0.007)	(0.001)
Age 6–10	-0.012	0.033***	0.046***	0.008**	0.014***	0.006***
	(0.011)	(0.001)	(0.010)	(0.003)	(0.002)	(0.002)
Age 11–20	-0.008	0.014***	0.022***	-0.000	0.003*	0.003**
	(0.006)	(0.001)	(0.007)	(0.002)	(0.002)	(0.001)
Blue and age 0–1	-0.083***	-0.073***	0.009*	-0.067***	-0.066***	0.001
	(0.027)	(0.023)	(0.005)	(0.019)	(0.019)	(0.003)
Blue and age 2–5	0.001	-0.003	-0.004	0.008	0.007	-0.001
	(0.007)	(0.004)	(0.006)	(0.008)	(0.008)	(0.002)
Blue and age 6–10	-0.003	-0.004*	-0.002	-0.009*	-0.005	0.004
	(0.005)	(0.002)	(0.005)	(0.005)	(0.005)	(0.003)
Blue and age 11–20	0.003	-0.002	-0.005	0.001	0.002	0.001
	(0.005)	(0.002)	(0.005)	(0.005)	(0.005)	(0.002)
Size <10	-0.034***	0.017***	0.050***	0.385***	0.327***	-0.057***
	(0.009)	(0.004)	(0.010)	(0.015)	(0.015)	(0.004)
Size 10–49	-0.043***	0.006	0.049***	0.025***	0.011*	-0.014***
	(0.012)	(0.005)	(0.009)	(0.008)	(0.006)	(0.004)
Size 50–199	-0.027***	0.007*	0.034***	-0.001	0.011***	0.013**
	(0.009)	(0.004)	(0.009)	(0.007)	(0.004)	(0.005)
Size 200–499	-0.034***	0.005	0.039***	-0.008	0.008**	0.015*
	(0.011)	(0.005)	(0.012)	(0.009)	(0.003)	(0.008)
Blue and size <10	0.043**	0.021***	-0.022	0.032	0.036*	0.004
	(0.020)	(0.006)	(0.018)	(0.021)	(0.019)	(0.008)
Blue and size 10–49	0.019	0.011	-0.008	0.000	0.005	0.004
	(0.019)	(0.007)	(0.015)	(0.010)	(0.006)	(0.008)
Blue and size 50–199	0.009	0.012*	0.003	-0.005	0.004	0.009
	(0.021)	(0.007)	(0.018)	(0.012)	(0.008)	(0.009)
Blue and size 200–499	0.032	0.000	-0.032	-0.010	-0.002	0.009
	(0.026)	(0.007)	(0.024)	(0.023)	(0.008)	(0.018)

Constant	-0.032***	0.036***	0.068***	-0.024***	0.034***	0.059***
	(0.008)	(0.003)	(0.008)	(0.005)	(0.004)	(0.004)
Observations	7,721,178	7,721,178	7,721,178	582,241	582,241	582,241
Adjusted R^2	0.137	0.189	0.0118	0.361	0.375	0.031

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses. Columns 1, 2, and 3 show the employment growth, job creation, and job destruction when agriculture, forestry, and fishing are excluded. Columns 4, 5, and 6 show the employment growth, job creation, and job destruction when firms with fewer than 10 employees are excluded.

7 Conclusion

Since EU and Swedish policies have prioritized the blue economy as a vehicle for job creation and economic growth, assessing whether these objectives are met is central. In this paper, I estimated job creation, job destruction, and employment growth in blue firms, relative to non-blue firms. I find that, on the one hand, job creation is significantly higher for blue firms before controlling for industry, but negative and insignificant afterwards. On the other hand, blue firms exhibit significantly higher employment growth and significantly lower job destruction when controlling for industry, but are insignificant before. This suggests that blue firms operate within sectors characterized by a higher degree of job creation, and that within these sectors, blue firms exhibit lower job destruction and higher employment growth. To increase comparability between blue and non-blue firms, the regressions are re-estimated after matching blue and non-blue observations using CEM. The results after the matching are similar to those before matching when industry dummies are included, but with marginally higher and more significant employment growth.

Firm age also plays a significant role, with firms within age groups 0–1 year and 2–5 years having a significantly higher employment growth and firm job creation, a pattern consistent with previous literature, as young surviving firms have a more rapid growth compared to more mature firms (Haltiwanger et al., 2013). However, firms within the 0–1 year age group have significantly lower job destruction, contradicting previous literature, which often finds that younger firms have higher job destruction, as a result of survival challenges (e.g., Eriksson &

Hane-Weijman, 2017; Persson, 2004). To further examine the differences in employment dynamics between blue and non-blue firms, interaction terms between the age groups and being blue, as well as size groups and being blue, are introduced to the model. The only interaction term significant relative to the age groups is for the youngest blue firms, with a firm age of 0–1 year. This term indicates that young blue firms experience significantly lower employment growth and job creation, as well as significantly higher job destruction, compared to non-blue firms.

Micro firms, i.e., firms with fewer than 10 employees, have a significantly higher job creation than firms with 500 or more employees, in all estimations. After matching blue and non-blue observations using CEM, this size group also get a significantly higher job destruction and significantly lower employment growth. Furthermore, the remaining size groups have significantly higher job destruction and significantly lower employment growth, compared to firms with 500 or more employees. While there is no significant effect on job creation for firms with sizes 10–49 and 200–499 employees, firms with 50 to 199 employees exhibit a higher degree of job creation, which is significant at a 10 percent level. When the interaction term is included, blue micro firms exhibit significantly higher job creation and employment growth compared to non-blue firms. Moreover, blue firms with 50–199 employees also have significantly higher job creation.

The results presented above are robust when firms within agriculture, forestry, and fishing are excluded, as part of the sensitivity analysis. However, when micro firms are excluded, there is no longer a significant difference between blue and non-blue firms in terms of job creation, job destruction, or employment growth. This indicates that the difference between blue and non-blue firms is driven by employment changes in micro firms.

This study provides new empirical insights into the employment dynamics of the blue economy. The findings suggest that blue firms of one year or younger exhibit significantly higher job destruction and significantly lower job creation and employment growth compared to non-blue firms within the same age group. Therefore, following the recommendation by Eriksson and Hane-Weijman (2017), I argue that it is

especially important for policy initiatives aimed at developing the blue economy to focus on the survival of start-ups. Furthermore, these policies might benefit from sector-specific adjustments to maximize job creation potential. Hence, further research is needed at the sector level to fully understand how blue firms differ from their non-blue counterparts.

In this study, firms within the Swedish blue economy are identified using a unique dataset that combines data on financial statements, member firms in business associations, electricity certificate applications, and geographic location. There are, however, some limitations in this dataset which should be addressed in future research. Firstly, many fisheries are likely excluded from this data, some because they are sole proprietorships and others because of missing SNI-codes. Secondly, there is a risk that coastal tourism is overstated in this paper, as all accommodations and restaurants in postal codes with borders along the coastline or one of Sweden's three largest lakes are included, and not just businesses along the coastline of either of the lakes Vänern, Vättern, or Mälaren. Therefore, regarding coastal tourism, a recommendation for future studies would be to include firms within a specific radius of the coast, rather than within specific postal codes.

Lastly, it is important to note that this study disregards the sustainability aspect of the blue economy. As the blue economy is expected to expand due to technological development and increased awareness about finite resources, it is relevant to examine whether job creation is concentrated among more sustainable businesses. This is especially important due to concerns that the push for growth within the blue economy may sideline policies on environmental and social sustainability (e.g., Bennett et al., 2019). Therefore, further research is necessary to comprehend the long-term sustainability of employment trends in the blue economy, ensuring that economic growth is aligned with environmental and social objectives.

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Appendix A: Additional results

Table A1: Results from pooled OLS estimations, with industry dummies

Explanatory variables	Employment Growth		Firm Job Creation		Firm Job Destruction	
	(1)	(2)	(3)	(4)	(5)	(6)
BE	0.006	0.006*	0.021**	-0.003	0.015	-0.009***
	(0.005)	(0.003)	(0.010)	(0.003)	(0.013)	(0.003)
AGE 0-1	0.631***	0.629***	0.538***	0.534***	-0.093***	-0.095***
	(0.030)	(0.031)	(0.028)	(0.029)	(0.003)	(0.003)
AGE 2-5	0.061***	0.060***	0.080***	0.076***	0.019***	0.016***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)
AGE 6-10	0.011***	0.011***	0.031***	0.028***	0.020***	0.018***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
AGE 11-20	0.005***	0.004**	0.014***	0.011***	0.009***	0.007***
	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.001)
SIZE <10	0.004	0.010	0.010***	0.021***	0.006	0.011
	(0.008)	(0.009)	(0.003)	(0.004)	(0.008)	(0.007)
SIZE 10-49	-0.012**	-0.011*	0.019***	0.017***	0.031***	0.028***
	(0.006)	(0.006)	(0.002)	(0.004)	(0.006)	(0.006)
SIZE 50-199	-0.011**	-0.010*	0.012***	0.014***	0.023***	0.024***
	(0.006)	(0.006)	(0.002)	(0.003)	(0.006)	(0.006)
SIZE 200-499	-0.011**	-0.009*	0.007***	0.010***	0.018***	0.019***
	(0.005)	(0.006)	(0.002)	(0.003)	(0.005)	(0.005)
Agriculture, forestry, and fishing		-0.009		-0.029***		-0.020***
		(0.010)		(0.009)		(0.006)
Mining and quarrying		-0.016		-0.043***		-0.026***
		(0.013)		(0.009)		(0.007)
Manufacturing		-0.016		-0.023***		-0.006
		(0.010)		(0.008)		(0.005)
Electricity, gas, etc.		-0.026		-0.091***		-0.065***
		(0.017)		(0.018)		(0.005)
Water supply, sewerage, waste management, etc.		0.004		-0.010		-0.014*
		(0.011)		(0.008)		(0.008)
Construction		0.008		0.006		-0.001
		(0.010)		(0.007)		(0.006)
Wholesale, retail, and repair		-0.030***		-0.027***		0.003
		(0.010)		(0.007)		(0.005)

Transportation and storage		-0.013 (0.010)		-0.006 (0.008)		0.006 (0.007)
Accommodation and food service		-0.027*** (0.009)		0.015 (0.009)		0.042*** (0.008)
Information and communication		-0.016 (0.011)		-0.006 (0.008)		0.010* (0.005)
Financial and insurance activities		-0.059*** (0.013)		-0.108*** (0.017)		-0.049*** (0.009)
Real estate activities		-0.056*** (0.012)		-0.106*** (0.014)		-0.050*** (0.007)
Professional, scientific, and technical activities		-0.019* (0.010)		-0.020*** (0.007)		-0.001 (0.005)
Administrative and support service		-0.013 (0.011)		-0.005 (0.011)		0.008 (0.008)
Public administration, defense, etc.		0.031 (0.031)		0.022 (0.031)		-0.009 (0.012)
Education		-0.013 (0.013)		-0.013* (0.008)		0.000 (0.008)
Human health and social work activities		-0.004 (0.012)		-0.007 (0.008)		-0.003 (0.006)
Arts, entertainment, and recreation		-0.020* (0.010)		-0.027*** (0.008)		-0.007 (0.006)
Activities of households as employers etc.		0.356 (0.248)		0.282 (0.261)		-0.074*** (0.014)
Extraterritorial organizations and bodies		-0.055*** (0.016)		0.042*** (0.013)		0.096*** (0.005)
Constant	-0.061*** (0.006)	-0.044*** (0.011)	0.039*** (0.002)	0.059*** (0.008)	0.099*** (0.007)	0.103*** (0.009)
Observations	8,763,606	8,763,606	8,763,606	8,763,606	8,763,606	8,763,606
Adjusted R^2	0.102	0.103	0.132	0.137	0.008	0.011

Notes: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses.

Table A2: Sensitivity analysis, excluding firms within agriculture, forestry, and fishing

Explanatory variables	Employment Growth		Job Creation		Job Destruction	
	(1)	(2)	(3)	(4)	(5)	(6)
Blue	0.006	0.007*	0.021**	-0.003	0.015	-0.011***
	(0.005)	(0.004)	(0.010)	(0.004)	(0.013)	(0.003)
Age 0–1	0.630***	0.628***	0.537***	0.533***	0.015	-0.011***
	(0.031)	(0.031)	(0.028)	(0.029)	(0.013)	(0.003)
Age 2–5	0.061***	0.059***	0.080***	0.076***	0.019***	0.017***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.003)
Age 6–10	0.011***	0.010***	0.031***	0.028***	0.020***	0.018***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Age 11–20	0.005***	0.004**	0.014***	0.011***	0.009***	0.008***
	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.001)
Size <10	0.003	0.010	0.010***	0.021***	0.006	0.011
	(0.008)	(0.009)	(0.003)	(0.004)	(0.008)	(0.007)
Size 10–49	-0.013**	-0.012*	0.019***	0.017***	0.031***	0.029***
	(0.006)	(0.006)	(0.002)	(0.004)	(0.006)	(0.006)
Size 50–199	-0.012**	-0.010*	0.012***	0.014***	0.024***	0.024***
	(0.006)	(0.006)	(0.002)	(0.003)	(0.006)	(0.006)
Size 200–499	-0.011**	-0.009	0.007***	0.010***	0.018***	0.019***
	(0.005)	(0.006)	(0.002)	(0.003)	(0.005)	(0.005)
Industry dummies	No	Yes	No	Yes	No	Yes
Constant	-0.061***	-0.044***	0.039***	0.059***	0.099***	0.103***
	(0.006)	(0.011)	(0.002)	(0.008)	(0.007)	(0.009)
Observations	8,579,535	8,579,535	8,579,535	8,579,535	8,579,535	8,579,535
Adjusted R^2	0.102	0.103	0.131	0.137	0.008	0.011

Notes: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses.

Table A3: Sensitivity analysis, excluding firms with fewer than 10 employees

Explanatory variables	Employment Growth		Job Creation		Job Destruction	
	(1)	(2)	(3)	(4)	(5)	(6)
Blue	-0.015**	0.000	-0.010	0.003	0.005***	0.002
	(0.007)	(0.002)	(0.007)	(0.003)	(0.002)	(0.002)
Age 0–1	1.015***	1.010***	0.986***	0.979***	-0.029***	-0.032***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.001)	(0.001)
Age 2–5	0.100***	0.095***	0.109***	0.101***	0.009***	0.006***
	(0.005)	(0.004)	(0.006)	(0.004)	(0.001)	(0.001)
Age 6–10	0.023***	0.018***	0.030***	0.023***	0.008***	0.005***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Age 11–20	0.007***	0.004***	0.011***	0.007***	0.005***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Size <10	0.394***	0.398***	0.325***	0.331***	-0.068***	-0.068***
	(0.011)	(0.011)	(0.009)	(0.009)	(0.004)	(0.004)
Size 10–49	0.043***	0.048***	0.014***	0.020***	-0.029***	-0.028***
	(0.004)	(0.005)	(0.002)	(0.002)	(0.004)	(0.004)
Size 50–199	0.011***	0.013***	0.011***	0.013***	-0.000	0.000
	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)
Size 200–499	0.003	0.004	0.009***	0.009***	0.005	0.005
	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)
Industry dummies	No	Yes	No	Yes	No	Yes
Constant	-0.034***	-0.039***	0.034***	0.028*	0.069***	0.068***
	(0.004)	(0.014)	(0.002)	(0.015)	(0.004)	(0.005)
Observations	738,985	738,985	738,985	738,985	738,985	738,985
Adjusted R^2	0.341	0.342	0.359	0.361	0.03	0.033

Notes: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the five-digit SNI level are presented in parentheses.

ESSAY II

Fishing quotas and decision-making in the EU

Estimating policy positions from bargaining outcomes

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Abstract

Overfishing is a global problem, and Europe is no exception, with 40–70 percent of fish stocks overexploited. In this paper, we propose how statistical analysis of quota-bargaining outcomes can shed light on the policy positions taken by the EU's member countries in the behind-closed-doors negotiations for fishing quotas (TACs). We use panel data on TACs and scientific advice from ICES for 162 zone-species combinations during 2005–2020. Using fixed-effects models, our results suggest that the UK's, Ireland's, Portugal's, Lithuania's, and Poland's policy positions correspond to catches significantly above the ICES advice, while Germany appears to prefer catches below the advice. Methodologically, our study contributes by suggesting how unobserved policy positions can be estimated from bargaining outcomes; policy-wise, it contributes to a better understanding of the political processes that determine fishing quotas.

Keywords: Fisheries Management; Policy Position; European Union; Decision-making; Policy Bargaining; Lobbying; Political Economy

JEL-codes: D72; Q22; Q28

1 Introduction

Overfishing is a global problem (Hutchings and Reynolds, 2004; FAO, 2018) and the European system for fisheries management has been declared to be one of the least successful in the world (O'Leary et al., 2011). It has been estimated that 40–70 percent of Europe's fish stocks are overexploited and that quotas are too high (Carpenter et al., 2016; Colloca et al., 2017; Fernandes et al., 2017; Froese et al., 2018; STECF, 2019). These unsatisfactory outcomes are at odds with Europe's generally high environmental ambitions. A possible cause is that fishing quotas are set in a complicated political process that is not open to public scrutiny and that, therefore, politicians cannot easily be held accountable for policy failure. In this paper, we propose a statistical method for estimating non-disclosed policy positions from bargaining outcomes. This method can shed light on which EU member states have been driving policy towards unsustainably high fishing quotas and which states have bargained for lower catches.

Since 1983, the European Union (EU) fisheries have been managed under the Common Fisheries Policy (CFP). A key policy instrument is the total allowable catches (TACs), set by the Council of the EU (the Council) following scientific advice from the International Council for the Exploration of the Seas (ICES), consultation with regional stakeholders (industry representatives and environmental groups), and negotiations with third countries.[24] The TACs have the double objective of ensuring sustainable fishing and maximizing yields (Carpenter et al., 2016). Since 2014, decisions have been legally binding for member states, and the EU has aimed to make its fisheries sustainable by 2020 (Froese et al., 2018, 2021). While numerous studies of overfishing exist, only a few directly compare TACs with ICES advice and then mainly use descriptive analysis, such as calculating TAC outcomes aggregated

[24] ICES only advises on TACs for the North Atlantic Ocean and adjacent seas, including the Arctic Ocean, the Azores, the Baltic Sea, the Barents Sea, the Bay of Biscay and the Iberian Coast, the Celtic Seas, the Faroes, the Greater North Sea, the Greenland Sea, Icelandic waters, the Norwegian Sea, and the Oceanic Northeast Atlantic (ICES, 2020).

by year and country. We consider each TAC decision for each species, fishing zone, and year as the unit of observation. The resulting panel dataset can then be subjected to formal econometric analysis, allowing us to estimate the EU member countries' unobserved policy positions, relative to ICES advice, when they enter the TAC negotiations.

Our study relates to the literature that uses collective bargaining models to shed light on how EU policy is formed and how decisions are taken. As discussed below, studies in this genre typically establish policy positions through document studies or expert surveys before using quantitative modeling to analyze how power and bargaining effectiveness are distributed between the member states (and sometimes, the European Commission and the European Parliament).[25] Our approach is, in some respects, the opposite. The highly structured setting allows us to make assumptions about how influential each member country is in each quota negotiation. These assumptions, together with the observed outcomes, make it possible to estimate the member states' policy positions. A key contribution is thus that we propose how unobserved policy positions can be estimated from bargaining outcomes, instead of departing from independent qualitative estimates of policy positions and then using econometric techniques to evaluate how influential each negotiating party has been for the final outcome.

Our dataset has several features that make it possible to identify policy positions from policy outcomes. TACs are set for a large number of geographic zones and fish species, TAC decisions involve various sets of member states, TACs can be compared with the ICES advice and can be converted to a meaningful one-dimensional policy scale. Thus, our key contribution to this literature is to suggest that in some settings, policy positions can be estimated from the outcomes of negotiations rather than evaluated qualitatively. This is particularly interesting in settings where politicians in closed-door negotiations may pursue objectives that deviate from their publicly announced policy platforms.

[25] When the member states bargain over money – e.g., agricultural support – countries can alternatively be assumed to maximize their share of the funds, as in Kauppi and Widgrén (2004).

Intuitively, if the ratio of the TAC to the ICES advice tends to be high (low) when country A has a large stake in a specific negotiation, the estimated parameter representing country A's policy position will also tend to be high (low). Policy outcomes are assumed to be weighted averages of the policy preferences, where weights are observed, but preferences are not. The observability of the countries' TAC shares and our key identifying assumption, that each country's relative influence in each negotiation is proportional to its share of that specific TAC, make it possible to estimate policy positions from the data. As TAC shares are virtually constant over time, it reasonable to assume that negotiations focus on the size of the TACs, not how they should be divided. Furthermore, we assume that countries' policy positions are consistent across all zones for a given year and species.[26]

As countries' share of each TAC, i.e., their weights, sum to one, our data is compositional. Thus, standard econometric techniques cannot be used. We apply the relative-shift regression framework, recently proposed by Li et al. (2023). Traditionally, log-ratio transformations have been used for compositional data, but the new framework is better able to handle zero values and facilitates interpretation of the results; the present study is one of the first that empirically uses relative-shift regression.

In this paper, we use a dataset made available by Griffin Carpenter and The New Economics Foundation (a British think tank).[27] After restricting the data to final agreements with matching ICES advice and agreements for the period 2005–2020, we end up with a panel of EU decisions on TACs covering 16 years and 165 zone-species combinations.

[26] The data confirm that TAC shares are constant, which is in line with the politically adopted "principle of relative stability" discussed below. While we allow policy positions to change over time and vary between species, we also assume that the countries' *relative* policy positions are constant across species and over time.

[27] An earlier version of the dataset was used by Carpenter et al. (2016).

Each TAC decision caps the total catch for a particular species in a particular geographical zone, allocated in fixed proportions to the countries entitled to TAC shares for that zone-species combination. Across all included zone-species combinations, the number of countries varies from 1 to 14. For example, TACs for cod have been allocated to between two and eight countries, with an average of about six countries. Each year, between 7 and 12 such TAC decisions were taken for this species.

We find that relative to the assumed default of following the scientific advice and setting the average ratio of TACs to the scientifically advised catch, hereafter defined as the exploitation ratio, to 1, our estimates of the policy positions of the United Kingdom, Ireland, Portugal, and the paring of Lithuania and Poland are significantly higher (more aggressive), while according to our preferred specification those of Germany are significantly lower (more prudent). Thus, our findings suggest that the UK, Ireland, Portugal, Lithuania, and Poland are aiming for higher TACs, while Germany seeks to reduce TACs.

2 Background

In 1976, the EU's member states extended their exclusive economic zones to 200 nautical miles, effective as of 1 January 1977, and, in principle, agreed to create a common fisheries policy. National quota shares were seen as necessary to prevent the kind of "race for fish" seen in some waters.[28] However, the negotiations for TAC shares were concluded only in 1983. The shares were mainly based on historical catches from 1973–1978, with adjustments to compensate for losses for some member states due to non-members extending their exclusive economic zones and with extra compensation for a few countries (UK, Ireland, and Greenland) that had communities that traditionally depended heavily on fishing (Hegland and Raakjær, 2008; Leigh, 1983; Starr, 2023).[29] Even though the CFP has been revised, these shares have been stable since 1983, when they were originally set. An important change

[28] See Birkenbach et al. (2017) for a survey.

[29] See also Gellermann (2020).

to the CFP came in 2014 when the Council's TAC decisions became legally binding for the member states. When this stricter policy was adopted, the EU also decided that all its fisheries should be sustainable by 2020.

At the request of the European Commission (the Commission), ICES, an intergovernmental marine science organization with a network of almost 6000 scientists, provides scientifically based advice on fishing efforts for different zones and species to the Scientific, Technical and Economic Committee for Fisheries (STECF), an EU committee appointed by the Director General responsible for fisheries (Carpenter et al., 2016; Starr, 2023). Depending on the species, ICES has agreed to use one of two approaches to calculate their advice: the precautionary approach or advice based on maximum sustainable yield (MSY).[30] Based on ICES advice and consultations with representatives from industry stakeholders and interest groups, a legislative proposal with TAC levels is drafted.

The TACs are decided during behind-closed-doors negotiations at an Agriculture and Fisheries (AGRIFISH) Council ministerial meeting. Historically, all TACs for EU waters were decided during the December Council meeting, but since 2009, there has been a separate October Council meeting for TACs within the Baltic Sea (Starr, 2023). TACs within the Atlantic and the North Sea are still decided on during the December Council, and TACs for deep-sea stocks are negotiated every other year. Further, the Council can revise TACs during the year they are valid (Villasante et al., 2011). Council mandates are used to negotiate TACs, which are shared with non-EU member states (Starr, 2023).

When the Council approves the TAC decision and legislation, the TACs are divided according to the principle of "relative stability". Thus, there is virtually no variation between years in the fraction of

[30] In our empirical analysis, we do not distinguish between the methods. Maximum sustainable yields are the highest yearly catch that can support a stock long-term and is either presented as a single estimate or as a range. The precautionary approach is typically used when there is limited stock related data. For further explanation of the methods, see ICES (2023).

each TAC (i.e., national quota shares or simply "TAC shares") that is allocated to a particular country (Hegland and Raakjær, 2008). For example, if Denmark were allocated 20 percent of the TAC for cod in Zone IIa (located in the North Sea) in 2001, Denmark would be allocated 20, or close to 20, percent of the cod in Zone IIa in all subsequent years. Stable TAC shares presumably facilitate the TAC negotiations, as there will only be one number to negotiate for each species-zone combination: the (size of the) TAC.[31] This institutional feature makes it easier to elicit the member countries' policy positions from the agreed-upon TACs.

Several studies have criticized the EU's TAC management system, and a small part focuses on deviations from scientific advice and the effects of such deviations. For example, when examining 11 fish stocks between 1987 and 2011, O'Leary et al. (2011) find that 68 percent of the TACs are set above scientific advice and, on average, 33 percent above the recommended level. Using yearly data on TACs, ICES advice, and spawning stock biomass for 18 fish stocks, Cardinale and Svedäng (2008) find that politicians have made a practice of ignoring scientific advice and prioritizing short-term effects.

Froese et al. (2021) investigate the status and exploitation of 119 fish stocks in the Northeast Atlantic and find that only 34 percent of these stocks were sustainably fished and of sufficient size in 2018, while more than 40 percent of stocks were overfished. The authors also find that one-third of the stocks were lower than the biologically safe limit, and two-thirds were below the level corresponding to the MSY.

Carpenter et al. (2016) investigate how well the EU complies with scientific advice on fishing quotas and whether some countries receive higher average excess TACs between 2001 and 2015. To answer these questions, the authors compare the average excess TAC, aggregated for the whole period and across all TAC decisions, to the corresponding scientific advice from ICES. The authors find that Denmark and the

[31] Without the principle of relative stability, the countries would have to negotiate the TAC shares and, possibly, which countries are entitled to a share of the TAC.

UK receive the largest excess TAC in tonnes and that Spain and Portugal receive the largest percentage excess. While the outcome of EU negotiations and their consequences for individual countries are interesting in their own right, these results do not directly address the countries' policy positions.

3 Theory and previous literature

3.1 Policy positions and power indices

Following the tradition of spatial-voting models, we assume that countries have preferences or ideal positions that can be ordered along a prominent dimension. Below, we will often refer to a country's ideal position as its policy position. We scale policy positions, using ICES' scientific advice as the reference point. We assume that policy positions concerning fishing quotas relative to scientific advice vary between EU member countries, depending on voter preferences and how political power is distributed between various parties and interest groups within each country.

In international negotiations in general, and EU negotiations in particular, different countries come with different power to the negotiation table. A country's total power can be assumed to be proportional to, e.g., its population size or the size of the economy – or it can be derived from formal voting rules. More sophisticated analysis relies on theoretically derived power indices. For example, the Shapley-Shubik Index is based on the assumption that voting power is proportional to the fraction of times a particular voter (e.g., a country in the Council of Ministers) is pivotal. This fraction, in turn, can be calculated if it is assumed that all preference orders are equally likely.[32]

Kauppi and Widgrén (2004) implicitly assume that all countries aim to maximize their revenues from the EU and focus on voting power.

[32] For an accessible explanation, see Kauppi and Widgrén (2004). The Council's voting system is qualified majority voting. A positive decision requires support from 55 percent of the member countries, representing at least 65 percent of the EU's total population.

Power indices are used to explain EU member countries' share of the overall EU budget or a particular spending item, such as agricultural support or structural funds.[33] Kauppi and Widgrén (2004) find that agricultural support from the EU can be explained by voting power and the share of the country's labor force that works in the agricultural sector. Similarly, Kandogan (2000) finds that the share of the total CAP funds to a country can be explained by a combination of power indices and how much the country's share of the population in agriculture deviates from the corresponding EU average.

Starr (2023) uses actual EU voting rules to calculate power indices, including the Shapley-Shubik Index, for countries with stakes in TAC negotiations for the Baltic, Atlantic, and North Sea, respectively. The author finds that Germany's influence is especially strong in both negotiations. France, Spain, and the UK also have high voting power for TAC negotiations within the Atlantic and the North Sea.

3.2 Saliency

An analysis that relies strictly on voting power suggests that large countries are highly influential in all decisions. While this may be true for the most important one-off decisions, even large countries have limited political capital that must be allocated over the multitude of issues that will be negotiated each year and will want to concentrate their influence on *salient* issues. Hence, a common assumption is that influence in less pivotal decisions is proportional to interest or saliency, not only to overall political power within the EU.

When discussing the concept of saliency, Leuffen et al. (2014) note that "capabilities are limited and any investment in one issue should imply fewer resources to be spent on other issues" (p. 617). In economists' terminology, this can be interpreted as a budget constraint for political

[33] Other applications of the power-index approach include Baldwin et al. (1997, 2000, 2001).

influence. Whenever influence is constrained by a budget, efforts should be focused where it matters – on *salient* issues.[34]

Schalk et al. (2007) argue that the outcome of an EU negotiation will depend on the countries' respective policy positions, their power, and the salience the issue at hand has for the countries. In addition, the nature of the bargaining process will matter. Following earlier research, the authors define salience as "the fraction of the power a member state is willing to utilize to bring the policy outcome closer to its preferred position" (p. 235).[35]

Schalk et al. (2007) apply their empirical model to an extensive dataset on member countries' policy positions and the saliency of those issues for the countries. The dataset, consisting of expert opinions on a wide range of issues, as well as the final decisions taken by the Council, was previously assembled by a group of researchers and presented in Thomson et al. (2006). Schalk et al. (2007) use 152 issues in their analysis, which is focused on the power of the presidency of the Council.[36] They find that the member state that holds the presidency during the voting stage increases its power fivefold.

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[34] The concept of "political capital" is discussed in Gratton et al. (2022). In their model, the leader of an organization has a stock of political capital that can be used to sway the organization's choice of action. The more that is spent, the stronger the leader's influence will be on that issue's outcome. Differently from our setting, spending capital is also an investment. If the leader's decision turns out well, the leader's political capital will be larger in the next period, while bad decisions erode the stock of political capital. Similar to our setting, political capital serves as a budget constraint for the exercise of influence.

[35] As discussed above, power can, for example, be measured by the Shapley-Shubik Index or simply by vote share.

[36] Leuffen et al. (2014) use an updated version of the same dataset and find that saliency can be predicted by how well a country is represented by interest groups in Brussels and by the length of its tenure in the EU.

3.3 Bargaining and outcomes

A model that has been demonstrated to perform well in predicting bargaining outcomes is the Nash bargaining solution (NBS). In the original formulation, the equilibrium maximizes the product of the difference between each party's equilibrium value and the value of the outside option. In EU negotiations, the outside option is often assumed to be the status quo.

It has been shown that if the value of the outside option is much lower than the equilibrium value, the NBS can be approximated by the salience-weighted mean of the parties' respective ideal positions (Achen, 2006). Thus, eliminating the role of the outside option drastically reduces the complexity of the model in empirical applications. Further, in the context of voting within the Council, it has been argued that there is a "preference for unanimity" and that voting according to the formal rules, i.e., qualified majority, is used as a threat in order to achieve consensus.[37] Formal voting is considered politically costly, as it would reveal positions for the public, possibly resulting in criticism, and at the same time risking retaliation from other participants in the process (Novak, 2013; Tsebelis, 2013).

Relying on Caplin and Nalebuff's (1991) median voter model as well as on Van den Bos (1991) and Achen (2006), Shalk et al. (2007) argue that EU negotiations could be understood as NBS resulting in outcomes that are the weighted means of the countries' policy positions, with weights equal to the product of power and salience.

Giving equal weights to salience and power with Nash bargaining over deviations from policy positions has been labeled the compromise model, further simplifying the analysis (Van den Bos, 1991). Given that policy positions can be interpreted as locations along one or more

[37] In October 2024, herring quotas in the Baltic Sea increased sharply, even though the stock was depleted. The Swedish representative in the Council, a minister of government, defended Sweden's choice not to vote against the proposal by commenting, "Of course I am disappointed, but we definitely held out as far as we could and dared. Our assessment is that if we had pulled out of the negotiations, the quotas would have been [much] higher." (Spolander, 2024).

policy dimensions and given the countries' weights in the negotiations, a prediction consistent with NBS is that the outcome will be close to the center of gravity.

Franchino and Mariotto (2022) evaluate the performance of cooperative bargaining models on 35 controversial economic governance issues faced by the EU from 1997 to 2013. The member states' policy positions and levels of salience were qualitatively evaluated and assessed from document studies; the authors find that the compromise model was the best-performing model. According to the compromise model, political influence in a particular negotiation can be approximated by the product of (general) political power and the saliency of the specific issue.

3.4 Economic value as a combined measure of power and saliency

A little-noticed interpretation of saliency and the compromise model is that when budget matters and similar economic issues are negotiated, a direct measure of the product of power and saliency is economic value, whether in employment, sales, value-added, or revenues from the EU. Power tends to be roughly proportional to population size or the size of the economy; the saliency of an issue or of a sector tends to be proportional to its share of the labor force or of GDP. Hence, the product of power and saliency for a sector x of the economy can be approximated with the size of the sector as shown by the following simple equation:

$$Saliency * Power = \left(\frac{Sector_x}{GDP}\right) * GDP = Sector_x \quad \textbf{(1)}$$

The implication is that a measure of a country's influence – the product of power and saliency – over an economic activity is the value of that economic activity for that country. In our application, a country's TAC share is proportional to its economic value at stake in the TAC decision. It can, therefore, be interpreted as a measure of the product of power and saliency.

3.5 Identifying policy positions

Following Shalk et al. (2007), we argue that the outcomes of the negotiations, i.e., the TAC decisions, can be modeled as weighted averages of the countries' policy positions, with weights equal to the product of saliency and power, for those countries that are entitled to shares of the TAC. According to the previous section, we approximate the product of power and saliency with the TAC share; this leaves the policy positions to be estimated from the data.

By definition, all countries that fish for a particular species in a particular zone have the same exploitation ratio. However, for a given country, the exploitation ratio will vary between zones, and the set of countries that share a zone will vary, making it possible to identify the countries' policy positions.

Formally, our outcome measure R_{zs}, the exploitation ratio in species-zone combination zs, is given by:

$$R_{sz} = \sum_{c=1}^{n_{zs}} \frac{w_{czs} * IR_c}{\sum_{c=1}^{n_{zs}} w_{czs}} = \sum_{c=1}^{n_{zs}} w_{czs} * IR_c \qquad \textbf{(2)}$$

where w_{czs} is country c's share of the TAC in zone-species combination zs, IR_c is country c's ideal exploitation ratio (or policy position), and n_{zs} is the number of countries with positive shares of the TAC for zone z and species s.[38]

To summarize, our ambition is to estimate the unobserved policy positions of the EU member countries from the outcomes of the TAC negotiations. We argue that we can do this given a reasonable set of assumptions on how much influence each country has in each negotiation. Our key identifying assumption is that a country's influence in a negotiation is proportional to its share of the TAC. We argue that this is consistent with what is becoming a standard assumption in the literature, that influence is proportional to the product of power and

[38] We suppress indexation for time *t*. The second equality follows from summing all TAC shares for each TAC; the sum will always equal 1.

saliency, if we are willing to assume that the economic value at stake can be used as a measure of influence.

4 The empirical model

The empirical model corresponding to Eq. 2 is:

$$r_{sz} = \sum_{c \in A_{zs}} w_{czs} * i_c + \alpha_s + \beta_t + \varepsilon_{zst} \quad \textbf{(3)}$$

where r_{zst} is the natural logarithm of the exploitation ratio R for species s in zone z at time t. For the countries active in zone zs (that belong to the set A_{zs}), the first term on the right-hand side is the weighted geometric mean of the countries' general overfishing preferences.[39] Here i_c represents the logarithm of the country c's preferences IR_c. The weights w_{czs} sum to 1 over all countries c active in zone z for species s (i.e., over all countries in set A_{zs}) and correspond to country c's share of the TAC for species s in zone z.[40] The second and third terms represent the species-fixed effects and the time-fixed effects, respectively, while ε_{zst} is the individual error term. Note that it follows from the specification that all countries' exploitation preferences are assumed to vary in the same way across species and over time.

As the weights are compositional data, they tend to be negatively correlated and, therefore, standard econometric techniques cannot be used. The most common solution is to transform the data with log-ratios (e.g., Aitchison, 1983). However, and as mentioned in the introduction, log-ratio transformation is less useful for datasets with numerous zero values and it may be difficult to interpret the results. Hence, we apply the relative-shift framework proposed by Li et al. (2023). In the authors'

[39] Eq. 2 uses the arithmetic mean. To facilitate the analysis, we depart from the geometric mean in the empirical application. Eq. 3 is obtained by taking the natural logarithm of an equation of the format $R = \prod_c {IR_c}^{w_c}$ where $r = \ln(R)$, $i = \ln(IR)$, and indexation for s, c, and t is suppressed.

[40] To clarify, if three countries, $c = 1,2,3$, each have a share of TAC, Eq. 3 can be rewritten as $r_{sz} = w_{1zs} * i_1 + w_{2zs} * i_2 + w_{3zs} * i_3 + \alpha_s + \beta_t + \varepsilon_{zst}$, where w_{czs} are the explanatory variables and r_{sz} is the response variable.

words, "a simple yet intriguing finding [is that] the regression on compositional predictors is completely identifiable if we just eliminate the intercept term" (p. 1319). Standard linear-regression techniques can be used, as long as the results are interpreted with the understanding that estimated coefficient cannot be interpreted individually; they have to be interpreted in a context with offsetting changes. In our setting, increasing the TAC share of one country must be offset by reducing the TAC share of at least one other country.

Note also that preferences are the unknown parameters to be estimated while the weights are treated as observations. Since there is minimal variation in the time dimension, the preference parameters are mainly identified through the cross-sectional variation. The same is true for the species-fixed effects; the time-fixed effects are left to account for variations over time.

5 Data

The data used in this study is an updated version of a dataset used by Carpenter et al. (2016) and has been provided by Griffin Carpenter and the British think-tank The New Economics Foundation.[41] The dataset contains agreements on TACs and scientific fishing advice from ICES for the period 2005–2020. As described above, these are set for combinateions of species and geographic zones and are, in most cases, expressed in tonnes per year. By restricting the dataset to the period 2005–2020, we can disregard potential effects of entry and exit of EU member states. Otherwise, we would have to account for the fact that Estonia, Latvia, Lithuania, and Poland entered the EU in May 2004, and the UK exited the EU in 2020.[42] As explained by Carpenter et al. (2016), the ICES Advice web portal (www.ices.dk) was used to collect data on ICES advice. Council Regulations were collected from the

[41] The dataset is found in the technical appendix at https://neweconomics.org/campaigns/landing-the-blame. We added on amendments for 2020 to this dataset, as they were not included in the original dataset.

[42] As TACs are decided on the year before they come into effect, the 2020 TACs were decided on in 2019, when United Kingdom still was part of the EU.

EUROLEX (www.eur-lex.europa.eu) for TAC agreements, including the TAC for each member state. TACs for other/third countries were collected through literature sources, such as government agency websites and news articles.

A strength of the dataset is that TACs have been matched with scientific advice when ICES fishing zones and TAC areas do not overlap. As there is no available documentation on how the EU matches TAC areas and quotas to the scientific advice from ICES, Carpenter et al. (2016) had to adjust the data. These adjustments include splitting the ICES advice proportionally to different TAC areas when an ICES area overlaps multiple TAC areas.[43] When ICES provides a range of advice for an area, the midpoint is used. Lastly, when the ICES advice is expressed in number of fish, a recalculation to tonnes was made.

We restrict the dataset in two steps. Firstly, for some observations, the scientific advice from ICES is missing. As we both need the TAC and the scientific advice to measure the exploitation ratio, we restrict our sample to TACs with matching ICES advice. This decreases the sample by 34.3 percent.[44] Secondly, the dataset includes both final and non-final agreements. If an amendment is made to an agreement, the original agreement will be viewed as a non-final agreement and the amendment as the final agreement. As there is always a final counterpart to non-final agreements and our interest lies in the final division of TACs between member countries, all non-final agreements are dropped for our main result, further decreasing the sample with 8.5 percent. However, we include estimates based on original agreements in our sensitivity analysis.

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[43] For example, if an ICES area covers two TAC areas, with the first corresponding to 80 percent of the ICES area and the second to 20 percent, the first TAC area will receive 80 percent of the ICES advice and the second 20 percent.

[44] Approximately 65 percent of these observations are for species-zone combinations which never receive an ICES advice during the period of study, 25 percent are for species-zone combinations which did not receive advice for earlier years but for later, and the remaining 10 percent have missing advice in the middle or end of the period.

The dependent variable is the exploitation ratio: the ratio of the TAC to the ICES advice by zone, species, and year. For 104 observations, where both their scientific advice and TAC are equal to zero, the exploitation ratio is set to 1. For 239 observations, the exploitation ratio cannot be calculated, as the ICES advice is equal to zero while the TAC is larger than zero. This leaves us with an unbalanced panel consisting of 162 zone-species combinations, 97 zones, and 40 species for 2005–2020, with a total of 1,659 observations in our main regression.

Our explanatory variables are the weights, w_{csz}, for country c, species s, and zone z. The countries included in the dataset are Belgium (BEL), Germany (DEU), Denmark (DNK), Spain (ESP), Estonia (EST), Finland (FIN), France (FRA), the UK (GBR), Ireland (IRL), Lithuania (LTU), Latvia (LVA), the Netherlands (NLD), Poland (POL), Portugal (PRT), and Sweden (SWE). We also include two non-member states, Faroe Islands (FRO) and Norway (NOR), in the sensitivity analysis.[45]

While according to the principle of relative stability country weights should be constant there is, in practice, some variation. The mean deviation from constant weights varies between the countries, from a minimum of 0.0003 to a maximum of 0.0195 with an overall average of about 0.0057, to be compared with average country weights (or TAC shares) between 0.002 and 0.186 (see Table A1 and Table A2 in Appendix A). One reason for varying weights is rounding effects for small total catches measured in integer tonnes. In particular, this may happen for a country entitled to only a small share of an agreement; if the total TAC is sufficiently small, the country may get a zero quota. Further, third countries, such as Norway and Faroe Islands, are sometimes

[45] Two countries were excluded from the data because of a lack of observations. The first one is Russia, with a total of three observations. The second is Greece, which is never active in more than one zone-species combination per year. Most of Greece's fishing opportunities are in the Mediterranean Sea, where TACs generally are not used, and, thus, are not included in our dataset. The Faroe Islands is an autonomous nation within the Danish Kingdom and has opted to remain outside of the EU. Via the EEA (European Economic Area) agreement, Norway is part of the European single market and subject to a large fraction of EU law.

included, and sometimes not, in the Council Regulations. In our main specification, we fix the weights at the average value over the 16-year period; in an alternative specification, we allow the weights to vary between years.[46]

5.1 Descriptive statistics

Figure 1 shows the annual TACs and ICES advice for our period of observation, measured in thousands of tonnes. Figure 1 show that both the TACs and ICES advice have followed an upward trend for most of the period, with a peak in 2017 and a subsequent decrease. Between 2019 and 2020 the TAC changes little while the ICES advice increases, resulting in the quantity-weighted average exploitation ratio (defined as aggregated yearly TACs divided by aggregated yearly ICES advice) falling below 1 for the first time during our period of observation (Figure 2).

Figure 2 shows the annual excess TAC and the quantity-weighted average exploitation ratio for the 2005–2020 period. Excess TAC measures the difference between the aggregated TACs and the aggregated ICES advice for each year, in thousands of tonnes, and is displayed on the left axis, while the quantity-weighted average of the exploitation ratio is displayed on the right.

According to Figure 2 total excess TAC and the quantity-weighted average of the exploitation ratio decreased during the period. The widened gap between the two measures between 2012 and 2018 is consistent with generally higher TACs and ICES advice during the same period, as shown in Figure 1.

[46] In our main estimation and several robustness checks, only EU member countries are included. For these estimations, the weights are constructed as the share of the TAC for EU. However, in the estimations where the Faroe Islands and Norway also are included, all weights are constructed as the share of the total TAC.

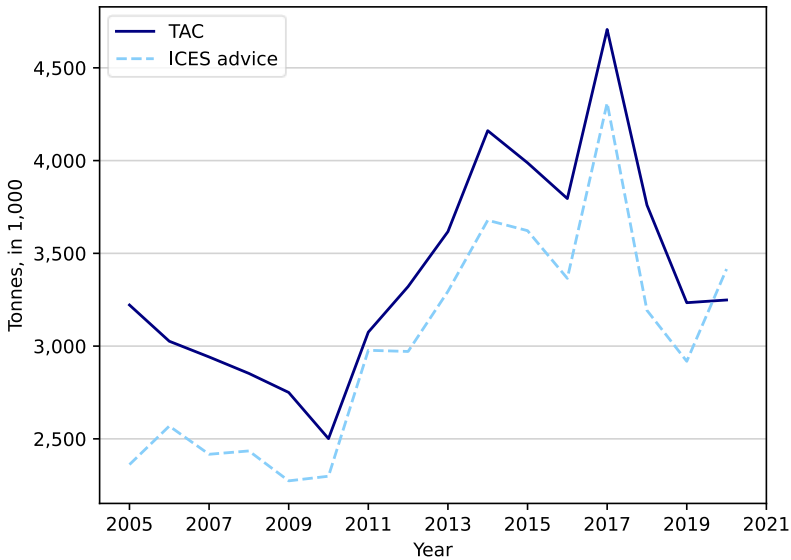

Figure 1: Total TAC and ICES advice by year

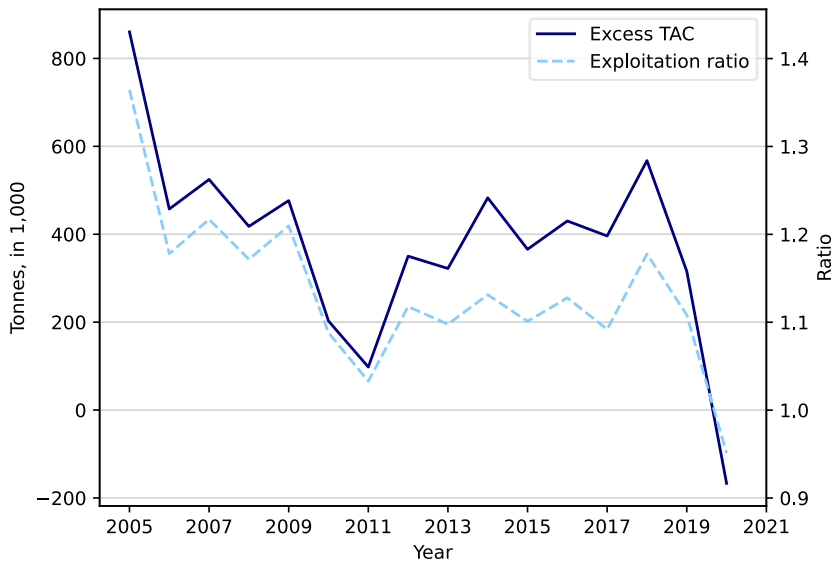

Figure 2: Excess TAC and exploitation ratio by year

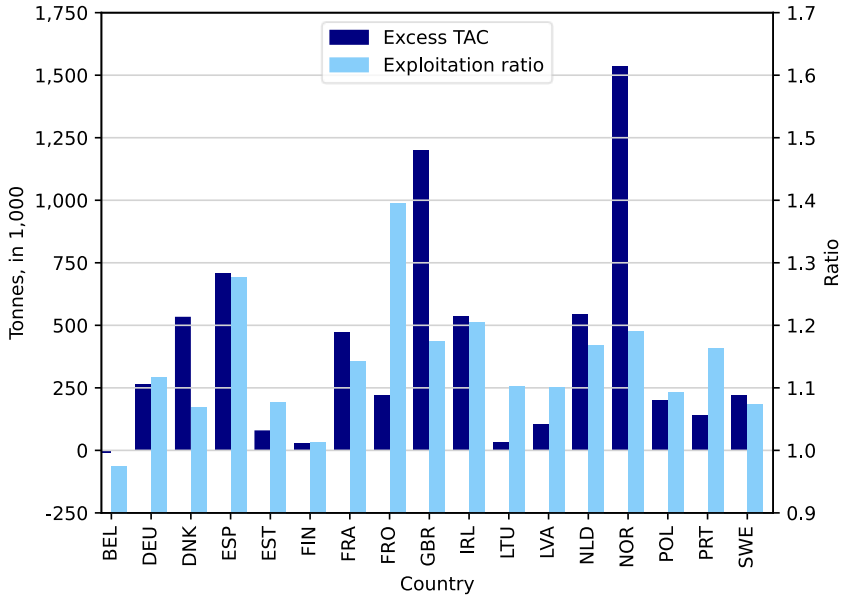

Figure 3: Excess TAC and exploitation ratio aggregated by country, 2005–2020

Figure 3 shows the aggregate excess TAC in tonnes and the quantity-weighted average exploitation ratio per country, for all zone-species combinations and years. Figure 3 show that countries with large total quotas can have high excess TACs in tonnes without necessarily having high quantity-weighted exploitation ratios. Among EU countries, the UK (EU member until early 2020) had the highest total excess TAC, about 1,200,000 tonnes, followed by Spain at about 700,000 tonnes and several other member countries with around 500,000 tonnes. Non-EU Norway's total excess TAC was just over 1,500,000 tonnes during the period.

Focusing on the quantity-weighted exploitation ratio, Spain, Ireland, the UK, the Netherlands, and Portugal, in descending order, had the highest ratios among EU members. Overall, the (non-EU) Faroe Islands had the highest exploitation ratio, at almost 1.4, but relatively low total excess TAC in absolute values, below 250,000 tonnes. The Faroe Islands are involved in relatively few agreements, 101 in total, and have the second-lowest average TAC share, as shown in Table 1.

Table 1 provides the total number of agreements in which each country participates and, out of these, the number of agreements for which the ICES advice is not to fish. Regarding agreements with advice not to fish, the "Main" column only includes agreements that are included in our main regression, where both the TAC and the advice are not to fish. The column called "All" also includes agreements with non-zero TACs that are excluded from the main regressions. Table 1 further shows the unweighted average for each country's TAC share, exploitation ratio, and excess TAC in tonnes for the zone-species combinations for which the country has a share.[47]

Table 1 show that France and the UK have TAC shares in the largest number of agreements – more than 1,000 each – while countries with coast exclusively in the Baltic Sea – Poland, Finland and the three Baltic states – partake in about 200 or fewer agreements. It is also noteworthy that Denmark, the UK, Spain, Portugal, France, and Ireland are entitled to between 20 and 40 percent, on average, of the TACs for the zone-species combinations where they have fishing rights. According to our assumptions, a large share of the TACs gives the six countries significant influence over the outcome of the negotiations. In contrast, Germany, Belgium, and the Netherlands, with similar number of agreements, have much lower average TAC shares, only 6–10 percent, and consequently less influence on the outcomes.

[47] For many countries the average exploitation ratios reported in Table 1 are higher than those shown in Figure 3, suggesting that these countries have many fishing quotas for zone-species combinations with high exploitation ratios and small total catches.

Table 1: Number of agreements, tonnes per agreement, and excess TAC per country

Country	Number of agreements	Number of agreements with advice not to fish		Average TAC share per agreement	Average exploitation ratio per agreement	Average excess TAC per agreement (tonnes)
		Main	All			
BEL	639	31	103	0.057	1.282	1,995.711
DEU	877	46	158	0.076	3.025	5,135.760
DNK	709	38	121	0.404	2.960	5,056.145
ESP	627	58	139	0.289	1.336	6,394.123
EST	173	11	47	0.075	1.139	9,632.328
FIN	127	0	6	0.234	1.185	4,269.244
FRA	1,154	78	247	0.247	1.623	4,174.325
GBR	1,010	85	235	0.291	1.650	4,517.168
IRL	608	66	197	0.211	1.987	5,775.866
LTU	131	2	28	0.022	1.220	12,632.569
LVA	146	9	13	0.099	1.195	12,494.153
NLD	668	39	126	0.102	1.255	6,609.616
POL	207	11	29	0.096	1.143	7,824.227
PRT	327	27	58	0.251	1.336	7,823.105
SWE	504	18	84	0.113	3.647	5,699.422
FRO	101	4	7	0.031	1.263	31,559.059
NOR	299	5	22	0.257	1.264	15,002.607
TOT	1,659	104	343	-	2.264	3,677.342

Note: The number of agreements is the total number of TAC agreements the country is part of during the period. The number of agreements with advice not to fish is the number of TAC agreements the country is part of where the scientific advice is not to fish anything and which are included in our main regression, shown in the “Main” column, or overall, in the columned titled “All”. The average TAC share per agreement is the mean country weight when the country is part of a TAC agreement. The average exploitation ratio per agreement and average excess TAC per agreement is the average exploitation ratio and excess TAC in tonnes, respectively, in zone-species combinations where the country has a share of the TAC. The countries are indicated by the three-letter abbreviation, where BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = United Kingdom, IRL = Ireland,

LTU = Lithuania, LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, SWE = Sweden, FRO = Faroe Islands, and NOR = Norway.

6 Results

After applying the relative-shift framework, we check whether there still is multicollinearity between the country weights, by calculating VIFs (variance inflation factors), presented in Table 2.

Table 2: Test of multicollinearity between country weights (VIF)

Country weight	Without any pairs (1)	With pairs (2)
BEL	1.12	1.12
DEU	1.37	1.22
DNK	1.29	1.29
ESP	1.18	1.17
EST	17.45	-
FIN	1.26	1.08
FRA	1.24	1.21
GBR	1.24	1.24
IRL	1.14	1.14
LTU	5.22	-
LVA	17.45	-
NLD	1.14	1.13
POL	5.68	-
PRT	1.13	1.13
SWE	1.59	1.58
EST + LVA	-	1.07
LTU + POL	-	1.41
Average	3.97	1.21

Note: The country weights, w_{csz}, are represented by the three-letter abbreviation according to ISO 3166 alpha 3, where BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = the United Kingdom, IRL = Ireland, LTU = Lithuania, LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, SWE = Sweden, EST + LVA = Estonia paired with Latvia, and LTU + POL = Lithuania paired with Poland.

Column 1 in Table 2 show that there is still an issue of multicollinearity in our data when the relative-shift framework is applied. To further handle the multicollinearity problem, we merge countries with close-to-perfect relationships. Table B1 (see Appendix B) shows a 96.2 percent correlation between the country weights for Estonia and Latvia and an 86.4 percent correlation for Lithuania and Poland. Thus, we pair Estonia with Latvia and Lithuania with Poland. As shown in column 2, after pairing Estonia and Latvia as well as Lithuania and Poland, the VIF values are well below 5 and 10, commonly used as rules of thumb for identifying inconsequential and serious multicollinearity, respectively.

Table 3 reports the results from our fixed-effects model. Column 1 reports the results for our main model, i.e., with the pairing of Estonia and Latvia as well as the pairing of Lithuania and Poland. The results without any country pairs are presented in column 2, for comparison. Our interpretation of the parameter is that it approximates the respective country's policy position. Hence, positive coefficients indicate policy positions above scientific advice, while negative coefficients indicate policy positions below.

The two model estimates reported in Table 3 yield fairly similar results. Germany has a significant and negative parameter in both estimations while the UK, Ireland, and Portugal are positive and significant. Further, Poland has a positive and significant coefficient, both when paired with Lithuania in column 1 and when estimated separately. In order to interpret these results, we raise natural e to the coefficient. For example, column 1's parameter estimates for Germany, -0.659, corresponds to a policy position of $e^{-0.659} \approx 0.517$. The interpretation is that Germany would prefer TACs to be set at just above 50 percent of the scientific advice. Similarly, our parameter estimates suggest that Ireland, Portugal, and the UK prefer TACs to be 89, 62, and 33 percent higher than the ICES advice, respectively. Lastly, the pairing of Lithuania and Poland seems to aim for a TAC roughly twice as high as the ICES recommendation.

Table 3: Fixed-effects model

Explanatory variables	With pairs (1)	Without any pairs (2)
BEL	-0.068 (0.163)	-0.043 (0.165)
DEU	-0.659* (0.356)	-0.838** (0.385)
DNK	0.204 (0.131)	0.212 (0.132)
ESP	0.118 (0.136)	0.106 (0.136)
EST	-	-2.602*** (0.963)
FIN	0.093 (0.137)	0.264* (0.146)
FRA	0.013 (0.144)	0.038 (0.142)
GBR	0.287** (0.133)	0.300** (0.133)
IRL	0.638*** (0.148)	0.663*** (0.150)
LTU	-	-9.385* (5.423)
LVA	-	2.720*** (0.856)
NLD	0.077 (0.153)	0.128 (0.156)
POL	-	2.326*** (0.815)
PRT	0.484*** (0.171)	0.506*** (0.172)
SWE	0.226 (0.175)	0.255 (0.179)
EST + LVA	0.214 (0.132)	-
LTU + POL	0.765* (0.394)	-
Year & Species FE	Yes	Yes
Observations	1,659	1,659

Adjusted R^2	0.542	0.544
Adjusted R^2 within	0.04	0.044

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses. The explanatory variables are the weights for different countries in each agreement. The three-letter abbreviation shows which country the weight corresponds to: BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = United Kingdom, IRL = Ireland, LTU = Lithuania, LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, and SWE = Sweden. For the variables including a +, we pair two countries together as one.

Portugal's, the UK's, and Ireland's aggressive policy positions are consistent with the findings of Carpenter et al. (2016). Their study reports that these three countries are among the countries with the highest aggregated excess TACs, either in percentage or tonnes. To the best of our knowledge, however, policy positions have not been previously estimated from data on negotiation outcomes, and similar findings based on aggregated values have not been reported for Lithuania, Poland, or Germany in the existing literature.

6.1 Sensitivity Analysis

In this section, several sensitivity analyses are reported in Table 4 and 5. As our descriptive statistics indicate outliers, showcased by a large maximum exploitation ration and difference between the mean and median (see Table A1 in Appendix A), we test whether they affect our results. To do this, we conduct a 98 percent winsorization of the dependent variable, reported in column 1.[48]

Our main regressions are based on final agreements. However, member states can be assumed to argue for their interest to the same degree when the original agreements and the amendments are negotiated.

[48] A 98 percent winsorization means that observations below the 1st percentile are set equal to the 1st percentile and observations above the 99th percentile are set equal to the 99th percentile. This leads to a reduction of our maximum value for the (logged) dependent variable, from 6.522 to 2.051 and an increase in our minimum value from -6.263 to -2.223.

Therefore, we also estimate policy positions from original agreements. Results are reported in column 2 in Table 4.

In column 3 in Table 4 we weigh observations according to the size of the catches. There are two justifications for this. Firstly, the assessments of fish stocks may be more reliable for plentiful species. Thus, the ICES' advice could be more reliable, and the outcomes of the quota negotiations could be better aligned with the member states' policy positions. Secondly, it is reasonable to assume that countries not only use more of their power on stocks with a larger TAC ratio but also on plentiful stocks. To account for these possible effects, we weigh the observations with the square root of the ICES advice.

Columns 1 and 2 in Table 4 show that the UK, Ireland, Portugal, and the pairing of Lithuania and Poland remain positive and significant after 98 percent winsorization and when original agreements are used. Germany, however, no longer has a policy position that is significantly different from 1 (i.e., from the ICES recommendation). After winsorizing, the coefficient for the UK decreases in significance and in magnitude. Ireland and Portugal remain highly significant but also decrease in magnitude, while Lithuania and Poland's coefficient increases in both size and significance. Thus, the extreme values in our data do not qualitatively change our results but seem to amplify coefficients for some countries.

According to column 2 in Table 4, the main results are robust for some countries when policy positions are estimated based on the original agreements. The coefficient for Lithuania and Poland remains approximately the same as in our main estimate. However, the coefficients for the UK, Ireland, and Portugal increase, possibly suggesting that countries pursue more extreme policy positions in the first round of negotiations. Another interesting finding is that Denmark, Sweden, and the pairing of Estonia and Latvia have significant, and positive, policy positions for the original agreements. According to this estimation, Denmark has a policy position corresponding to a 29 percent increase in TACs, compared to the advice from ICES, while Sweden's correspond to a 46 percent increase, and Estonia and Latvia correspond to a 37 percent increase.

Table 4: Sensitivity analysis, three fixed-effects models

Explanatory variables	Winsorization	Original agreements	Weighted regression
	(1)	(2)	(3)
BEL	-0.065	-0.040	-1.239
	(0.158)	(0.172)	(1.137)
DEU	-0.434	-0.552	0.264
	(0.265)	(0.365)	(0.173)
DNK	0.180	0.256*	0.196*
	(0.124)	(0.138)	(0.105)
ESP	0.121	0.200	0.124
	(0.133)	(0.142)	(0.101)
FIN	0.086	0.188	0.144
	(0.133)	(0.143)	(0.108)
FRA	0.085	0.074	0.088
	(0.129)	(0.149)	(0.113)
GBR	0.249*	0.382***	0.114
	(0.129)	(0.139)	(0.111)
IRL	0.574***	0.699***	0.014
	(0.143)	(0.152)	(0.128)
NLD	0.072	0.144	-0.042
	(0.147)	(0.161)	(0.212)
PRT	0.403***	0.565***	0.023
	(0.151)	(0.175)	(0.127)
SWE	0.186	0.381**	-0.101
	(0.173)	(0.186)	(0.178)
EST + LVA	0.198	0.316**	0.197*
	(0.129)	(0.139)	(0.104)
LTU + POL	0.827**	0.765*	0.257
	(0.330)	(0.404)	(0.237)
Year & Species FE	Yes	Yes	Yes
Observations	1,659	1,586	1,555
Adjusted R^2	0.336	0.542	0.462
Adjusted R^2 within	0.0418	0.0396	0.0345

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses. The explanatory variables are the weights for different countries in each agreement. The three-letter abbreviation shows which country the weight corresponds to: BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = United Kingdom, IRL = Ireland, LTU = Lithuania,

LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, and SWE = Sweden. For the variables including a +, we pair two countries together as one.

When using weighted regression (column 3 in Table 4), only two country weights are significant – those of Denmark and the pairing of Estonia and Latvia. Thus, none of the statistically significant policy positions in our main regression remain significant in the weighted regression.

In our main model, we assume that the country weights for each zone-species combination are stable over time, according to the principle of relative stability. To test to which extent this assumption influences our results, we re-estimate the model with (contemporaneous) yearly TAC shares as weights. Results are reported in Table 5. Estimates in columns 1 and 2 are based on actual contemporaneous TAC shares and hence exclude observations with a TAC equal to zero. In columns 3 and 4 we imputed values for observations with zero TACs. For these observations we use the average TAC shares from our main estimates in column 3 and the average TAC share of the total TAC in column 4. Further, columns 1 and 3 only include EU countries, while columns 2 and 4 also include the Faroe Islands and Norway.

As shown in columns 1 and 2 in Table 5, several countries' coefficient gain significance and increase in magnitude when using yearly weights without imputed values. Similar results are shown in column 4, when we impute constant weights for observations with TACs equal to zero and control for the non-EU members Norway and the Faroe Islands. When estimating policy positions for EU members only and imputing values when TACs are equal to zero, as reported in column 3, we obtain results similar to those of our main models (Table 3).

According to Table 5, the Faroe Islands has a policy position similar to the most aggressive EU members, while Norway's parameter estimates are insignificant. As noted above, including the two non-members in the model increases the estimated coefficients for several EU members, relative to the main results.

Table 5: Sensitivity analysis, yearly country weights

Explanatory variables	Without imputed values		With imputed values	
	(1)	(2)	(3)	(4)
BEL	-0.025	-0.000	-0.084	0.135
	(0.144)	(0.152)	(0.174)	(0.360)
DEU	-0.808***	-0.829***	-0.631*	-0.453
	(0.278)	(0.287)	(0.337)	(0.455)
DNK	0.312***	0.355***	0.209	0.447
	(0.082)	(0.096)	(0.130)	(0.345)
ESP	0.173**	0.212**	0.116	0.351
	(0.081)	(0.088)	(0.135)	(0.337)
FIN	0.142*	0.156*	0.084	0.296
	(0.085)	(0.093)	(0.136)	(0.338)
FRA	0.132	0.170	0.059	0.289
	(0.097)	(0.109)	(0.142)	(0.346)
GBR	0.317***	0.387***	0.228*	0.490
	(0.085)	(0.085)	(0.135)	(0.323)
IRL	0.703***	0.733***	0.626***	0.846**
	(0.105)	(0.113)	(0.146)	(0.342)
NLD	0.201*	0.244**	0.134	0.361
	(0.112)	(0.122)	(0.151)	(0.345)
PRT	0.522***	0.562***	0.473***	0.706**
	(0.139)	(0.144)	(0.169)	(0.347)
SWE	0.144	0.338*	0.182	0.516
	(0.184)	(0.194)	(0.180)	(0.333)
EST + LVA	0.257***	0.295***	0.213	0.441
	(0.080)	(0.085)	(0.132)	(0.330)
LTU + POL	0.888***	0.845**	0.690**	0.869*
	(0.332)	(0.358)	(0.331)	(0.476)
FRO	-	0.661**	-	0.892*
		(0.284)		(0.458)
NOR	-	0.044	-	0.200
		(0.109)		(0.344)
Year & Species FE	Yes	Yes	Yes	Yes
Observations	1,659	1,659	1,659	1,659
Adjusted R^2	0.546	0.548	0.540	0.542
Adjusted R^2 within	0.0471	0.0519	0.0347	0.0390

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses. The explanatory

variables are the weights for different countries in each agreement. The three-letter abbreviation shows which country the weight corresponds to: BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = United Kingdom, IRL = Ireland, LTU = Lithuania, LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, SWE = Sweden, FRO = Faroe Islands, and NOR = Norway. For the variables including a +, we pair two countries together as one.

7 Conclusion

Our main results, shown in column 1 of Table 3, show positive and significant estimates for the UK, Ireland, Portugal, and the paring of Lithuania and Poland, indicating that these countries aim for catches above the scientific advice. In contrast, we find a negative and significant coefficient for Germany, suggesting a policy position corresponding to TACs below ICES' advice. Specifically, our findings indicate that Germany has a policy preference for TACs only about half the size of the advice, while the UK, Ireland, and Portugal would prefer TACs to be about 30, 90, and 60 percent higher than the ICES advice, respectively. However, the most aggressive policy positions, according to our estimates, are those of Lithuania and Poland. Due to multicollinearity, we estimate a single parameter for the two countries, suggesting that they aim for TACs more than double those of the ICES advice.

These results are stable under most of our modeling assumptions, except for Germany, which only stays significant in the sensitivity analysis when yearly weights are used. Some of the regressions also suggest that Denmark, Sweden, and the pairing of Estonia and Latvia prefer catches above the scientific advice. Looking at policy positions for non-EU members, we find that the Faroe Islands aims for TACs well above the scientific advice.

For Ireland, Portugal, and the UK, our results align with previous work that focuses on aggregated excess TAC, in tonnes or as share of the aggregated ICES advice (e.g., Carpenter et al., 2016). However, this is not the case for some of the other countries. While Carpenter et al. (2016) find that Spain and the Netherlands are among the three countries with the highest aggregated excess TAC as percentage of aggregated ICES advice, our analysis finds that their policy positions do not significantly diverge from the ICES advice. Moreover, contrary to the descriptive

statistics discussions in previous literature, we find that policy positions for Lithuania and Poland are above the ICES advice, while those for Germany are below the advice.

According to our preferred model, Germany has a significant moderating effect on the exploitation ratio, despite an average TAC share (according to Table 1) of only 7.6 percent. We interpret the TAC share as a combined measure of power and saliency and hence as a proxy for the country's influence in negotiations. Other researchers have used more complex measures of influence, such as power indices reflecting institutional details. Starr (2023) applied voting power indices to the EU's fisheries policy based on voting weights in the Council, under the assumption that member countries without coasts on the relevant sea abstain from voting. He found that Germany, given these assumptions, was positioned to exert strong influence over TAC negotiations.

Our study provides a foundation for further research on policy positions in TAC negotiations. A relevant avenue for future work is examining whether national policy positions remain stable when EU's combined TAC share, relative to the share for non-EU countries, is renegotiated, as happened following Brexit.[49] Investigating potential shifts in negotiation strategies and their long-term implications could offer valuable insights into how political and economic changes influence quota-setting dynamics.

Further, the method proposed in this study more generally offers a way to gain insight into other instances of behind-closed-door negotiations. It is often said that politicians prioritize short-term goals over long-term objectives, such as sustainable fishing. Increased transparency – for example regarding TAC negotiations – could sway politicians towards a more responsible policy. Our method will not be applicable to all instances of short-termism, but it can be useful for reoccurring negotiations with known outcomes and where reasonable assumptions can be made concerning power and saliency.

[49] See Jensen et al. (2015) for a discussion of renegotiations following the 2008–2012 "Mackerell War".

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Appendix A: Descriptive statistics

Table A1: Descriptive statistics, dependent and independent variables

Variable	Mean	Median	Min	Max	Std. Dev.	Skewness	Kurtosis	N	N if positive	Mean if positive
Excess TAC (tonnes)	3,677	82.13	-143,511	480,078	23,068	7.995	133.3	1,659	982	8,148.4
R (ratio)	2.264	1.070	0.003	680	21.74	27.78	803.2	1,659	1,659	2.264
r (ln ratio)	0.146	0.068	-6.263	6.522	0.763	-2.748	40.62	1,659	982	0.403
BEL	0.022	0	0	0.625	0.075	5.922	43.20	1,659	631	0.059
DEU	0.043	0.002	0	0.639	0.104	4.032	20.69	1,659	875	0.081
DNK	0.191	0	0	1	0.318	1.492	3.651	1,659	710	0.445
ESP	0.110	0	0	0.968	0.237	2.422	7.766	1,659	623	0.292
EST	0.008	0	0	0.461	0.048	8.535	79.90	1,659	173	0.075
FIN	0.018	0	0	0.898	0.107	7.137	54.66	1,659	127	0.234
FRA	0.177	0.046	0	0.940	0.258	1.460	3.842	1,659	1,150	0.256
GBR	0.186	0.077	0	0.976	0.256	1.484	4.207	1,659	1,009	0.306
IRL	0.078	0	0	0.909	0.173	3.012	12.29	1,659	604	0.215
LTU	0.002	0	0	0.056	0.008	5.045	29.13	1,659	131	.022
LVA	0.009	0	0	0.539	0.055	8.759	83.20	1,659	146	0.099
NLD	0.044	0	0	0.797	0.122	4.008	20.71	1,659	673	0.109
POL	0.012	0	0	0.271	0.047	4.427	22.29	1,659	207	0.097
PRT	0.05	0	0	0.982	0.163	3.996	18.71	1,659	331	0.248
SWE	0.04	0	0	0.702	0.101	3.445	17.03	1,659	509	0.129
FRO	0.002	0	0	0.098	0.01	6.568	50.59	1,659	101	0.031
NOR	0.046	0	0	0.902	0.145	3.897	18.91	1,659	299	0.257

Note: The three-letter abbreviation shows which country the weight corresponds to. BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = United Kingdom, IRL = Ireland, LTU = Lithuania, LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, SWE = Sweden, FRO = Faroe Islands, and NOR = Norway. The statistics are average value (Mean), median, minimum (Min), maximum (Max), standard deviation (Std. Dev.), skewness, kurtosis, number of observations (N), number

of observations if the value is positive (N if positive), and the average value if positive (Mean if positive).

Table A2: The difference between constant and yearly weights (in absolute terms)

Country	Minimal difference	Mean difference	Median difference	Maximal difference	Percentage of agreements with difference
BEL	0	0.002	0	0.2338	0.3635
DEU	0	0.0049	0	0.269	0.4979
DNK	0	0.0122	0	1	0.4031
ESP	0	0.0069	0	0.9603	0.363
EST	0	0.0004	0	0.0157	0.1027
FIN	0	0.0008	0	0. 0667	0.0701
FRA	0	0. 0195	0.00004	0.8219	0.6681
GBR	0	0.017	0. 00002	0.9626	0.5896
IRL	0	0.0103	0	0.9091	0.3825
LTU	0	0.0003	0	0.0854	0.0806
LVA	0	0.0005	0	0.0398	0.079
NLD	0	0.0015	0	0.3305	0.3936
POL	0	0.0143	0	0.1061	0.1164
PRT	0	0.0032	0	0.8469	0.1855
SWE	0	0.0045	0	0.7019	0.2987
FRO	0	0.0018	0	0.9022	0.055
NOR	0	0.0095	0	0.9022	0.1665

Note: The three-letter abbreviation shows which country the weight corresponds to. BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = United Kingdom, IRL = Ireland, LTU = Lithuania, LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, SWE = Sweden, FRO = Faroe Islands, and NOR = Norway.

Appendix B: Correlation matrix

Table B1: Correlation matrix (constant) country weights

	BEL	DEU	DNK	ESP	EST	FIN	FRA	GBR
BEL	1							
DEU	-0.09	1						
DNK	-0.132	-0.074	1					
ESP	-0.13	-0.106	-0.274	1				
EST	-0.049	0.001	-0.082	-0.073	1			
FIN	-0.05	-0.042	-0.076	-0.074	0.126	1		
FRA	0.057	-0.094	-0.375	-0.057	-0.1	-0.115	1	
GBR	0.072	-0.036	-0.273	-0.259	-0.118	-0.121	-0.072	1
IRL	-0.0002	-0.142	-0.239	-0.162	-0.073	-0.075	0.027	0.051
LTU	-0.066	0.084	-0.017	-0.071	0.197	0.103	-0.084	-0.149
LVA	-0.047	-0.014	-0.063	-0.07	0.962	0.03	-0.093	-0.112
NLD	0.13	0.066	-0.037	-0.148	-0.06	-0.06	-0.148	-0.015
POL	-0.077	0.267	-0.024	-0.042	0.207	0.103	-0.16	-0.166
PRT	-0.091	-0.038	-0.182	0.237	-0.045	-0.051	-0.151	-0.188
SWE	-0.098	0.04	0.302	-0.181	0.067	0.206	-0.261	-0.259

	IRL	LTU	LVA	NLD	POL	PRT	SWE
IRL	1						
LTU	-0.092	1					
LVA	-0.071	0.239	1				
NLD	0.001	-0.08	-0.058	1			
POL	-0.114	0.864	0.204	-0.091	1		
PRT	-0.127	-0.067	-0.047	-0.108	-0.061	1	
SWE	-0.169	0.348	0.073	-0.106	0.369	-0.12	1

Note: The three-letter abbreviation shows which country the weight corresponds to. BEL = Belgium, DEU = Germany, DNK = Denmark, ESP = Spain, EST = Estonia, FIN = Finland, FRA = France, GBR = United Kingdom, IRL = Ireland, LTU = Lithuania, LVA = Latvia, NLD = Netherlands, POL = Poland, PRT = Portugal, SWE = Sweden, FRO = Faroe Islands, and NOR = Norway.

ESSAY III

Lobbying for depletion?

Examining lobbying success in fishing quota negotiations in the Baltic Sea area

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Abstract
Although the European Union (EU) set a target to achieve sustainable fisheries by 2020, the state of fish stocks in the Baltic Sea has continued to deteriorate. Lobbying is a potential but unexplored aspect, with informational lobbying being the most prevalent form of lobbying in the EU. I compiled a dataset linking interest group recommendations, scientific advice from ICES, TAC proposals from the European Commission, and final TACs for the period 2015–2025. This study examines how interest groups' lobbying success, in terms of preference attainment, is influenced by interest group type, recommendation type, whether the ICES advice deviates more than 20 percent from the status quo, and the level of conflict. I find that fisheries have a high degree of lobbying success, relative to other interest groups, when the scientific advice is more than 20 percent below the previous year's final TAC and the level of conflict is high.

Keywords: Fisheries Management; European Union; Interest Groups; Informational Lobbying

JEL-codes: D72; Q22; Q28

1 Introduction

Overfishing represents a significant global challenge, and while unsustainable fishing has generally decreased in European Seas, the state of the Baltic Sea stocks has worsened (Altmayer, 2025). Altmayer (2025) argues that overexploitation is one of several reasons for the environmental deterioration of the Baltic Sea. Even though management measures have been taken, several stocks in the Baltic Sea are fished above sustainable levels (ICES, 2022).[50] A potential but unexplored aspect of European fisheries management is lobbying.

Informational lobbying is the most prevalent form of lobbying in the EU, reflecting the fact that interest groups typically hold superior issue-specific knowledge compared to policymakers, who often face significant constraints in terms of time, staff capacity, and technical expertise. Interest groups can utilize this informational asymmetry to gain legitimate access to the policymaking process, thereby increasing their influence by providing relevant information (Chalmers, 2013a).

Ahead of the yearly TAC negotiations, the EU decision-makers seek information on sustainable fishing quotas, both in terms of sustainable stock and a viable fishing sector. As part of this decision-making process, interest groups have been granted formal consultative roles through advisory councils. For the Baltic Sea, the interest group advisory council is the Baltic Sea Advisory Council (BSAC). In this study, I examine the lobbying success of interest groups within BSAC.

I have collected a unique dataset containing clearly stated quota recommendations from interest groups within BSAC, making it possible to analyze information from interest groups to politicians, which is often

[50] Fishing above sustainable levels is here defined as fishing above F_{MSY}, which is the case for both cod stocks, sprat, and most herring stocks, except for Gulf of Riga herring (ICES, 2022). F_{MSY} indicates the fishing mortality that gives maximum yield long-term, under current conditions (ICES, 2023).

challenging to obtain.[51] Bombardini and Trebbi (2020) argue that the challenge of finding evidence of information exchange between interest groups and policymakers, as well as the informational needs of policymakers, is the reason that quid-pro-quo models have been favored over informational models in the economic lobbying literature.[52]

There is a long-standing debate on the influence of different interest groups on policymaking within the EU (Dür et al., 2015). While some scholars argue that the EU offers a more accessible arena for marginalized interests, such as pro-migrant advocates and environmental groups (Mazey, 1998; Geddes, 2000; Mazey & Richardson, 1992), others highlight the limited effectiveness of non-governmental organizations (NGOs) despite their access to decision-makers (Dür & De Bièvre, 2007). Meanwhile, business groups tend to maintain consistent involvement through inside lobbying and benefit from clearer incentives and member support.[53] Nevertheless, Dür and Mateo (2014) and Dür et al. (2015) suggest that EU policy outcomes shift toward citizen group preferences, particularly when public attention is high and change is favored over the status quo. This is further supported by De Bruycker and Colli (2023), who find that civil society organizations are more likely to achieve their preference than encompassing business groups and that congruence with public opinion positively affects preference attainment. Thus, this study contributes to the lobbying literature by further analyzing interest group influence, highlighting whether certain groups wield disproportionate power compared to others.

The novel data enable two methodological contributions. Firstly, previous literature on informational lobbying typically employs expert interviews and surveys to identify interest groups' policy preferences or

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[51] Even though these recommendations may not be the only way in which these groups communicate, inform, or attempt to influence the policy process, they provide a strong indication of their preferred outcome.

[52] In quid-pro-quo models, interest groups promise a reward to policymakers in exchange for a specific vote or to put forward a political proposal (Awad, 2024).

[53] Inside lobbying occurs when interest groups directly contact policymakers, such as through meetings, phone calls, or letters (Chalmers, 2013a).

assess their lobbying success (e.g., Bocse, 2021; Chalmers, 2013a; Mahoney, 2007). However, in this study, direct communication from interest groups is used, facilitating more exact estimations. Secondly, it is common to use a binary variable or, for example, three-value scores to estimate lobbying success (e.g., Chalmers, 2020; Junk & Rasmussen, 2019; Sebők & Kozák, 2021).[54] However, my dataset contains a continuous indicator of the preferences of interest groups. Furthermore, as the TAC negotiations are an annual process rather than a one-time occurrence, the dataset provides richer insights into interest groups' preference attainment.

To the best of my knowledge, the effect of informational lobbying on TACs has not previously been studied. Although a few studies within fishery management analyze aspects of lobbying, they do not assess whether interest groups affect policy output, such as the TACs.[55] There are also studies criticizing EU's TAC management system, some of which focus on deviations from scientific advice and the effects of such deviations. Cardinale and Svedäng (2008) argue that politicians have made a practice of ignoring scientific advice and prioritizing short-term effects. O'Leary et al. (2011) find that 68 percent of the TACs are set above scientific advice when examining 11 fish stocks between 1987 and 2011. Similar results are found by Froese et al. (2021) when analyzing 119 fish stocks in the Northeast Atlantic. Froese et al. (2021) find that only 34 percent of these stocks were sustainably fished and of sufficient size in 2018, and that one-third of the stocks were lower than the biologically safe limit.

Studying the effect of informational lobbying on fishing quotas can also shed light on the linkages between policymaking, interest groups'

[54] An example of using three-value scores assigns 0 for no objectives attained (no success), 1 for some but not all objectives attained (partial success), and 2 for all objectives attained (full success) (e.g., Mahoney, 2007).

[55] For example, Birchall and Sanchirico (2021) examine the welfare cost of commercial lobbying in New Zealand fisheries and find that lobbying leads to a redistribution of welfare from the public to firms, resulting in a minor total welfare cost.

influence, and resource management more generally. This sector offers unique opportunities to study the political processes, as there are yearly negotiations and TAC decisions, a relatively small number of actors, and the regulatory framework is straightforward. This setting makes it possible to trace the decision-making process and its outcomes in detail (Berkow, 2024).

To examine the impact of informational lobbying from interest groups within BSAC on the final TACs, I have compiled a dataset containing recommendations from BSAC, scientific advice from the International Council for the Exploration of the Seas (ICES), TAC proposals from the European Commission (the Commission), and the final TACs.[56] For each TAC, BSAC presents one collective recommendation (hereafter called main recommendation). However, interest groups that disagree with the collective recommendation can provide their own minority position. For most BSAC recommendations, especially after 2018, one or several minority positions are presented for each TAC. The dataset covers all TACs in the Baltic Sea between 2015 and 2025, and includes five species, 10 stocks, and 734 interest group recommendations.[57]

A fixed-effects model is used to estimate lobbying success, in terms of preference attainment. The preference attainment measurement assesses the extent to which the policy output aligns with, or diverges from, the preferences of interest groups. The model estimates how preference attainment is affected by the interest group type, recommendation type, whether the ICES advice deviates more than 20 percent from the status

[56] ICES is an intergovernmental marine science organization whose activities include data collection and advising policymakers.

[57] The species with Baltic Sea stocks are cod, herring, plaice, salmon, and sprat. For three of these species, their Baltic Sea TACs are divided into different zones, resulting in 10 stocks: western cod, eastern cod, western herring, central herring, Gulf of Bothnian herring, Gulf of Riga herring, plaice, main basin salmon, Gulf of Finland salmon, and sprat.

quo, and the level of conflict.[58] The model first estimates the effect of interest group type and recommendation type separately, and then combines them in the same model.

The findings indicate that interest group type is more important than recommendation type for lobbying success, as there is no longer a significant difference between main recommendations and minority positions when interest group type is being controlled for. Furthermore, when all control variables are included, the results suggest that when the level of conflict between the BSAC recommendations is low and the ICES advice deviates by less than 20 percent from or exceeds the status quo, OIGs and interest groups supporting minority positions have higher lobbying success. However, as the level of conflict increases between BSAC members' recommendations or if the ICES advice is more than 20 percent lower than the status quo, the lobbying success increases for fisheries.

The rest of the paper is organized as follows. Section 2 explains the process leading up to the annual TAC negotiations and the role interest groups play in this process. Sections 3 and 4 present the related literature on informational lobbying and lobbying in the EU. In Section 5, the methodological framework for measuring preference attainment is presented. After that, the data is presented in Section 6, followed by the results in Section 7. Lastly, in Section 8, the results are discussed and concluded along with future research and policy implications.

2 Institutional setting

Within the EU, fisheries are managed under the Common Fisheries Policy (CFP). A central legislative tool of the CFP is the EU multi-annual management plans (MAP) for fisheries. The Baltic Sea regulates eight stocks, covering the following three species: cod, herring, and sprat. The first objective of the MAP is to keep the exploitation of stocks

[58] Where the two interest group types are fisheries and other interest groups, and the recommendation types are main recommendation and minority positions. The level of conflict measures the difference between the lowest and the highest recommended.

at a level that maintains the population, so that Maximum Sustainable Yield (MSY) is produced (Regulation 2016/1139). Furthermore, to minimize the negative impacts of fishing activities, the MAP states that ecosystem-based management (EBM) should be implemented.[59] The MAP also includes a target focusing on fishing opportunities, which states that changes in fishing opportunities should be no more than 20 percent between consecutive years (Regulation 2016/1139). Another instrument of the CFP is the TACs, which are decided on for most commercial fish stocks. Figure 1 shows the annual process leading up to the final TAC decision for stocks in the Baltic Sea.

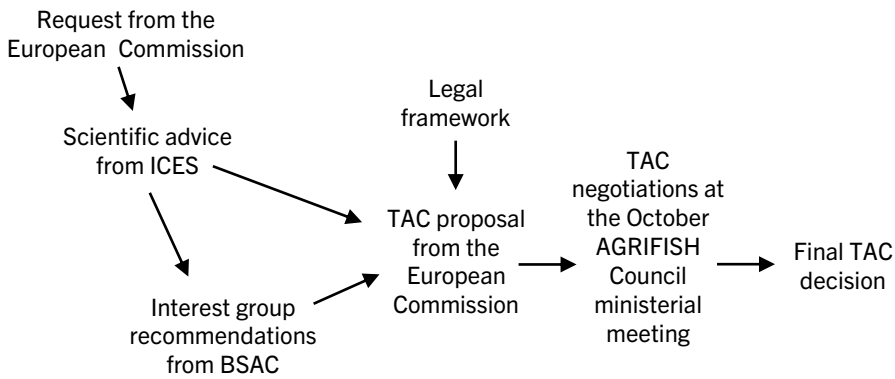

Figure 1: The yearly process for TACs in the Baltic Sea

Note: ICES is an abbreviation for the International Council for the Exploration of the Seas, BSAC for the Baltic Sea Advisory Council, and AGRIFISH for the Agriculture and Fisheries Council. Typically, the ICES advice is published in May, the BSAC recommendations in June/July, the TACs proposal in late August, and the final TACs are published in October/November each year.

[59] It is also stated in the MAP for the Baltic Sea, article 4(6), that fishing opportunities should be fixed, so that the probability of falling below B_{lim} is less than 5 percent. However, an ongoing court case related to the interpretation of this target was filed by Coalition Clean Baltic against the European Council in July 2024. See Case T-342/24 and Council of the European Union (2024) for more information. Furthermore, B_{lim} is a reference point below which there is a high risk of reduced recruitment for the stock (ICES, 2023).

The yearly process begins with a request from the Commission to ICES to provide scientific advice on fishing efforts for different zones and species within a given framework. For each specific species, zone, and year, one of two approaches is used: the precautionary approach or the MSY approach.[60] It is important to note that even though principles of EBM are integrated into the MSY reference point (ICES, 2020), broader environmental objectives, such as biodiversity, habitat integrity, and food webs, are not taken into account when creating the ICES advice (Berkow, 2024; EMFAF, 2023).[61] Thus, even though the ICES advice is scientific advice, sometimes based on EBM, it should not be interpreted as a recommendation based on broad environmental objectives. Instead, it has been argued that the advice is more of a prognosis, answering specific questions posed by the Commission (Baltic Sea Centre, 2024).

In the next step of the process, the ICES headline advice serves as a baseline for the interest group recommendations from BSAC. BSAC is a stakeholder-led advisory council that provides TAC recommendations and other recommendations related to fishery management in the Baltic Sea to the Commission and EU Member States. BSAC represents various interest groups, including fisheries, environmental groups, and sports and recreational fishing organizations. Sixty percent of the seats in the BSAC are reserved for fisheries, while the remaining 40 percent are reserved for OIG.[62] Within the TAC process, BSAC usually presents

[60] I do not distinguish between these approaches in my estimations. However, the precautionary approach is typically used instead of the MSY approach when there is limited stock-related data. See ICES (2023) for more information about the different ICES approaches.

[61] EBM is integrated into the reference points, by considering the current state of the ecosystem and how it affects stock dynamics (ICES, 2020).

[62] There are currently 18 fisheries in BSAC's Executive Committee and nine OIG. There are also three vacant seats, belonging to OIGs. See Table A1 in Appendix A for more information about the current members of the Executive Committee. Unfortunately, I do not have information about all historical members since 2015, but I have been informed that there have not been any drastic changes. Historical members identified from BSAC recommendations are presented in Table A2 in Appendix A.

one main recommendation for each TAC, i.e., their collective recommendation. The main recommendation is often complemented with one or several minority positions, from interest groups which does not agree with the main recommendation.[63] The main BSAC recommendation and minority positions are given in quantified values in tonnes or individuals.[64] Moreover, for each recommendation, there is also a reasoning, which discusses factors such as the ICES advice, the status of the stock, legal frameworks, environmental impacts, and socioeconomic impacts.

Based on the BSAC recommendations, the ICES' advice, and the legal framework, such as the MAP, the European Commission drafts and publishes a TAC proposal. This proposal serves as a starting point for the TAC negotiations. Furthermore, EU Member States can collect information to bring to the negotiation. The TACs for the Baltic Sea are decided during behind-closed-doors negotiations at the October Agriculture and Fisheries (AGRIFISH) Council ministerial meeting (Starr, 2023). During the year in which the TACs are valid, they can be revised by the European Council (Villasante et al., 2011). This is, however, uncommon for stocks in the Baltic Sea, with very few amendments between 2015 and 2025. Moreover, most amendments in the sample are textual amendments, focusing on which articles and regulations shall or shall not apply to the stock and whether there are any restrictions concerning when or where fishing is permitted.

3 Informational lobbying

Informational lobbying models study direct communication from interest group representatives. Exchange of information characterizes lobbying within the EU, since interest groups are often more well-informed than policymakers (Chalmers, 2013a). Interest groups can

[63] See Table B1 and B2 in Appendix B for an excerpt of the BSAC recommendations for 2018 and 2022, respectively. The tables illustrate how the quantitative recommendations from BSAC are presented, including four out of ten stocks.

[64] The BSAC recommendations, as well as the TACs, for salmon are presented as the number of individuals, while remaining stocks are presented in tonnes.

use this information asymmetry to gain access to and strategically present information to policymakers (Awad, 2024; Chalmers, 2013a). However, interest groups are still constrained by policymakers' own beliefs. Thus, the information cannot be used to completely manipulate or deceive decision-makers (Awad, 2024).

Using document analysis and expert interviews, Orach et al. (2017) find that during the 2013 CFP reform there was a significant demand for policy-relevant information. Thus, representatives from environmental interest groups provided information in exchange for attention from EU representatives, such as members of the European Parliament and Council ministers, aiming to influence problem framing and arguing for their resolutions. Some environmental interest groups mentioned that assistance to members of the European Parliament was important to gain influence, as they accepted support with information provision and interpretation. The high demand for policy-related information from both the European Commission and the European Parliament, combined with the complexity and technical nature of the CFP, further benefited these interest groups (Orach et al., 2017).

Although there is information demand from policymakers, Chalmers (2013b) explains that there is an information overload among interest groups in the EU. Thus, it is more important to verify the reliability of information than to gather new information, which is easier to do in strong-tie networks where trust between members has already been established. Interest groups can also use different information types and tactics. Chalmers (2013a) finds that the content of the information is less important than how the information is delivered to policymakers. Returning to the CFP reform in 2013, Orach et al. (2017) find that some of the activities used by environmental interest groups to inform decision-makers were summarizing policy proposals, providing recommendations and factsheets, inviting expert speakers, meetings, emails, and phone calls. Interest groups also emphasized the importance of a unified communication strategy, where an environmental coalition publishes joint reports to inform policymakers and the media (Orach et al., 2017).

4 Lobbying success

In the lobbying literature, especially the literature on informational lobbying, there are three main approaches to measure interest groups' influence or lobbying success. These are preference attainment, process tracing, and attributed influence. While preference attainment measures to what extent, if any, the policy output moves toward the actors' preferences, attributed influence measures perceived influence, either through interest groups' self-evaluations or experts' assessments of interest groups' influence (Klüver, 2011). Process tracing is a method to examine a process's intermediate steps to draw conclusions about how the process unfolded and whether, and in what way, it led to the outcome of interest (Bennett & Checkel, 2014). Within the lobbying literature, process tracing means that qualitative assessments are used to uncover which mechanism and activities increases interest group influence. In this study, lobbying success is measured through preference attainment. The advantages of the preference attainment approach are that it allows for objective assessments, without being biased by subjective perceptions, and is not dependent on observable interest group activities (Klüver, 2011). It should, however, be noted that higher lobbying success does not automatically mean that an interest group has a higher degree of influence. For example, interest groups may benefit from favorable outcomes without contributing to them or fail despite shaping policymakers' views. Still, examining lobbying success offers insight into who prevails in policy debates and why (Mahoney, 2007).

The EU is an important policy arena for interests that are marginalized at the national level (Mazey, 1998). Analyzing pro-migrant advocacy, Geddes (2000) finds that lobbying groups have focused on building alliances with sympathetic EU institutions, such as the Commission. These alliances may be the result of a strategic choice to participate and comply, rather than mobilizing against the EU, to secure EU resources. Furthermore, as the institutional context of the EU favors expertise, lobbying groups have been able to participate through consultation processes (Geddes, 2000).

Using surveys and in-depth case studies, Dür and De Bièvre (2007) find that NGOs have failed to attain favorable policy outcomes, although they have gained access to policymakers. The authors note several possible explanations for NGOs' lack of influence. For example, politicians care about a strong public backing, which might be more visible for businesses and trade associations, as they pursue the interests of actors that are directly and sometimes substantially affected by a policy. For NGOs, donors might not be as aware or concerned about their lobbying activities. Thus, while NGOs may dominate the initial stage of the process, using outside lobbying, it is hard to keep the momentum going through the process, and both supporters and representatives may abandon the issue.[65] Business groups, however, have members with clear incentives to monitor the process and utilize insider lobbying to provide information to policymakers during policy formulation and implementation (Dür & De Bièvre, 2007). Similarly, Bocse (2021) argues that business actors are generally better equipped to influence policy outcomes, compared to NGOs. Brokers are mentioned as particularly important to partake in information exchange with policymakers and advocacy through well-connected actors.

Bunea (2013) examines interest groups' preference attainment within environmental policy and finds that businesses directly affected by a policy have a higher degree of preference attainment than environmental NGOs and local authorities, possibly because business groups represent more concentrated interests.[66] Furthermore, Bunea (2013) finds

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[65] Outside lobbying tactics put pressure on policymakers by mobilizing citizens, such as through the launch of public campaigns, media utilization, and the organization of rallies or other events. In comparison, inside lobbying is when interest groups directly contact policymakers (Chalmers, 2013a).

[66] Mazey and Richardson (1992) also study environmental groups and find that, on the one hand, these groups have several strengths, such as the capacity for European-level coalitions through networking and umbrella organizations. Additionally, by structuring content to their advantage, they have the capacity to set the political agenda. On the other hand, the authors find several weaknesses of environmental groups. For example, their ability to influence policymakers

that interest groups that support preserving the status quo or are closer to the median of other groups' preferences tend to have higher preference attainment.

Dür et al. (2015) find that policy outcomes in the EU tend to shift away from business interests and closer to citizen groups' preferences. This trend is amplified as the level of conflict increases, i.e., the more the preferences of interest groups diverge from each other. The authors explain that business groups often want to defend the status quo, while citizen groups, allied with the Commission and the European Parliament, want to change it (Dür et al., 2015). De Bruycker and Colli (2023) find that civil society organizations are more likely to achieve their preference than encompassing business groups. However, there is no significant difference between civil society organizations and firms. Furthermore, De Bruycker and Colli (2023) find that congruence with public opinion positively affects preference attainment. However, the authors argue that this association is a result of policymakers listening to the public and, therefore, is unrelated to the actions of interest groups. De Bruycker and Hanegraaff (2024) find that lobbying groups with substantial economic means benefit the most from congruence with public opinion. Nevertheless, they do not find a significant difference between civil society organizations and industry groups (De Bruycker & Hanegraaff, 2024).

Mahoney (2007) examines 47 issues and 149 advocates in the EU and the US and finds that, in the EU, business associations as well as citizen groups and foundations are almost as likely to attain at least some level of success, i.e., the actor's goal was partially or fully attained. Moreover, the authors find that it is less likely for an advocate to be successful in their lobbying if the salience of an issue is generally high or if they are

might be restricted by their lobbying style, sometimes seen as confrontational. However, if they change their lobbying style, some supporters may choose to no longer back them. Another weakness, mentioned by Mazey and Richardson (1992), is their lack of resources or will to participate within and through the policy process, from the initial phase up to implementation.

active on several issues. However, advocates are more likely to succeed if they campaign for the status quo.

Concerning highly conflictual issues, Mahoney (2007) finds that while the level of conflict does not have a significant impact on lobbying success in the EU, it has a negative effect on lobbying success in the US. Comparing different types of interest groups, Dür et al. (2015) find that citizen groups and businesses have similar lobbying success at a low level of conflict. However, as the level of conflict increases, the lobbying success for businesses decreases. Thus, the level of conflict among actors seems to affect different interest groups to different degrees. Furthermore, having a uniform policy position among homogenous groups, with similar interests, has been found to be of more importance for lobbying success than uniform positions among heterogeneous groups (Truijens & Hanegraaff, 2021).

Using quantitative text analysis, Klüver (2011) finds that it is not the individual characteristics of an interest group that define its success but the characteristics of the lobbying coalition that the group is part of. More specifically, the study finds that larger coalitions have higher success compared to smaller coalitions working on the same issue. Thus, Klüver (2011) argues that a coalition can be regarded as one lobbying team. Similarly, Orach et al. (2017) find that coalitions are important to gain political influence when examining how interest groups achieved influence on the 2013 CFP reform.

5 Methodological framework

Preference attainment measures the extent to which, if any, the policy output moves toward the actors' preferences. The measure can be calculated in alternative ways. There are, for example, more basic metrics where preference attainment is coded as a binary variable or using three-value scores, where, for example, -1 indicates lobbying failure, 0 partial failure/success, and 1 indicates lobbying success (e.g., Sebők & Kozák, 2021). Another version is to measure the distance between the actors', e.g., interest groups', ideal points and the final policy output.

In the institutional setting under study, it would be insufficient to use a binary variable or three-value scores. The novel dataset, with clearly

stated quantitative interest group recommendations, makes it possible to calculate the exact difference between the interest groups' recommendations, the ICES advice, and the TACs, resulting in more detailed insights. It is, however, not enough to merely look at the distance between an interest group's recommendation, or ideal point, and the TACs. By examining this distance alone, it is unclear whether the policy output has moved in the preferred direction of the interest group's recommendation during the policy process (Vannoni & Dür, 2017). Thus, the measurement should be adapted to the current institutional setting. Drawing on frameworks by Bernhagen et al. (2014) and Vannoni and Dür (2017), I present the following preference attainment calculation:

$$PA_{ij} = \frac{|I_i - RP| - |I_i - P_j|}{0.5(|I_i - RP| + |I_i - SQ|)} \quad \textbf{(1)}$$

where PA_{ij} is the preference attainment for interest group i at policy stage j, $j = 1,2$, I_i is the preference for interest group i, RP is the reference point, P_j is either the proposed or final policy output, and SQ is the status quo. In this setting, I_i represents the BSAC recommendation for interest group i, RP is the headline advice from ICES, P_1 is the TAC proposal, P_2 is the final TAC, and SQ is the TAC from the previous year.

The numerator in Eq. 1 measures the extent to which the proposed or final policy output has shifted in the direction of the actor's preference compared to the reference point. This measure increases if the distance between the reference point and the actor's preference increases or the distance between the proposed or final policy output and the actor's preference decreases. Thus, the numerator measures preference attainment in absolute terms. If all policy outputs were, for example, on a standardized scale between 0 and 100, this might be sufficient. However, the final policy output for TACs in the Baltic Sea has varied between 266 and 270,772 tonnes/individuals during 2015–2025.[67] Thus, it is more accurate to measure the preference attainment in relative terms.

[67] The TACs are measured in tonnes for all species except for salmon, for which the TAC is measured in individuals.

To do this, I use the mean of two distances in the denominator. The first distance, $|I_i - RP|$, measures the distances between ICES headline advice and interest group *i*'s recommendation. It could be argued that this distance alone suffices as a denominator. However, Vannoni and Dür (2017) argue that the status quo should be controlled for in the preference attainment measurement, otherwise the measurement might be overestimated. In this institutional setting, it is also important to regard the previous year's TAC as the MAP states that fluctuations in TACs should not be more than 20 percent between continuous years. Thus, the second distance in the denominator, $|I_i - SQ|$, is the distance between interest group *i*'s recommendation and the final TAC of the previous year.[68]

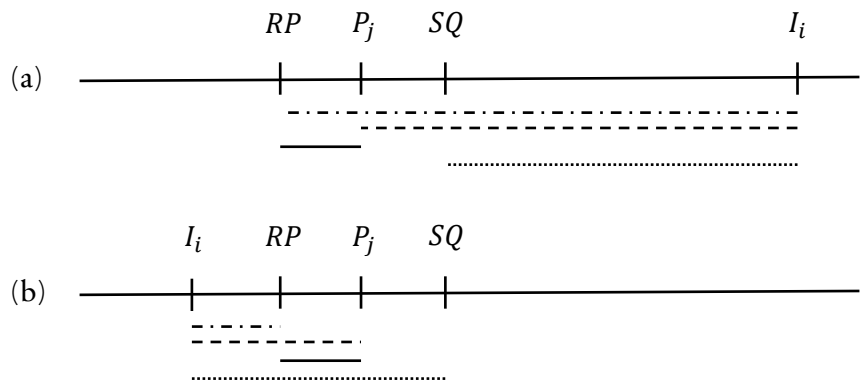

Figure 2: Preference attainment

To clarify further, Figure 2 shows the distances used in the preference attainment measurement with two examples. The top line in (a) and (b), dashed with dots, shows the distance between the headline advice from ICES and interest group *i*'s recommendation. The second, dashed, line, shows the distance between interest group *i*'s recommendation and the proposed or final TAC. The difference in length of these lines,

[68] Including $|I_i - SQ|$ in the denominator also helps decrease the number of outliers in the data, which otherwise would occur when the BSAC recommendation almost equals the ICES headline advice.

as indicated by the solid line, is the numerator of Eq. 1. As shown in Figure 2, the numerator equals the difference between the headline advice from ICES and the proposed or final TAC. If the proposed or final TAC has moved in interest group *i*'s preferred direction, the numerator will have a positive value, and if not, it will be negative. To get the preference attainment in relative terms, this value is divided by the mean of the two distances. The first is the distance between the headline advice from ICES and interest group *i*'s recommendation, showcased by the dashed line with dots, and the second is the distance between interest group *i*'s recommendation and the final TAC of the previous year, showcased by the dotted line.

The examples in Figure 2 are based on the mean values from Table 1. Where I use the mean BSAC recommendation for fisheries, corresponding to 95,550, in (a), and the mean BSAC recommendation from OIGs is used, corresponding to 53,249, in (b). In both (a) and (b), RP is the mean headline advice from ICES, corresponding to 59,746, P_j is the mean final TAC, corresponding to 65,805, and SQ is the mean final TAC for $t-1$, corresponding to 72,580. Thus, for (a) the numerator in Eq. 1 is $|95{,}550-59{,}746|-|95{,}550-65{,}805|=6{,}059$ and the denominator is $0.5(|95{,}550-59{,}746|+|95{,}550-72{,}580|)=29{,}387$. This equals a preference attainment of about 0.2062. For (b), the corresponding equation is $\frac{|53{,}249-59{,}746|-|53{,}249-65{,}805|}{0.5(|53{,}249-59{,}746|+|53{,}249-72{,}580|)}\approx -0.4692$, i.e., a negative preference attainment of 0.4692.

Using measures of preference attainment as calculated by Eq. 1, I examine whether preference attainment is affected by recommendation type – supporting the main recommendation or a minority position – and interest group type – fisheries or OIGs. To do this, I propose the following fixed-effect model:

$$\begin{aligned} PA_{ist} = \beta_0 + \ & \beta_1 Main_{ist} + \beta_2 Fish_i + \beta_3 Low_{st} + \beta_4 High_{st} \\ & + \beta_5 Con_{st} + \beta_6 (Low_{st} * Fish_i) \\ & + \beta_7 (High_{st} * Fish_i) + \beta_8 (Con_{st} * Fish_i) + \alpha_s \\ & + \mu_t + \varepsilon_{st} \end{aligned} \quad \textbf{(2)}$$

where PA_{ist} is the preference attainment for interest group i, for stock s at time t, $Main_{ist}$ is a dummy variable equal to 1 if interest group i explicitly supports the main recommendation, and $Fish_i$ is a dummy variables equal to 1 if interest group i represents fisheries. The model

also includes the following control variables: Low_{st}, $High_{st}$, Con_{st}, $Low_{st} * Fish_i$, $High_{st} * Fish_i$, and $Con_{st} * Fish_i$. Low_{st} ($High_{st}$) is a dummy variable indicating whether the ICES headline advice is more than 20 percent lower (higher) compared to the previous year's TAC, to control for the Baltic Sea MAP target focusing on fishing opportunities. This target is likely of more importance for fisheries than OIGs and, thus, I include the interaction terms $Low_{st} * Fish_i$ and $High_{st} * Fish_i$. Con_{st} measures the level of conflict, i.e., the distance between the highest and lowest recommendation, relative to the denominator in the preference attainment measurement, for stock s at time t. The level of conflict is included as a control variable to control for the conflict between alternative outcomes, as a larger level of conflict may make it more challenging for policymakers to reach a decision. An interaction term for Con_{st} and $Fish_i$ is included to examine whether fisheries and OIGs are affected to the same degree when the level of conflict increases. The model further includes stock- and time-fixed effects, represented by α_s and μ_t. Lastly, ε_{st} is the classical error term.

6 Data

The data used in this study comes from several sources. The annual TAC recommendations from BSAC were collected from the BSAC's Advice web portal (https://www.bsac.dk/recommendations/). These publications usually present one main recommendation and one or several minority positions for each stock. For the minority positions, BSAC also publishes which interest groups that support which position (see Table B1 and B2 in Appendix B for examples). It should be noted that minority positions have been presented for most stocks since 2018. However, prior to that, no minority positions were reported for 3–5 stocks per year.

The data on BSAC recommendations was merged with data on TAC proposals and agreements collected from the EUROLEX (www.eur-lex.europa.eu) and ICES headline advice, obtained from the ICES Advice web portal (www.ices.dk). When the ICES headline advice is given as a range around MSY, I use the recommended value, if such a value is given. If no recommended value is provided, the midpoint is used. All data was collected for the period 2015–2025. The final dataset

spans 11 years and encompasses 10 stocks, comprising five species with one to four geographical zones per species.[69]

The main strength of this dataset is that interest groups' preferences are quantified, making it possible to compare them to the headline advice from ICES as well as the proposed and final TAC. This is especially valuable as data on information from interest groups to policymakers can be troublesome to obtain. In comparison to previous literature on informational lobbying, this dataset has two additional strengths. Firstly, the TAC negotiations and the corresponding preparations constitute an annual process, not a one-time occurrence. Secondly, the dataset uses a continuous measure of interest groups' preferences rather than a binary one, such as agreeing with a policy output or not. Together, these features provide richer insights into the success of interest groups' lobbying efforts.

There are, however, limitations with this dataset. Although the BSAC recommendations clearly state the interest groups that support each minority position, there is generally no information on which groups favor the main recommendation. This will, in turn, lead to a decrease in the sample, particularly when recommendation type and interest group types are estimated together. For the final TACs, this leads to a decrease of 115 observations, equivalent to almost 16 percent of the sample.

6.1 Descriptive statistics

This section presents the descriptive statistics for the dataset and the included variables. Table 1 presents the descriptive statistics for the ICES headline advice, proposed TAC, final TAC, and the BSAC recommendations. The descriptive statistics for BSAC recommendations are presented as a whole and divided into different sub-samples based on the recommendation and interest group type. Every interest group that

[69] Stocks included in the Baltic Sea TAC negotiations, and, thus, in the dataset are western cod, eastern cod, western herring, central herring, Gulf of Bothnian herring, Gulf of Riga herring, plaice, main basin salmon, Gulf of Finland salmon, and sprat.

explicitly supports a recommendation has its own observation.[70] Thus, one recommendation can be part of several observations, but for different interest groups. If a recommendation does not have explicit support from an interest group, it is included as one observation.

Table 1: General descriptive statistics for the dataset

	N	Mean	Std. Dev.	Min	Max
ICES headline advice	727	59,746	81,396	0	282,349
BSAC recommendations	734	64,282	85,815	0	375,838
Main recommendations	150	80,815	93,267	340	285,860
Minority positions	560	60,945	84,775	0	375,838
Recommendations from fisheries	166	95,550	114,538	0	375,838
Recommendations from OIGs	468	53,249	72,131	0	270,772
Main recommendations from fisheries	55	107,702	110,197	600	285,860
Main recommendations from OIGs	0	-	-	-	-
Minority positions from fisheries	93	98,197	124,965	0	375,838
Minority positions from OIGs	462	53,667	72,472	0	270,772
Proposed TAC by the Commission	709	62,606	74,960	93	282,349
Final TAC	734	65,805	78,184	266	270,772
TAC for t-1	734	72,580	83,442	340	270,772

Note: The statistics are number of observations (N), average value (Mean), standard deviation (Std. Dev.), minimum (Min), and maximum (Max).

Table 1 shows that 150 of all BSAC recommendations are main recommendations, while 560 are minority positions. The reason for this skewness toward minority positions is that while there generally are several interest groups supporting one minority position and there can be several minority positions for a stock, there is generally no notation about the interest groups support the main recommendations. Simultaneously, there are only three instances during the period where there is more than one main recommendation, corresponding to 27 observations. The remaining 24 recommendations were included in postponed BSAC recommendations, without any division between main

[70] An example from Table B2 (Appendix B) is the minority position of zero catch for western herring (SDs 22-24), which is supported by Coalition Clean Baltic, WWF, and Fisheries Secretariat. This minority position will result in three observations, one for each interest group.

recommendations or minority positions. Looking at interest group type, 166 recommendations are explicitly supported by the industry, while OIGs explicitly support 468. Interestingly, there are no main recommendations that an OIG explicitly supports, but there are 93 observations where fisheries support a minority position.

Table 2 shows the summary statistics for the preference attainment model, including the degree of preference attainment, dummy variables for main recommendations and fisheries, and the included control variables. As shown in Table 2, the preference attainment for the TAC proposal and the final TAC is between -2 and 2 when outliers are excluded and between -21.56 and 2 when all observations are included. As the outliers are excluded in the main estimation, I will focus on the summary statistics when the outliers are disregarded.

Table 2 shows that about 20 percent of the BSAC recommendations are main recommendations, and about 26 percent are from fisheries. However, it should be noted that for 24 observations, information on whether the recommendation is the main recommendation or a minority position is missing. In comparison, 100 observations lack information on whether fisheries or OIGs support the recommendation. Furthermore, the control variables indicate that approximately 51 (15) percent of the ICES advice is more than 20 percent lower (higher) than the status quo, i.e., the previous year's TAC. Out of these, 16 (0) percentage points correspond to recommendations explicitly supported by fisheries. When the ICES advice is presented as a range, the recommended value or the midpoint is used. Thus, there might be cases where part of the range deviates by less than 20 percent, but not the midpoint or recommended value. Furthermore, the average level of conflict, relative to the ICES advice and the status quo, is generally high. However, for BSAC recommendations with explicit support from fisheries, the level of conflict is lower on average.

Table 2: Summary statistics for preference attainment, proposed TAC

	Description	N	Mean	Std. Dev.	Min	Max
Dependent variable						
PA_1	Preference attainment, TAC proposal	693	0.193	0.953	-2	2
PA_1, with outliers		702	0.095	1.444	-21.56	2
PA_2	Preference attainment, final TAC	720	0.157	0.976	-2	2
PA_2, with outliers		727	0.09	1.333	-21.56	2
Explanatory variables						
$Main$	Dummy variable, 1 if main recommendation	699	0.203	0.403	0	1
$Fish$	Dummy variable, 1 if the interest group represents fisheries	626	0.262	0.440	0	1
Control variables						
Low	Dummy variable, 1 if the ICES advice is more than 20 percent lower than the status quo	720	0.508	0.500	0	1
$High$	Dummy variable, 1 if the ICES advice is more than 20 percent higher than the status quo	720	0.147	0.355	0	1
Con	Level of conflict	720	2.093	2.688	0	17.77
$Low * Fish$	Dummy variable, 1 if the ICES advice is more than 20 percent lower and the interest group represents fisheries	720	0.119	0.325	0	1
$High * Fish$	Dummy variable, 1 if the ICES advice is more than 20 percent higher and the interest group represents fisheries	720	0	0	0	0
$Con * Fish$	Level of conflict if the interest group represents fisheries, otherwise equal zero	720	0.646	1.860	0	17.77

Note: The statistics are number of observations (N), average value (Mean), standard deviation (Std. Dev.), minimum (Min), and maximum (Max).

7 Results

Tables 3 and 4 report the results of the fixed-effect model according to Eq. 2. The effects of recommendation type and interest group type on preference attainment are first estimated separately and then combined in the same estimation. The interaction term for when the ICES advice is more than 20 percent above the status quo and the interest group represents fisheries is excluded, as the variable is always equal to zero (see Table 2). Table 3 presents the results related to the TACs proposed

by the Commission, and Table 4 presents the results related to the final TACs.

Table 3: Preference attainment, TAC proposal

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Main recommendation	-0.004		-0.095	-0.010	0.057	0.028	-0.099	-0.296**
	(0.094)		(0.162)	(0.169)	(0.173)	(0.178)	(0.168)	(0.137)
Recommendation from fisheries		0.231**	0.303***	0.293**	0.267**	0.235*	-0.392***	-0.827***
		(0.096)	(0.113)	(0.114)	(0.113)	(0.122)	(0.117)	(0.129)
More than 20 percent below				-0.510***	-0.221**	-0.191*	-0.526***	-0.546***
				(0.104)	(0.103)	(0.100)	(0.107)	(0.105)
More than 20 percent above					0.937***	0.921***	0.941***	0.897***
					(0.156)	(0.156)	(0.150)	(0.154)
Level of conflict						-0.045*	-0.056**	-0.124***
						(0.027)	(0.024)	(0.015)
More than 20 percent below & fisheries							1.192***	1.064***
							(0.143)	(0.143)
Level of conflict & fisheries								0.204***
								(0.030)
Constant	0.189***	0.128***	0.116***	0.372***	0.106	0.199**	0.397***	0.566***
	(0.037)	(0.044)	(0.045)	(0.065)	(0.071)	(0.089)	(0.082)	(0.077)
Observations	672	605	584	584	584	584	584	584
Adjusted R^2	0.225	0.269	0.267	0.297	0.347	0.358	0.427	0.493
R^2 within	4.27e-06	0.013	0.017	0.059	0.128	0.144	0.237	0.326
Adjusted R^2 within	-0.002	0.011	0.014	0.054	0.122	0.136	0.229	0.318

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses.

Table 3 shows no significant difference between interest groups that explicitly support the main recommendation and those that support minority positions (columns 1 and 3–7). Furthermore, fisheries have, on average, a significantly higher preference attainment compared to OIGs (columns 2–6). Thus, the results suggest that interest group type matters more for preference attainment than recommendation type, and that fisheries, on average, have a greater influence on, or preferences more in line with, the Commission's TAC proposals. These results remain robust when controlling for whether the ICES advice is more

than 20 percent below or above the previous year's TAC and the level of conflict.

When the interaction terms are included, the direction of the fisheries coefficient changes (columns 7–8 in Table 3). Both interaction terms are positive and significant. Thus, the results suggest that fisheries are influential for the Commission's TAC proposal when ICES advice is more than 20 percent below the status quo and the level of conflict is high, while OIGs achieve higher preference attainment when the ICES advice is less than 20 percent below or higher than the status quo. Additionally, when the level of conflict is low, holding a minority position can be beneficial.

Tables 4 report the estimates for the final TACs. Column 1 in Table 4 shows that being part of the main recommendation has a positive and significant effect on interest groups' preference attainment, compared to minority positions. However, this effect becomes insignificant when controlling for fisheries (column 3). Column 2 shows that the effect of being a fisheries representative is significantly positive and remains significant when the recommendation type is controlled for. Thus, similar to when TACs are proposed by the Commission, the results indicate that interest group type is more relevant for preference attainment than recommendation type, and that fisheries exert more influence on, or have preferences that are more in line with, the final TACs. These results are robust when controlling for the level of conflict and whether the ICES advice deviates by more than 20 percent compared to the previous year's TAC.

Table 4: Preference attainment, final TAC

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Main recommendation	0.343***		-0.074	-0.006	0.043	0.040	-0.123	-0.291**
	(0.089)		(0.164)	(0.171)	(0.173)	(0.174)	(0.158)	(0.131)
Recommendation from fisheries		0.533***	0.585***	0.575***	0.555***	0.552***	-0.259***	-0.633***
		(0.095)	(0.122)	(0.121)	(0.122)	(0.126)	(0.100)	(0.113)
More than 20 percent below				-0.379***	-0.176*	-0.173*	-0.596***	-0.610***
				(0.094)	(0.101)	(0.099)	(0.105)	(0.103)
More than 20 percent above					0.635***	0.633***	0.652***	0.612***
					(0.131)	(0.131)	(0.129)	(0.135)
Level of conflict						-0.005	-0.019	-0.078***
						(0.023)	(0.019)	(0.012)
More than 20 percent below & fisheries							1.539***	1.425***
							(0.150)	(0.146)
Level of conflict & fisheries								0.175***
								(0.023)
Constant	0.082**	-0.027	-0.033	0.163***	-0.021	-0.011	0.248***	0.392***
	(0.037)	(0.039)	(0.040)	(0.060)	(0.069)	(0.089)	(0.081)	(0.079)
Observations	699	626	605	605	605	605	605	605
Adjusted R^2	0.234	0.313	0.313	0.328	0.348	0.347	0.452	0.495
R^2 within	0.024	0.061	0.065	0.086	0.115	0.115	0.258	0.318
Adjusted R^2 within	0.023	0.06	0.062	0.081	0.109	0.108	0.250	0.310

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses.

Similar to Table 3, Table 4 shows that the fisheries coefficient becomes significantly negative after including the interaction terms. The results suggest that OIGs have a higher degree of preference attainment compared to fisheries when the ICES advice is less than 20 percent below or exceed the status quo and when the level of conflict is low. Furthermore, both interaction terms have a positive and significant effect on preference attainment, indicating that fisheries' preference attainment increases as the level of conflict increases and when the ICES advice is more than 20 percent below the status quo.

7.1 Sensitivity analysis

This section examines the sensitivity of the results to alternative sampling periods and the exclusion of cod, a species close to collapse. As mentioned in Section 6, minority positions were not included in the BSAC recommendations to the same degree before 2018. Thus, to test whether this affects the results, only observations from 2018 or later are included in Tables 5 and 7.

Due to the state of the eastern (Baltic) cod, by-catch TACs have been used since 2020.[71] The western (Baltic) cod was already in crisis in 2017, with the stock's reproductive capacity threatened. At that time, it was the only stock in crisis covered by the Baltic Sea MAP (Berkow, 2024). Thus, the stock has been in crisis for most, if not all, of the period studied. Since 2022, the western cod has also had by-catch TACs. Tables 6 and 8 report results excluding eastern and western cod. Tables 5 and 6 examine interest groups' preference attainment for TACs proposed by the Commission, while Tables 7 and 8 focus on preference attainment for the final TAC.

Table 5 shows that the results are robust when the first three years are excluded. All coefficients have the same sign as those reported in Table 3, while the level of significance changes for some estimates. For example, estimates for fisheries increase in significance in columns 4–6, while level of conflict loses significance in column 6. This pattern suggests that, although excluding earlier years can affect significance, it does not change the overall direction of the results.

Estimates after excluding eastern and western cod are shown in Table 6. Contrary to the main results in Table 3, when the effect of recommendation type and interest group type is estimated separately, interest groups supporting the main recommendation have a significantly lower preference attainment (column 1). The coefficient for the main recommendations remains negative and significant, but increases in both magnitude and significance when recommendation and interest

[71] A by-catch TAC is a TAC without targeted fishing. However, exceptions do exist, such as targeted fishing for scientific investigations. For more information, see, e.g., Council Regulation 2019/1838.

group type are estimated together (column 2). The effect of fisheries remains insignificant until interaction terms are included. Thus, when cod stocks are excluded, minority positions have a significantly higher preference attainment compared to the main recommendations. These results suggest that whether interest groups' preference attainment for TACs proposed by the Commission is more affected by recommendation type or interest group is species- or stock-dependent. When the interaction terms are included, the main recommendations continue to have a higher degree of significance in Table 6. For the remaining variables, the results are more similar to those in Table 3, with some increases in significance and changes in magnitude.

Table 5: Sensitivity analysis 2018–2025, TAC proposal

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Main recommendation	-0.002		-0.123	-0.041	0.026	0.003	-0.114	-0.310**
	(0.110)		(0.159)	(0.168)	(0.171)	(0.176)	(0.166)	(0.135)
Recommendation from fisheries		0.276***	0.365***	0.352***	0.327***	0.293**	-0.362***	-0.809***
		(0.097)	(0.114)	(0.113)	(0.113)	(0.124)	(0.122)	(0.132)
More than 20 percent below				-0.520***	-0.217*	-0.194*	-0.560***	-0.594***
				(0.109)	(0.111)	(0.108)	(0.115)	(0.112)
More than 20 percent above					0.935***	0.921***	0.928***	0.879***
					(0.158)	(0.158)	(0.151)	(0.155)
Level of conflict						-0.038	-0.052**	-0.121***
						(0.027)	(0.024)	(0.015)
More than 20 percent below & fisheries							1.201***	1.086***
							(0.144)	(0.147)
Level of conflict & fisheries								0.202***
								(0.030)
Constant	0.158***	0.078	0.062	0.320***	0.034	0.123	0.347***	0.540***
	(0.041)	(0.049)	(0.050)	(0.071)	(0.079)	(0.100)	(0.093)	(0.086)
Observations	584	540	519	519	519	519	519	519
Adjusted R^2	0.200	0.248	0.247	0.278	0.331	0.339	0.410	0.480
R^2 within	5.67e-07	0.018	0.025	0.067	0.138	0.150	0.243	0.334
Adjusted R^2 within	-0.002	0.016	0.021	0.062	0.131	0.141	0.234	0.325

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses.

Table 6: Sensitivity analysis excluding cod, TAC proposal

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Main recommendation	-0.167*		-0.447***	-0.381**	-0.302*	-0.355**	-0.406***	-0.472***
	(0.098)		(0.147)	(0.156)	(0.160)	(0.155)	(0.151)	(0.139)
Recommendation from fisheries		0.008	0.177	0.162	0.143	0.078	-0.272**	-0.624***
		(0.097)	(0.116)	(0.118)	(0.114)	(0.140)	(0.126)	(0.131)
More than 20 percent below				-0.472***	-0.258**	-0.225**	-0.468***	-0.501***
				(0.111)	(0.109)	(0.104)	(0.111)	(0.113)
More than 20 percent above					0.874***	0.814***	0.827***	0.818***
					(0.182)	(0.186)	(0.182)	(0.184)
Level of conflict						-0.080**	-0.088***	-0.129***
						(0.032)	(0.030)	(0.015)
More than 20 percent below & fisheries							0.780***	0.656***
							(0.147)	(0.139)
Level of conflict & fisheries								0.173***
								(0.045)
Constant	0.255***	0.228***	0.218***	0.427***	0.224***	0.391***	0.520***	0.621***
	(0.037)	(0.044)	(0.045)	(0.065)	(0.070)	(0.097)	(0.088)	(0.074)
Observations	536	481	463	463	463	463	463	463
Adjusted R^2	0.294	0.338	0.342	0.369	0.416	0.455	0.487	0.529
R^2 within	0.007	1.85e-05	0.018	0.06	0.133	0.192	0.241	0.305
Adjusted R^2 within	0.006	-0.002	0.014	0.054	0.125	0.183	0.231	0.293

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses.

Proceeding to interest groups' preference attainment for the final TAC, the sensitivity analysis is presented in Tables 7 and 8. Specifically, Table 7 presents the results when the first three years in the dataset are excluded, while Table 8 displays results excluding TACs for cod stocks.

Table 7: Sensitivity analysis 2018–2025, final TAC

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Main recommendation	0.287***		-0.047	-0.011	0.036	0.043	-0.098	-0.251*
	(0.104)		(0.166)	(0.171)	(0.173)	(0.170)	(0.156)	(0.133)
Recommendation from fisheries		0.599***	0.653***	0.647***	0.629***	0.639***	-0.152	-0.502***
		(0.099)	(0.126)	(0.124)	(0.125)	(0.129)	(0.106)	(0.118)
More than 20 percent below				-0.231**	-0.017	-0.024	-0.466***	-0.492***
				(0.098)	(0.106)	(0.104)	(0.110)	(0.109)
More than 20 percent above					0.663***	0.667***	0.676***	0.638***
					(0.133)	(0.133)	(0.131)	(0.136)
Level of conflict						0.012	-0.004	-0.058***
						(0.023)	(0.019)	(0.013)
More than 20 percent below & fisheries							1.451***	1.362***
							(0.153)	(0.151)
Level of conflict & fisheries								0.158***
								(0.024)
Constant	0.100**	-0.050	-0.060	0.056	-0.147**	-0.175*	0.096	0.247***
	(0.040)	(0.044)	(0.045)	(0.060)	(0.071)	(0.092)	(0.086)	(0.084)
Observations	585	540	519	519	519	519	519	519
Adjusted R^2	0.204	0.302	0.304	0.309	0.335	0.335	0.440	0.482
R^2 within	0.016	0.086	0.093	0.101	0.137	0.138	0.275	0.331
Adjusted R^2 within	0.014	0.084	0.089	0.096	0.130	0.129	0.267	0.322

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses.

Table 7 presents results similar to those in the main model (Table 4). However, there are some changes in significance for when the ICES advice is more than 20 percent below the status quo, which is no longer significant in columns 5 and 6. Furthermore, there is a loss of significance for fisheries in column 7. Table 8 shows the results relative to final TACs, after cod stocks are excluded.

Table 8: Sensitivity analysis excluding cod, final TAC

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Main recommendation	0.122		-0.251*	-0.208	-0.168	-0.187	-0.259*	-0.321***
	(0.091)		(0.146)	(0.152)	(0.152)	(0.150)	(0.143)	(0.124)
Recommendation from fisheries		0.245***	0.331***	0.322***	0.312***	0.287**	-0.202*	-0.532***
		(0.093)	(0.120)	(0.119)	(0.118)	(0.133)	(0.105)	(0.109)
More than 20 percent below				-0.310***	-0.200**	-0.188**	-0.528***	-0.558***
				(0.089)	(0.099)	(0.096)	(0.104)	(0.103)
More than 20 percent above					0.449***	0.427***	0.445***	0.437***
					(0.142)	(0.144)	(0.151)	(0.156)
Level of conflict						-0.030	-0.042*	-0.080***
						(0.028)	(0.024)	(0.011)
More than 20 percent below & fisheries							1.088***	0.972***
							(0.165)	(0.155)
Level of conflict & fisheries								0.162***
								(0.021)
Constant	0.197***	0.135***	0.132***	0.269***	0.165***	0.228**	0.408***	0.503***
	(0.038)	(0.039)	(0.040)	(0.053)	(0.063)	(0.095)	(0.086)	(0.077)
Observations	538	481	463	463	463	463	463	463
Adjusted R^2	0.285	0.343	0.347	0.357	0.369	0.373	0.436	0.473
R^2 within	0.004	0.017	0.022	0.041	0.06	0.068	0.164	0.220
Adjusted R^2 within	0.002	0.015	0.018	0.034	0.051	0.059	0.152	0.207

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Robust standard errors are presented in parentheses.

Table 8 shows that, without cod stocks, the main recommendations are no longer significant when estimated separately (column 1). However, in columns 3 and 7, the main recommendations have a significantly lower preference attainment. Consistent with Table 4, there is a positive and significant effect for fisheries before the inclusion of interaction terms. Furthermore, results for the control variables align with the main findings, showing similar signs and some increases in significance.

8 Discussion and conclusion

This study contributes to the long-standing debate on how different interest groups influence policymaking in the EU by estimating the

impact of recommendation type – main recommendation or minority position – and interest group type – fisheries or OIGs – on interest groups' lobbying success in terms of preference attainment. A unique dataset was collected, linking clearly stated quota recommendations from interest groups within BSAC with scientific advice from ICES, TACs proposed by the Commission, and the final TACs for 2015–2025.

The effect of supporting the main recommendation, relative to a minority position, and representing fisheries, relative to being an OIG, is first estimated separately and then included in the same estimations. When the effects are estimated separately, the main recommendations have an insignificant and negative effect on interest groups' lobbying success for the TACs proposed by the Commission and a significantly positive effect on lobbying success for the final TACs. Moreover, when the effect of representing fisheries is estimated relative to being an OIG, there is a significantly higher lobbying success for fisheries, both for the proposed and final TAC.

When both the effect of supporting the main recommendation and representing fisheries are measured, supporting the main recommendation becomes insignificant, while the positive effect of representing fisheries remains significant and increases slightly. This suggests that interest group type influences lobbying success more than alignment with the main recommendation or minority position. These results remain robust when controlling for deviations in ICES advice and the level of conflict. Thus, fisheries generally have the highest influence on, or preferences that are more in line with, the Commission's TAC proposals and the final TACs.

There are several possible explanations for the finding that fisheries generally have a higher preference attainment for proposed and final TACs. One possibility, as argued by Cardinale and Svedäng (2008), is that politicians disregard scientific advice and prioritize short-term effects within the EU's TAC management system. Moreover, previous studies have found that interest groups experience a lower degree of lobbying success when they are active in multiple issues (Mahoney, 2007). Similarly, Bunea (2013) finds that business groups, which represent more concentrated interests and are directly affected by a policy, have a higher degree of preference attainment compared to other

organizational forms in environmental policy. Part of these increased preference attainment could be explained by donor or member behavior. Dür and De Bièvre (2007) explain that while members in business groups have clear incentives to monitor their lobbying activities, donors for NGOs might not be as concerned with, or even aware of, these activities. This could also be the case within BSAC. Although some OIGs focus on recreational or sustainable fishing and the state of the Baltic Sea, others have a broader focus. For OIGs with a wider focus, questions within fishery management may have less saliency, and thus, less of their power is used to influence the policy output. In contrast, representatives for fisheries focus on fisheries management, as their own employment or that of their members is directly affected.

One of the targets in the Baltic Sea MAP states that fishing opportunities should not change by more than 20 percent between consecutive years. Interestingly, when an interaction term is included that measures how fisheries, relative to OIGs, are affected by the ICES advice being more than 20 percent below the status quo, i.e., the previous year's TAC, the coefficient is positive and significant. Furthermore, with the inclusion of this interaction term, the coefficient for fisheries changes direction, indicating a significantly lower preference attainment. However, this negative estimate is of lower magnitude than the positive estimate for the interaction term. Thus, these results suggest that when the ICES advice is more than 20 percent below the status quo, which is the case for just above half of the observations, fisheries have a higher degree of lobbying success compared to OIGs. However, when the ICES advice deviates by less than 20 percent from or exceeds the status quo, OIGs have more lobbying success.

These results are consistent with and might be explained by preferences for stable TACs being incorporated in the fisheries policy, even when the models used for the ICES advice suggest higher fluctuations in the TACs. Moreover, these results align with previous studies, which find that business groups tend to defend the status quo (e.g., Dür et al., 2015) and that interest groups supporting the status quo have a higher degree of preference attainment (e.g., Buena, 2013; Mahoney, 2007). In the circumstances of this study, this is evident when the ICES advice is more than 20 percent lower than the previous year's TAC. If this advice were

to become reality, it would likely have a negative impact on fisheries in the short run.

Moreover, the findings indicate that the level of conflict generally has a negative and significant impact on preference attainment, suggesting that when the difference between different BSAC recommendations increases, interest groups' preference attainment decreases. However, when the interaction term for the level of conflict and representing fisheries is included, the coefficient for representing fisheries becomes more negative, and the estimate for main recommendation becomes significantly negative.

In short, these results indicate that when the level of conflict between BSAC recommendations is low and ICES advice deviates by less than 20 percent from or exceeds the status quo, OIGs and interest groups supporting minority positions have higher lobbying success. However, as the level of conflict increases between BSAC recommendations or when ICES advice is more than 20 percent lower than the status quo, fisheries' lobbying success increases.

These results remain robust when observations before 2018 are excluded. However, when cod stocks are excluded, main recommendation have significantly lower preference attainment for TACs proposed by the Commission. Indicating that for stocks other than cod, minority positions have a significantly higher lobbying success, with regard to the Commission's proposals. These results could indicate that while business groups tend to defend the status quo, the Commission seeks to change it (as argued by Dür et al., 2015), and that the Commission is less inclined towards the status quo than the ministerial council that decides on the final TACs.

One weakness of this paper is that, while it controls for desired stability in fishing opportunities, it does not account for the status of the stock or aims related to minimizing negative impacts from fishing activities. Therefore, I recommend that future research include these types of controls. For example, ICES reference points could be used to decide the status of the stock in terms of its reproductive capacity. Depending on the outcome of the ongoing court case regarding the interpretation of Article 4(6) in the Baltic Sea MAP, it may also be interesting to

examine how this article has been considered in TAC decisions and, in turn, whether it affects the lobbying success of interest groups for relevant stocks.[72]

Another possibility for future research would be to categorize interest groups based on their preferred TAC, rather than their type. Although subsets of industries may be vocal in their criticism of specific environmental regulations, other business organizations may support the same regulations. In this institutional context, representatives of small-scale fisheries and OIGs have jointly supported minority positions.

As my findings suggest that fisheries generally have a higher preference attainment, it is essential to discuss whether these results align with the objectives of BSAC and the CFP. If the aim of BSAC is to voice OIG's concerns alongside fisheries, politicians should investigate why some of the OIG seats are currently vacant and consider increasing the share of seats reserved for OIGs in the long run. However, suppose the findings of this study are the effect of an industrial policy with the intention to maintain a degree of stability within the fishing sector, as suggested by the results. In that case, it is logical that fisheries have higher preference attainment when the ICES advice deviates by more than 20 percent. Still, it is important to also prioritize the other aims of the CFP. This is especially true as the state of the Baltic Sea stocks has worsened, partly because of overexploitation.

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[72] Article 4(6) states that fishing opportunities should be fixed so that the probability of falling below B_{lim} is less than 5 percent. B_{lim} is a reference point below which there is a high risk of reduced recruitment for the stock (ICES, 2023). See Case T-342/24 and Council of the European Union (2024) for more information.

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Appendix A: BSAC's Executive Committee

Table A1: List of members in BSAC's Executive Committee 2024–2027

Member	Sector	Country
Sweden Pelagic Federation PO	Fisheries	SE
Latvian Fisheries Association	Fisheries	LV
Swedish Fishermen PO	Fisheries	SE
Finnish Fishermen's Association	Fisheries	FI
Association for Low Impact Coastal Fishery PO	Fisheries	DK
Association of Fishermen's of Sea- PO	Fisheries	PL
Fishermen's Federation for Small-Scale Fishery in Sweden	Fisheries	SE
Danish Pelagic Producers Organisation	Fisheries	DK
Fischereischutzverband (Association of Fisheries Protection)	Fisheries	DE
The Association of Fishermen and Fish Processors Baltijos zvejas	Fisheries	LT
National Chamber of Fish Producers	Fisheries	PL
Union of German Cutter Fishery	Fisheries	DE
Darłowska Group of Fish Producers & Shipowners	Fisheries	PL
Federation of Finnish Fisheries Associations	Fisheries	FI
Estonian Fishermen's Association	Fisheries	EE
Danish Fishers P.O.	Fisheries	DK
The Fishermen's Association of Bornholm and Christiansø	Fisheries	DK
European Fishmeal and Fish Oil Producers	Fisheries	EU
Coalition Clean Baltic	OIG	INT
Danish Recreational Fishermen	OIG	DK
European Anglers Alliance	OIG	INT
Finnish Association for Nature Conservation	OIG	FI
Fisheries Secretariat	OIG	SE
German Angling Association	OIG	DE
WWF	OIG	FI
BalticWaters	OIG	SE
Baltic Salmon Rivers Association	OIG	SE

Note: This list is collected from the Baltic Sea Advisory Council (n.d.).

Table A2: List of organizations previously partaking in BSAC's recommendations

Member	Sector	Member in General Assembly 2024–2025
European Association of Fishmeal and Fish Oil Producers	Fisheries	Yes
Polish Association of Fish Processors	Fisheries	Yes
Low Impact Fishers of Europe	Fisheries	Yes
Kołobrzeg Group of Producers Fish	Fisheries	No
Marine Ingredients	Fisheries	No
The Polish Ecological Club / Polski Klub Ekologiczny	OIG	Yes
Swedish Society for Nature Conservation	OIG	Yes
Environmental Defense Fund	OIG	No

Note: This list includes members who have been identified through BSAC recommendations for 2015–2025 but are not part of the current Executive Committee. Some of whom are currently members of the General Assembly in BSAC, others are not, as identified in the table.

Appendix B: BSAC recommendations

Table B1: An excerpt from the BSAC recommendation for 2018

	TAC for 2017 Tonnes (except salmon)	BSAC recommendation for 2018	Minority positions for 2018
Cod 25-32	30.857	30.857	24.767[5]
Herring 22-24	28.401	24.141	17.309[6]
Herring 25-29, 32, ex GoR	191.129	263.665	238.229[7]
Herring Gulf of Riga SD	31.074	30.687	28.999[8]

[5] WWF, Oceana, The Fisheries Secretariat, Coalition Clean Baltic, European Anglers Alliance, Finnish Association for Nature Conservation

[6] idem

[7] idem

[8] idem

Note: The table shows how the quantitative recommendations from the Baltic Sea Advisory Council (2017) are presented for four of the ten stocks.

Table B2: An excerpt from the BSAC recommendation for 2022

	ICES advice on fishing opportunities 2022[1]		BSAC recommendation for EU TAC 2022	BSAC minority positions TAC 2022
Cod 25-32	ZERO CATCH PA	ICES advice that when the precautionary approach is applied there should be zero catch in 2022. This advice applies to all catches from the stock in subdivision 24–32	By-catch TAC 2.000 t	Zero catch By-catch TAC of 595 t[2]
Herring SDs 22-24	ZERO CATCH MSY approach	ICES advises that when the MSY approach is applied, there should be zero catch in 2022.	Rollover of 2021 TAC 1.575 t	Zero catch[3]
Herring SDs 25-29, 32, ex GoR	Range 52.443 – 97.581 t	EU multiannual plan (MAP) for the Baltic Sea	62.353 t (EU MAP FMSY)	82.918 t[4]
Herring Gulf of Riga SD 28.a	Range 34.797 – 52.132 t	EU multiannual plan (MAP) for the Baltic Sea	47 697 t (EU MAP FMSY)	

[1] Note that reference is made to ICES advice only. More details and nuances may be found in the "Issues relevant for the advice" section of the ICES advice.

[2] Coalition Clean Baltic, WWF and Fisheries Secretariat

[3] Coalition Clean Baltic, WWF and Fisheries Secretariat

[4] Confederation of Fishermen and Fish Processors of West Lithuania

Note: The table show how the quantitative recommendations from the Baltic Sea Advisory Council (2021) are presented for four of the ten stocks.

ESSAY IV

The effect of wind turbines on property values

A meta-regression analysis

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Abstract
Wind power is predicted to expand to meet some of the increasing electricity demand while tackling the ongoing climate issue. However, there has been an increase in local opposition, leading to an intensified discussion of the magnitude of the external effects of wind turbines. In this study, we conduct a meta-analysis, relying on 252 property value estimates presented in 21 studies, to examine whether, and to what extent, property prices are affected by the distance to wind turbines. We also test how this relationship is affected by the construction or announcement year and the population density in the studied area. We find no significant effect of having a more recent announcement or construction year. However, we find that studies with one more inhabitant per square kilometer have a more negative effect of 0.01 percentage points. With regards to distance to wind turbines, we find a negative and significant effect on properties within 4 km from a wind turbine, with a more negative effect size for properties closer to wind turbines.

Keywords: Wind Turbines; Property Values; Meta-Regression Analysis

JEL-codes: C8; Q42

1 Introduction

Wind power met 18 percent of the EU's final energy consumption in 2023 (Eurostat, 2025).[73] Nevertheless, it is argued that the installed capacity of wind power must increase as part of the solution to the ongoing climate issue (Barthelmie & Pryor, 2021). At the same time, we should expect an increase in suggested sites where the external effects of wind power are more visible, as sites with good wind conditions and minimal impact on humans have already been fully utilized. This is visible in the increased local opposition to wind turbines (e.g., Niskanen et al., 2024; Reusswig et al., 2016; Susskind et al., 2022), and the discussion of the magnitude of external effects will likely be intensified. One way to measure these external effects is by analyzing the impact of wind power turbines on real estate values in adjacent properties. In this study, we conduct a meta-analysis to examine previous findings on how the distance to the nearest wind turbine affects property values. We use distance as a measurement of wind turbine disturbance, as distance is assumed to incorporate effects of view, noise, and flicker.

The choice of studying the impact of wind power development on property values is motivated by the facts that: (a) it can be seen as a direct valuation of the external effects; and (b) the empirical literature is large enough to conclude. The econometric analysis in the paper relies on 252 property value estimates presented in 21 studies conducted between 2011 and 2024. These studies, in turn, employ data from the period 1985–2020.

Earlier literature does not present a unified picture of the impact on property values. North American studies, on the one hand, tend to be inconclusive (e.g., Castleberry & Greene, 2018; Hoen et al., 2011, 2015; Lang et al., 2014), with a few showing negative or mixed effects on property values (e.g., Heintzelman & Tuttle 2012; Vyn, 2018). European studies, on the other hand, tend to show negative effects (e.g.,

[73] Final energy consumption is the total end user consumption, e.g., electricity consumed by industry, households, and agriculture (Eurostat, 2025).

Dröes & Koster, 2016, 2021; Gibbons, 2015; Jensen et al., 2014; Sunak & Madlener, 2016, 2017).

Schütt (2024) published a comprehensive meta-analysis on the effect of wind turbines on property values. To our knowledge, Schütt (2024) is the only meta-analysis previously conducted on this subject, except for a mini meta-analysis included in a literature review by Parsons and Heintzelman (2022), which uses 18 observations to calculate the mean effect. We contribute to this literature by estimating the effect for different distance bands, unlike Schütt (2024), who includes the mean distance in their estimations. Furthermore, Schütt (2024) thoroughly examines the effects of data and model specifications, whereas we take a more policy-oriented approach. As compensation for residents affected by wind power has become a more debated issue (see, for example, Lundin, 2024), it is crucial to examine factors that might affect the relationship between wind turbines and property values but are often overlooked in the literature, such as population density.

In the data section of our meta-analysis, we see that later studies generally find a negative impact of wind turbines. This could be an indication that less contestable sites were chosen initially. To control for this, we include a variable for the mean announcement or construction year, depending on whether the effect of announcing or constructing a wind turbine is studied. Additionally, we control for the population density in the studied area.

2 The impact of wind power

Apart from the production of electricity, wind power electricity generation can broadly be said to have two positive socioeconomic impacts. First, electricity generation is renewable, and as such, it aligns well with a future circular economy. This is a value not explicitly remunerated in many countries, but can be part of the reason for subsidizing wind power production, where that is the practice. Secondly, wind power is

climate-friendly in the sense that no climate gases are emitted during electricity generation.[74]

Wind power also has negative external effects. Most commonly cited are the impacts on fauna and landscape view (Dai et al., 2015; Wang & Wang, 2015). Other external effects discussed are, for example, infra-noise and negative effects on reindeer herding (Eftestøl et al., 2023; van Kamp & van den Berg, 2018). In relation to property values, the most important issues are the changing landscape and noise/light issues, as both can negatively impact the values of adjacent properties.

2.1 Property values and hedonic pricing

Hedonic pricing is one of the primary methods used to value non-market goods. Fundamentally, it presumes that an individual's decision to purchase goods or services depends on the features or attributes of those goods (Hanley et al., 1997). The hedonic pricing method is frequently employed when examining property markets (e.g., Khoshnoud et al., 2023).

We can typically divide the characteristics controlled for in hedonic price models into three groups (Khoshnoud et al., 2023; Kong et al., 2007; Skenteris et al., 2019). First, we have physical attributes of the property, such as size, number of rooms, age or construction year, heating, and house type. Second, we have neighborhood characteristics such as good schools, transportation infrastructure, and closeness to services. Finally, we have environmental characteristics such as views, noise, air pollution, and proximity to lakes and forests. By analyzing data on such characteristics, econometrics can be used to derive values of property changes for different characteristics.

3 Literature review

This section reviews the existing empirical literature on the impact of wind turbines on property values. The aim is twofold: first, to illustrate the variation in findings across countries and methodologies, and

[74] However, the climate effect is priced through the EU emissions trading system, which raises electricity prices. Thus, the climate effect is already internalized.

second, to situate the studies included in our meta-analysis within the broader field of research. We therefore discuss both studies that are part of our sample and others that were excluded.

In an early study, Sims and Dent (2007) find that property values located within a mile of a wind farm were affected to a relatively modest degree in the UK. These results contradicted interviews conducted with estate agents from the area, which revealed no negative attitudes toward wind farms upon the purchase of nearby houses. By analyzing over 11,000 sales transactions in the USA, Heintzelman and Tuttle (2012) study the impact of wind power on property values. Their results also indicate that closer proximity to wind farms leads to a reduction in property values. This result was again confirmed by Sunak and Madlener (2016) in a study covering North Rhine-Westphalia, Germany. The results of negative impacts are further confirmed by Dröes and Koster (2021) and Eichholtz et al. (2023), both studying the Netherlands, Joly and De Jaeger (2021) studying Belgium, and Westlund and Wilhelmsson (2021) studying Sweden.

However, there are also studies that yield mixed or nonsignificant results. For example, Heintzelman et al. (2017) find, on the one hand, decreasing values in New York, USA. However, on the other hand, no negative impacts were identified for properties in Ontario, Canada. Similarly, Skenteris et al. (2019) study two Greek islands and find a decrease in property values for properties withing 2 km from wind firms in Evia, but no significant effect in Kefalonia. Jensen et al. (2018) employ hedonic pricing models to examine the impact of onshore and offshore wind turbines on property values in Denmark, yielding mixed results. More specifically, the authors find that the price of properties within three kilometers of an onshore wind farm is negatively affected, while they find no impact of offshore wind turbines. Several studies report that property values are not affected by nearby wind farms, in the UK (Sims et al., 2008), USA (Carter, 2011; Castleberry & Greene, 2018; Hoen et al., 2011; Lang et al., 2014; Laposa & Mueller, 2010), and in Ashhurst, New Zealand (McCarthy & Balli, 2014).

Our study explicitly tests the effect of wind turbines on property prices at varying distances, categorized into distance bands. We further control for the impact of population density on the change in property

value when wind farms are announced or built. We believe this to be one possible explanation of the differences in the previous literature. We also test the hypothesis that earlier wind power developments have a smaller impact on adjacent property prices, possibly because they utilize land where the impacts on the population would be less significant or due to technological advancements, resulting in higher wind turbines with wider blades.

4 Meta-regression analysis

We use a meta-regression analysis to examine which variables are of importance when estimating the effect of wind power plants on property values. A meta-regression analysis is a statistical method that combines the results of related studies to investigate study-to-study variation (Stanley, 2001). Consequently, meta-analysis has become a conventional tool to summarize existing evidence in a research field (Havránek et al., 2020).

4.1 Study selection

The literature search was initially conducted in June 2023 and updated in March 2025, using the search engines Google Scholar and Elicit. To find relevant studies, a predefined search query with placeholders for "wind power" and "property value" was used (Table 1). To ensure that no relevant studies were excluded, we went through a literature review by Parsons and Heintzelman (2022) and employed backward snowballing, where we examined the reference lists of the included papers to identify additional studies.

Table 1: Predefined search query

Search term category	Synonyms
Wind power	"wind turbine" or "wind farm"
Property value	"real estate", "residential property", or "property price"

Note: The search term categories were interconnected via the Boolean operator "AND".

Figure 1 illustrates the flowchart of the selection process. Only studies written in English were included. We also used several selection criteria to ensure comparability between the included studies. Only studies using hedonic price models with a semi-logarithmic functional form were included in the meta-analysis. By solely including hedonic price models with a semi-logarithmic functional form, we ensure comparability between the included studies and their reported coefficients. This restriction led to the exclusion of studies using surveys and preference choice models. Thus, the sample was restricted to studies examining the effect on actual, and not perceived, property values.

Regarding property type, we only included studies with estimates based on residential properties and/or residential land. The sample was further restricted to studies based on individual-level data, i.e., where property prices for each property are measured. Lastly, our sample was restricted to one measurement for wind turbine disturbance, the actual distance. Distance is the most common measurement in this literature, as it is expected to incorporate other disturbance effects, such as noise, view, and flicker. However, there are two ways to measure the effect of distance to wind turbines on property values: using distance bands or inverse distance. As previous literature has found the effect of distance to wind turbines on property values to be non-linear (e.g., Dröes & Koster, 2021; Guo et al., 2024), distance bands are the favorable distance measurement. Furthermore, distance bands enable us to estimate the effect at different distances and when the effect, if any, increases or diminishes.

Linnala (2024) and Mei et al. (2024) are two studies excluded because they did not use hedonic price models. Linnala (2024) finds no significant effect of wind farm visibility on residential land within 1 km distance bands, up to 5 km of a wind farm. Mei et al. (2024) finds a negative price effect for land parcels within 1 to 3 km and a positive price effect for those between 3 and 6 km from a wind turbine.

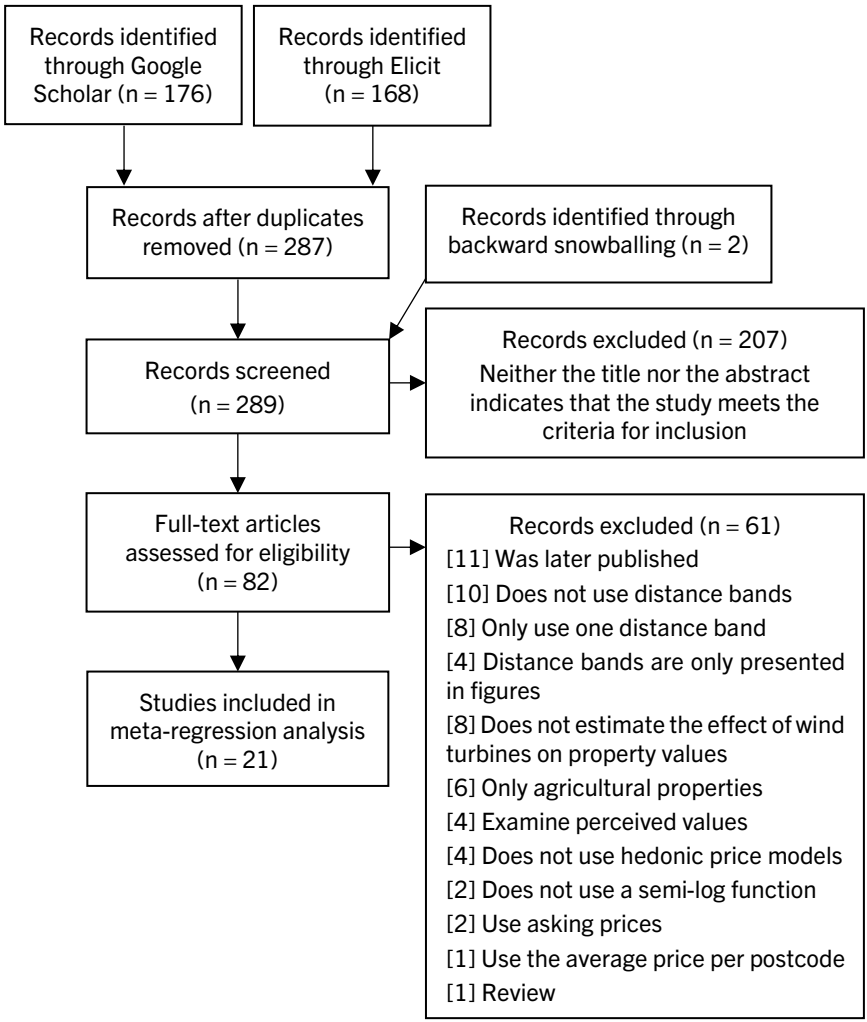

Figure 1: Flowchart of the selection process

4.2 Dataset

Our initial search encompassed articles published in academic journals, as well as gray literature, including working papers, reports, conference papers, and theses at various levels. We ended up with a sample of 16 articles published in academic journals, two working papers, two PhD thesis chapters, and one conference paper. These 21 studies provided

255 estimates of the effect of the distance of wind turbines on property values, at different distance bands.

To avoid skewing the results toward any paper, we include estimates from one model for each paper, unless the paper presents results for different sub-samples. If estimates are presented for different sub-samples, we also include estimates from one model per sub-sample. Thus, when more observations are included from a paper, it is generally because more distance bands are used in that paper. For example, three observations are included from Vyn and McCullough (2014) as three distance bands – 0–1 km, 1–3 km, and 3–5 km – are used in the study. On the contrary, 20 observations from estimates based on the full sample are included from Guo et al. (2024), as distance bands of 500 m each are used, extending up to 10 km from wind turbines.

To increase comparability between the studies, we primarily use regressions that include distance bands as the sole measure of wind turbine disturbance.[75] If several models that solely include distance bands are presented, the model that is assumed to be the preferred model is used. Suppose a study does not include a model that solely uses distance bands to measure the impact of wind turbines. In that case, we include a model from that study that also controls for other indicators of wind turbine disturbances and is assumed to be the authors' preferred or most reliable model.

The included studies are summarized in Table 2, which shows the studied county, time period, sample size, and general findings of each study. The number of estimates from each study that are included in our meta-analysis is also presented in Table 2. As previously mentioned,

[75] One extreme example is Meyer (2021). The author's preferred model appears to be a Difference-in-Difference-in-Differences model, where visible wind turbines within a distance band are compared to non-visible wind turbines within the same distance band. Thus, this model isolates the effect of wind turbine view and disregards other effects, such as noise. Therefore, to ensure comparability with other studies and decrease the risk of disregarding some wind turbine disturbance effects, we include one of the authors' more basic models, which focuses on the effect of proximity.

some studies present their estimates for their whole sample, while others present estimates for different sub-samples. In Table 2, we differentiate between estimates based on full sample observations, in the column called "Full", and estimates based on sub-samples, in the column called "Sub".

Table 2: Studies included in the meta-analysis

Study	Country	Study period	Study sample	General findings	Incl. obs.	
					Full	Sub
Hoen et al. (2011)	US	1996–2007	7,459	ø	16	
Heintzelman & Tuttle (2012)	US	2000–2009	11,331[76]	↓		20
Gorelick (2014)	US	2000-2013	67,768	↑	10	
Lang et al. (2014)	US	2000–2013	48,557	ø	8	
Vyn & McCullough (2014)	Canada	2002–2010	7,004[77]	ø	3	
Hoen et al. (2015)	US	1996–2012	51,276[78]	ø	4	
Hoen & Atkinson-Palombo (2016)	US	1998–2012	122,198	ø	4	
Sunak & Madlener (2016)	Germany	1992–2010	2,141	↓	5	
Sunak & Madlener (2017)	Germany	1992–2010	1,405	↓	5	
Vyn (2018)	Canada	2002–2013	22,159[79]	↓,ø	12	24
Yu & Levy (2018)	US	2006-2015	1,624	↓	6	

[76] 11,331 is the total number of observations used in Heintzelman and Tuttle (2012). However, their sample is divided into three markets: Clinton County, 6,142 observations; Franklin County, 3,251 observations; and Lewis County, 1,938 observations.

[77] The authors divided these into two sub-samples: rural residential houses, 5,414 observations, and farmland, 1,590 observations. In this paper, we include the estimates for residential properties.

[78] Out of these, 38,407 observations are included in the relevant model, which is a spatial error model (SEM).

[79] 19,683 sales are in areas opposed to wind farms, while 2,476 sales are in unopposed areas.

Skenteris et al. (2019)	Greece	2006–2016	1,816[80]	↓,Ø		4
Jarvis (2021)	UK	1995–2020	8,100,000	↓	5	
Joly & De Jaeger (2021)	Belgium	2004–2016	207,776[81]	↓	6	12
Meyer (2021)	England and Wales	1995–2018	4,717,888	Ø	5	
Westlund & Wilhelmsson (2021)	Sweden	2013–2018	97,229	↓	9	
Westlund & Wilhelmsson (2022)	Sweden	2005–2018[82]	134,621[83]	↓		18
Dong et al. (2023)	US	2000–2019	369,260	↓	6	
Eichholtz et al. (2023)	Netherlands	1985–2015	~2,300,000[84]	↓	4	
Brunner et al. (2024)	US	2015–2020	496,054[85]	↓	3	6
Guo et al. (2024)	US	1997–2020	8,482,088	↓	20	40

Note: Where Ø, ↓, and ↑ specify the general findings: Ø indicate no effect, ↓ indicate a price decline, and ↑ indicate a price increase.

Table 2 shows that the included studies were published between 2011 and 2024 and use data from 1985 to 2020. Examining the general findings, the included studies generally find that wind turbine distance has either a negative effect or no significant impact on residential prices. One interesting pattern is that recent studies more often find a negative effect. As explained by Westlund and Wilhelmsson (2022), wind turbines have grown larger, both in height and blade size, and wind turbines are built closer to residential areas as wind power production expands. This likely leads to higher degrees of visual and noise disturbances

[80] Out of these, 400 properties are in Evia and 1,416 are in Kefalonia.

[81] 83,241 properties are in West Flanders and 124,535 are in East Flanders.

[82] The period used for the relevant estimations is 2012–2018, even though other parts of the paper use data for the period 2005–2018.

[83] These are divided into three sub-samples: 95,716 sales are in the south of Sweden, 24,980 in the central region, and 13,925 in the north of Sweden.

[84] 1,196,458 of these are included in the relevant model.

[85] 358,734 of these are in counties with a population of 250,000 or more, and 135,874 are in counties with a population of less than 250,000.

within the same distance, which might explain this pattern. Moreover, data and methodological choices may also impact the overall findings.

4.3 Effect size measures

In this meta-analysis, the included studies employ semi-logarithmic regression equations with distance bands to investigate whether, and to what extent, wind turbines impact property prices. As distance bands are dummy variables, the estimated coefficient cannot be interpreted as the percentage change. Halvorsen and Palmquist (1980) explain that, as dummy variables are dichotomous variables, their coefficients measure the dichotomous effect of a factor's existence, operationalized by the dummy variable, on the dependent variable.[86] The coefficient of a dummy variable, c, can be interpreted as $\ln(1+g)$, where g is the relative effect on the dependent variable. Thus, the relative effect (g) equals $e^c - 1$, and the percentage effect is:

$$100 * (e^c - 1) \quad \textbf{(1)}$$

where c denotes the coefficient estimate. We apply the calculation in Eq. 1 to the coefficient estimates of the included studies.[87]

4.4 Publication bias

One factor that might influence published estimates, except for the choice of data, methodological choices, and model specifications, is publication bias. Publication bias occurs when researchers or journals reject findings based on the effect's direction, magnitude, or statistical precision, resulting in a skewed representation of reality in the literature. A simple yet effective method for detecting publication bias is to

[86] Where a semi-logarithmic regression equation with a single dummy variable, i.e., $\ln Y = a + \sum_i b_i X_i + cD$, can be written as $y = (1+g)^D \exp(a + \sum_i b_i X_i)$ (Halvorsen & Palmquist, 1980).

[87] However, Jarvis (2021) estimates the effect of added capacity within different distance bands. Thus, the author uses continuous, and not dichotomous, variables. Instead of using the adjustment in Eq. 1, these estimates are multiplied by 100.

utilize a funnel plot (Stanley & Doucouliagos, 2010). We conduct two funnel plots, one for the whole sample and one for distances between 0 and 2 km from a wind turbine. As we could not draw any clear conclusions from the funnel plots (Figure A1 and A2 in Appendix A), we turned to a more formal method to detect publication bias. A related asymmetry test to the funnel plots in Figures A1 and A2 is to regress the t-value for each estimate as a function of their precision (Stanley & Doucouliagos, 2010; Tang & Liu, 2000):

$$t_i = \beta_0 + \beta_1 \left(1/_{SE_i}\right) + v_i \quad \textbf{(2)}$$

where t_i and SE_i are the t-value and standard error for each reported estimate i, and v_i is the error term. The estimated intercept, $\hat{\beta}_0$, provides an estimate of the publication bias. The sign indicating the direction of the bias and the significance of the intercept indicate whether publication bias is present.

However, as argued by Valickova et al. (2015), when multiple estimates are included for each study, there is a potential dependence within studies. In a test for publication bias, the within-study dependence can be controlled for by applying the mixed-effects multilevel model:

$$t_{ij} = \beta_0 + \beta_1 \left(1/_{SE_{ij}}\right) + \alpha_j + \epsilon_{ij} \quad \textbf{(3)}$$

where t_{ij} and SE_{ij} are the t-value and standard error for each reported estimate i in study j. Further, α_j and ϵ_{ij} are two components of the overall error term in Eq. 2, where α_j is the study-level random effects and ϵ_{ij} is the estimate-level disturbances.

Table 3 presents the results from the mixed-effects multilevel model in Eq. 3. Where the rejection of the null hypothesis of $\beta_0 = 0$ implies the existence of funnel asymmetry and visible publication bias. Similar to the funnel plots (Figure A1 and A2 in Appendix A), the model is estimated both for the entire sample, in column 1, and for estimates for distance bands within 2 km, in column 2. Table 3 reports no indications for publication bias, as the constants are insignificant for both estimations.

Table 3: Test for publication bias

	(1)	(2)
$1/SE_{ij}$	-0.006***	-0.138***
	(0.001)	(0.02)
Constant (bias)	-1.429	4.026
	(1.029)	(2.725)
Within-study correlation	0.297	0.714
Observations	254	87
Nr of studies	21	21

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the study level are presented in parentheses. Column 1 included all collected estimates in this study, except for one, which was excluded as both the estimated effect and the standard error were equal to 0. Column 2 only includes estimates for distance bands within 2 km.

4.5 Variable definitions

In the meta-analysis, our dependent variable is the estimated percentage price change, as it facilitates a clearer understanding of how proximity to wind power plants is associated with variations in property values, compared to the estimated coefficient. The main explanatory variables are four distance bands of 1 km each, estimating the price change relative to properties more than 4 km from a wind turbine. Further, to understand study-to-study variation, we include moderator variables for (1) whether the estimate measures the construction or announcement effect; (2) the population density in the area; (3) the mean year for construction or announcement, depending on which effect is being measured; and (4) whether the estimate is significant at the 10 percent level. As we employ a fixed-effects model and include estimates from one model per study, as further discussed in Section 4.6, we do not include moderator variables related to method choices, as these would be omitted anyway. Table 4 summarizes the definitions and basic descriptive statistics for our dependent and independent variables. As shown in Figure A1 (Appendix A), there are three extreme

outliers. These outliers are excluded from the descriptive statistics and from our regression analysis.[88]

Table 4: Variable definitions and descriptive statistics

Variables	Definition	Mean	Std. Dev.	Min	Max	Obs
est	Estimated price change	-0.034	0.067	-0.392	0.120	252
$\Delta Price$	Percentage price change	-3.140	6.136	-32.43	12.75	252
$0-1$ km	Distance band, 0–1 km	0.135	0.342	0	1	252
$1-2$ km	Distance band, 1–2 km	0.099	0.300	0	1	252
$2-3$ km	Distance band, 2–3 km	0.087	0.283	0	1	252
$3-4$ km	Distance band, 3–4 km	0.06	0.237	0	1	252
>4 km	Distance band, > 4 km	0.349	0.478	0	1	252
$PostCon$	Dummy, 1 if the observation measures construction, and not announcement, effects	0.710	0.455	0	1	252
$PopDens$	Population density	315.9	531.6	6.011	2,521	252
$Year$	Construction or announcement year	2010	3.631	2000	2015	252
$Sig10$	Dummy, 1 if the estimate is significant at a 10% level	0.421	0.495	0	1	252
With imputed values						
$0-1$ km	Distance band, 0–1 km	0.210	0.408	0	1	252
$1-2$ km	Distance band, 1–2 km	0.194	0.397	0	1	252
$2-3$ km	Distance band, 2–3 km	0.147	0.355	0	1	252
$3-4$ km	Distance band, 3–4 km	0.099	0.300	0	1	255

Note: The statistics are average value (Mean), standard deviation (Std. Dev.), minimum (Min), maximum (Max), and number of observations (Obs).

Our dependent variable is $\Delta Price$. $\Delta Price$ is the percentage price change in property values, which is a transformed version of the estimate, est, in accordance with Eq. 1.

The main explanatory variables are the distance bands. In our main model, the distance bands are 0–1 km, 1–2 km, 2–3 km, 3–4 km, and more than 4 km, as we want to use distance bands that are short enough

[88] These three outliers correspond to positive price changes of 52, 55, and 110 percent, respectively.

to capture changes in the estimated effect while being long enough to include a sufficient number of estimates. However, as not all observations are included in these distance bands, we estimate the same model with imputed values for larger distance bands. For example, if a study estimates the effect for distances between 0 and 2 km, that estimate is included both in the 0–1 km and 1–2 km distance bands. Further, we estimate the effect with larger distance bands in the sensitivity analysis.

As the included observations either examine the announcement effect or the construction effect, we include a dummy for post-construction, called $PostCon$. Table 4 show that 71 percent of the observations examine the post-construction period, i.e., the construction effect, while the remaining 29 percent examine the post-announcement and pre-construction period, i.e., the announcement effect.

The variable $Year$ is included to account for the period in which the price change was estimated. As each of our estimations is the mean price change within a specific area, we use the mean announcement or construction year for that area. When sub-samples are used, the mean announcement or construction year is calculated for each sub-sample; otherwise, it is calculated for the entire sample. We primarily collect information on the announcement and construction year from each study. However, when this information is not included in a study, the variable is estimated based on available information on wind turbines in the area.

Population density ($PopDens$), measured as inhabitants per square kilometer, is included as a moderator variable to examine whether differences in the estimated effects across studies can be attributed to variations in the degree of urbanization. This allows us to test whether the impact of wind turbines on property values is systematically larger in densely populated areas, where both opposition and exposure may be higher. As with the $Year$ variable, we primarily extract population density data from the studies themselves. When such information is missing, we use external sources to estimate the population density for the relevant announcement or construction year, depending on which effect is analyzed. Lastly, $Sig10$ accounts for whether the estimate,

which we include as an observation, is significant. As shown in Table 4, this is true for 42 percent of our sample.

4.6 Econometric specification

To estimate the effect of proximity to wind turbines on property prices across studies, we employ a meta-regression framework. This approach enables us to systematically combine results from different contexts while also accounting for study-specific differences. As there are small variations between the distance bands used in the included studies, multiple observations from one study can be included in the same distance band. Estimates from the same source may be correlated, and when multiple observations from the same paper are used for the same variable, heteroscedasticity may occur. If an OLS model is used, this heteroscedasticity might lead to biased and inefficient estimates. Thus, to account for study-specific effects, we employ a fixed-effect regression model, with standard errors clustered at the study level:

$$\Delta Price_{ij} = \mu_j + \sum_{k=1}^{K} \beta_k DistBands_{kij} + \beta_{K+1} PostCon_{ij} + \beta_{K+2} PopDens_{ij} + \beta_{K+3} Year_{ij} + \beta_{K+4} Sig10_{ij} + \varepsilon_{ij} \quad (4)$$

where i index each included estimate, and j indexes the individual study. $\Delta Price_{ij}$ is the percentage change in property prices, with respect to a set of K distance bands, $DistBands_{kij}$. We include four distance bands in the main model: 0–1 km, 1–2 km, 2–3 km, and 3–4 km, which are estimated relative to the excluded dummy >4 km. The model also includes a set of moderator variables: $PostCon$ is a dummy variable equal to one if it is the construction, and not announcement, effect that is estimated, $PopDens_{ij}$ is the population density in the studied area, $Year_{ij}$ is mean construction, or announcement, year, and $Sig10_{ij}$ indicates whether the estimate is significant at, at least, 10 percent level. Lastly, μ_j is the study-fixed effects and ε_{ij} is the classical error term.

The study-fixed effects help remove the effect of study-invariant from the regression process and focuses on the within-study variation. Thus, this allows us to estimate the effect at different distances based on the within-study variation, while controlling for whether a study finds an

overall negative or positive effect at all distances. One obvious drawback with study-fixed effects is that the effect of different method specifications on studies' results cannot be estimated. However, the effect of methodological choices in wind turbine studies has already been thoroughly examined by Schütt (2024). Thus, we focus on variables that have not been previously examined, such as the effect at different distance bands and whether population density in the studied area affects the price effects.

5 Empirical results

Table 5 presents the results from our fixed-effects model. We include both full and sub-sample estimates in our main estimation to account for within-study variations in construction/announcement year and population density. Columns 1–5 in Table 5 only include estimates from distance bands of 1 km or within 1 km. However, as larger distance bands or distance bands based on miles are used in some studies, columns 6–8 include imputed values for these studies.

Columns 1–4 in Table 5 show that there is a negative and significant effect for all distance bands within 4 km, relative to properties more than 4 km away from wind turbines. For properties within 1 km of a wind turbine, the negative effect size is approximately 5.9 percentage points. For the remaining distance bands, the negative size effect is 5.4 percentage points for properties within 1–2 km, approximately 4.1 percentage points for properties within 2–3 km and 3–4 km, compared to properties further than 4 km from a wind turbine. Thus, the impact is generally greater the closer the property is to the wind turbine. When including a control for significant estimate, in column 5, the magnitude of the size effect is lower for all distance bands. Further, the coefficient for the significance dummy is significantly negative, indicating that significant estimates are generally more negative, with a magnitude of 2.6 percentage points.

Table 5: FE model, estimates based on full and sub-samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0–1 km	-5.889**	-5.889**	-5.889**	-5.889**	-5.000*	-3.377**	-3.366**	-2.652**
	(2.444)	(2.453)	(2.463)	(2.472)	(2.471)	(1.430)	(1.447)	(1.267)
1–2 km	-5.366***	-5.366***	-5.366***	-5.366***	-4.156***	-2.634*	-2.641*	-1.695
	(0.592)	(0.594)	(0.596)	(0.598)	(0.831)	(1.277)	(1.278)	(1.105)
2–3 km	-4.104***	-4.104***	-4.104***	-4.104***	-3.254**	-1.453	-1.443	-0.717
	(1.120)	(1.124)	(1.128)	(1.133)	(1.238)	(0.885)	(0.903)	(0.921)
3–4 km	-4.103***	-4.103***	-4.103***	-4.103***	-3.015***	-1.912*	-1.914*	-0.646
	(0.214)	(0.215)	(0.216)	(0.216)	(0.644)	(0.949)	(0.953)	(0.897)
PostCon		-0.605	-0.604	-0.907	-0.397		0.527	1.208
		(1.018)	(1.022)	(1.164)	(1.043)		(1.542)	(1.423)
PopDens			-0.001***	-0.001***	-0.000		-0.001**	0.000
			(0.000)	(0.000)	(0.000)		(0.001)	(0.001)
Year				0.576	0.494		-0.344	-0.290
				(0.499)	(0.428)		(0.582)	(0.483)
Sig10					-2.642***			-4.506***
					(0.678)			(1.181)
Constant	0.004	0.458	0.751	-1,157.296	-990.956	-1.515**	690.666	582.290
	(0.711)	(1.287)	(1.292)	(1,001.590)	(858.165)	(0.628)	(1,168.738)	(969.504)
Observations	137	137	137	137	137	252	252	252
Adjusted R^2	0.622	0.621	0.622	0.621	0.678	0.410	0.406	0.506
R^2 within	0.381	0.384	0.392	0.395	0.489	0.130	0.136	0.284
Adjusted R^2 within	0.361	0.359	0.362	0.360	0.455	0.114	0.109	0.258

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the study level are presented in parentheses. Columns 1–5 are without any imputed values, and columns 6–8 are with imputed values from studies that use distance bands other than those of 1 km each.

The magnitude and significance of the distance bands decrease further when imputed values are included for studies with distance bands which does not fit within the 1 km bands, in columns 6–8 in Table 5. It is reasonable to observe some decrease in magnitude, as larger distance bands are included in several of the 1 km distance bands. However, it is unexpected that the negative size is reduced by more than half, which might indicate that studies using larger distance bands find a lesser impact of wind turbines.

Table 5 also shows a negative and significant effect of higher population density, in columns 3, 4, and 7. Put more precisely, in study areas with one more inhabitant per km, a more negative effect of 0.01 percentage points is found. This finding aligns with our hypothesis that population density influences the impact of wind turbines. For our other hypothesis, that later wind power development has a higher impact on property prices, as it has become harder to avoid areas with other competing values and wind turbines increase in size, we do not find a significant effect. If anything, there is a positive effect of the construction or announcement year. However, the variable is based on the mean year of announcement or construction. For short time periods or areas with very few wind turbines, the mean year may be a good indication of the announcement or construction year. For studies examining the effect in entire countries or for a very long period, however, it might not be a proper measurement.

Furthermore, the result indicates that studies analyzing the construction effect, compared to the announcement effect, find a more negative impact on property prices (columns 2–5). However, when imputed values are included (columns 7 and 8), the coefficients become positive. In both cases, the variable is insignificant, indicating that there is no significant difference in the price effect when wind turbines are constructed or when the construction of future wind turbines is announced.

5.1 Sensitivity analysis

To test the robustness of our estimations, we conduct three sensitivity analyses. Firstly, we estimate our model based on full sample observations in Table 6. By only using full sample estimates, we decrease the risk that a few studies, with more observations within each distance band, skew the sample. However, by only including full sample observations, we decrease the within-study effects, especially for variables such as population density and construction or announcement year. Secondly, in the main estimation, three extreme outliers are excluded. As all three outliers have positive price effects, we also want to examine whether our results are robust to the exclusion of six negative, but less

extreme, outliers, as shown in Table 7.[89] In Tables 6 and 7, columns 1–5 only include estimates from distance bands of 1 km or within 1 km, while columns 6–8 also include imputed values for studies with distance bands of other sizes. Lastly, we test the effect of different distance bands in Tables 8 and 9, without any imputed values.

Columns 1–5 in Table 6 show that there is a negative and significant effect of the four distance bands when only full sample estimates are included. More specifically, there is a negative size effect of 5.5–6.5 percentage points for properties within 0–1 km, 4.3–5.3 percentage points for properties within 1–2 km, 3.5–4.3 percentage points within 2–3 km, and 2.3–4.1 percentage points within 3–4 km, relative to properties more than 4 km from a wind turbine.

Interestingly, all moderator variables are significant in columns 4 and 5 in Table 6. The reason that some within-study variations persist when only estimates based on full sample observations are included is that several studies examine both the announcement and construction effect. However, when the within-study variation is only dependent on whether the announcement or construction effect is being examined, there is a higher risk of correlation between the *PostCon*, *Year*, and *PopDens*, potentially leading to imprecise estimations.[90] When values are imputed for distance bands other than 1 km each, all variables become insignificant, except for population density and the significance dummy, shown in columns 6–8 in Table 6.

[89] Six estimates are excluded, all of which have negative price effects ranging from 20.9 to 32.4 percent.

[90] Looking at the correlation matrix, there is a negative correlation of 63.6 percent between *PostCon* and *PopDens* when only estimates based on full sample observations are included, compared to a negative correlation of 8.2 percent when all estimates are included.

Table 6: FE model, estimates based on full samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0–1 km	-6.557**	-6.557**	-6.557**	-6.557**	-5.475**	-2.251	-2.251	-1.511
	(2.233)	(2.253)	(2.274)	(2.295)	(2.275)	(1.589)	(1.608)	(1.362)
1–2 km	-5.280***	-5.280***	-5.280***	-5.280***	-4.277**	-1.906	-1.906	-1.324
	(1.064)	(1.073)	(1.083)	(1.094)	(1.321)	(1.456)	(1.474)	(1.259)
2–3 km	-4.252**	-4.252**	-4.252**	-4.252**	-3.545**	-1.016	-1.016	-0.662
	(1.380)	(1.392)	(1.405)	(1.418)	(1.401)	(0.977)	(0.989)	(1.009)
3–4 km	-4.082***	-4.082***	-4.082***	-4.082***	-2.867*	-0.795	-0.795	0.443
	(0.936)	(0.944)	(0.953)	(0.962)	(1.309)	(1.094)	(1.107)	(1.239)
PostCon		-0.501	-0.393	-1.166***	-0.506**		0.735	1.516
		(0.577)	(0.729)	(0.272)	(0.163)		(1.633)	(1.530)
PopDens			-0.146	-0.576***	-0.338***		-0.614**	-0.375*
			(0.253)	(0.064)	(0.094)		(0.229)	(0.208)
Year				0.979***	0.727***		0.099	-0.005
				(0.127)	(0.110)		(0.584)	(0.472)
Sig10					-2.957***			-4.310**
					(0.811)			(1.906)
Constant	-0.044	0.325	28.593	-1,853.913***	-1,393.374***	-1.540*	35.634	152.926
	(0.956)	(1.224)	(48.036)	(252.081)	(204.781)	(0.861)	(1,206.203)	(991.963)
Observations	61	61	61	61	61	131	131	131
Adjusted R^2	0.808	0.805	0.801	0.805	0.844	0.522	0.511	0.577
R^2 within	0.546	0.549	0.550	0.567	0.662	0.0798	0.0854	0.217
Adjusted R^2 within	0.509	0.503	0.492	0.502	0.602	0.0461	0.0250	0.157

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the study level are presented in parentheses. Columns 1–5 are without any imputed values, and columns 6–8 are with imputed values from studies that use distance bands other than those of 1 km each.

Table 7 shows the results after the exclusion of six potential outliers with negative price effects between 20.9 and 32.4 percent. Columns 1–5 only include estimates from distance bands of 1 km, while columns 6–8 also include imputed values for studies with distance bands of other sizes.

Table 7: FE model, excl. potential outliers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0–1 km	-5.556***	-5.556***	-5.556***	-5.556***	-4.830***	-2.394***	-2.395***	-1.898**
	(1.208)	(1.219)	(1.197)	(1.201)	(1.148)	(0.824)	(0.814)	(0.762)
1–2 km	-5.394***	-5.394***	-5.394***	-5.394***	-4.267***	-2.030***	-2.023***	-1.205*
	(0.659)	(0.645)	(0.654)	(0.649)	(0.745)	(0.742)	(0.744)	(0.715)
2–3 km	-4.131***	-4.131***	-4.131***	-4.131***	-3.338***	-0.582	-0.578	-0.064
	(0.643)	(0.639)	(0.651)	(0.653)	(0.681)	(0.849)	(0.863)	(0.826)
3–4 km	-4.199***	-4.199***	-4.199***	-4.199***	-3.166***	-2.131***	-2.132***	-1.022
	(0.798)	(0.778)	(0.809)	(0.802)	(0.826)	(0.713)	(0.737)	(0.706)
PostCon		-0.605	-0.604	-0.907	-0.436		0.026	0.641
		(0.690)	(0.692)	(0.824)	(0.785)		(0.964)	(0.929)
PopDens			-0.001	-0.001	-0.000		-0.002*	-0.000
			(0.001)	(0.001)	(0.001)		(0.001)	(0.001)
Year				0.576	0.500		0.152	0.148
				(0.522)	(0.513)		(0.568)	(0.593)
Sig10					-2.442***			-3.743***
					(0.595)			(0.610)
Constant	0.106	0.560	0.851	-1,157.231	-1,003.465	-1.455***	-306.592	-297.395
	(0.387)	(0.595)	(0.624)	(1,049.453)	(1,030.445)	(0.398)	(1,140.459)	(1,191.373)
Observations	136	136	136	136	136	246	246	246
Adjusted R^2	0.570	0.570	0.571	0.571	0.626	0.349	0.345	0.440
R^2 within	0.380	0.384	0.392	0.396	0.478	0.0936	0.101	0.235
Adjusted R^2 within	0.360	0.359	0.362	0.361	0.443	0.0772	0.0721	0.207

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the study level are presented in parentheses. Columns 1–5 are without any imputed values, and columns 6–8 are with imputed values from studies that use distance bands other than those of 1 km each.

Columns 1–4 in Table 7 show that coefficients are similar after the exclusion of the six most negative estimates, but with a marginally less negative effect size for properties within 2 km from a wind turbine and more negative for properties between 2 and 4 km from wind turbines. More precisely, after the exclusion and before controlling for significant estimates, there is a negative effect size of 5.56 percentage points for properties within 1 km from a wind turbine, 5.39 for properties within 1–2 km, 4.13 within 2–3 km, and 4.2 within 3–4 km, compared

to properties further away than 4 km from a wind turbine. This can be compared to the negative effect sizes in the main results of 5.89, 5.37, 4.104, and 4.103 percentage points, respectively. Once again, the effect size becomes less negative after controlling for the significance of the included estimates, shown in column 5. Further, compared to our main result, the size effect for population density remains negative but becomes insignificant. After the imputation for distance bands other than 1 km each, the size effects decrease in magnitude and significance, shown in columns 6–8 in Table 7. Population density becomes significant before controlling for significance in the included estimates, implying that a more negative effect of 0.02 percentage points is found in areas with one additional inhabitant per square kilometer.

We estimate the effect for different distance bands in Table 8. Columns 1–3 include the distance bands 0–2 km, 2–4 km, and 4–6 km, relative to properties more than 6 km away from a wind turbine. Columns 4–6 include distance bands for 0–4 km and 4–6 km, relative to more than 8 km.

Table 8 shows that the effect size becomes insignificant for distance bands more than 4 km from a wind turbine. In columns 1 and 2, there is a negative effect size of about 4.1 percentage points for properties within 2 km of a wind turbine and 3 percentage points for properties between 2 and 4 km, compared to more than 6 km from a wind turbine. However, for properties within 4–6 km, the effect size is insignificant. Similarly, in columns 4 and 5, there is a negative effect size of about 4.2 percentage points for properties within 4 km of a wind turbine and an insignificant effect for those between 4 and 8 km, compared to properties more than 8 km from a wind turbine. These effect sizes remain significant but decrease in magnitude when the significance dummy is included, in columns 3 and 6. Lastly, similar to our main results, there is a negative and significant effect size of 0.001 percentage points for the variable population density in columns 2 and 5.

Table 8: FE model, 2 km and 4 km distance bands

	(1)	(2)	(3)	(4)	(5)	(6)
0–2 km	-4.139***	-4.125***	-2.968***			
	(0.937)	(0.932)	(0.852)			
2–4 km	-3.031***	-3.010***	-1.821*			
	(1.096)	(1.086)	(0.981)			
4–6 km	0.711	0.721	0.367			
	(1.007)	(1.009)	(0.943)			
0–4 km				-4.173***	-4.170***	-2.556***
				(0.969)	(0.968)	(0.890)
4–8 km				-0.198	-0.195	0.210
				(0.857)	(0.858)	(0.816)
PostCon		0.445	1.138		-0.130	0.752
		(0.975)	(0.986)		(1.289)	(1.261)
PopDens		-0.001*	0.000		-0.001*	0.000
		(0.001)	(0.001)		(0.001)	(0.001)
Year		-0.463	-0.366		-0.074	-0.091
		(0.841)	(0.814)		(0.937)	(0.908)
Sig10			-4.356***			-4.764***
			(0.676)			(0.767)
Constant	-1.357***	928.621	734.787	-1.308**	148.885	181.724
	(0.501)	(1,690.751)	(1,634.794)	(0.622)	(1,883.066)	(1,824.020)
Observations	244	244	244	212	212	212
Adjusted R^2	0.420	0.417	0.511	0.424	0.418	0.519
R^2 within	0.136	0.142	0.284	0.142	0.147	0.299
Adjusted R^2 within	0.124	0.119	0.261	0.133	0.125	0.277

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the study level are presented in parentheses. Columns 1–3 include the distance bands 0–2 km, 2–4 km, and 4–6 km, relative to properties more than 6 km away from a wind turbine. Columns 4–6 include distance bands for 0–3 km and 3–5 km, relative to more than 5 km.

The effect size for different distance bands is further examined in Table 9. Columns 1–3 include distance bands for 0–3 km and 3–5 km, relative to more than 5 km to the nearest wind turbine. Columns 4–6 include the distance band 0–5 km, relative to more than 5 km.

Table 9: FE model, 3 km and 5 km distance bands

	(1)	(2)	(3)	(4)	(5)	(6)
0–3 km	-3.833***	-3.832***	-2.737***			
	(0.922)	(0.921)	(0.851)			
3–5 km	-0.958	-0.964	-0.903			
	(1.041)	(1.059)	(0.931)			
0–5 km				-3.577***	-3.566***	-2.287***
				(0.758)	(0.759)	(0.732)
PostCon		0.219	0.752		-0.399	0.534
		(1.349)	(1.261)		(1.371)	(1.288)
PopDens		-0.001	0.000		-0.001	0.001
		(0.001)	(0.001)		(0.001)	(0.001)
Year		-0.439	-0.091		-0.513	-0.438
		(0.965)	(0.908)		(1.747)	(1.581)
Sig10			-4.764***			-4.558***
			(0.767)			(0.753)
Constant	-1.308**	880.105	181.724	-1.192***	1,031.101	879.954
	(0.622)	(1,938.082)	(1,824.020)	(0.448)	(3,510.486)	(3,177.312)
Observations	220	220	220	166	166	166
Adjusted R^2	0.394	0.389	0.516	0.290	0.280	0.410
R^2 within	0.103	0.110	0.298	0.118	0.123	0.287
Adjusted R^2 within	0.0945	0.0871	0.276	0.113	0.100	0.263

Note: ***, **, and * indicate significant p-values at the 1 %, 5 %, and 10 % level, respectively. Standard errors clustered at the study level are presented in parentheses. Columns 1 to 3 include distance bands for 0–4 km and 4–8 km, relative to more than 8 km, and columns 4 to 6 include the distance band 0–5 km, relative to more than 5 km to the nearest wind turbine.

Similar to Table 8, Table 9 shows that the effect size becomes insignificant for distance bands around 4 km. Columns 1–3 show a significant negative effect size of properties within 3 km from a wind turbine, but no significant effect for properties within 3–5 km, compared to properties more than 5 km from a wind turbine. Furthermore, there is a significant negative size effect for properties within 5 km from a wind turbine, compared with those more than 5 km away, in columns 4–6.

6 Conclusion

There are several aims for conducting a meta-analysis, such as providing guidance on model specifications for future research or synthesizing the results of previous studies. In this meta-analysis, we do the latter. Our focus has been on finding estimates that can inform policies aimed at internalizing some of the external effects of wind power electricity generation.

In this paper, we use a meta-analysis to examine the effect of wind turbines on property values found in previous research. To account for study-specific effects, we use fixed-effect models with clustered standard errors. To decrease the risk of skewing our sample toward studies with more results tables, we narrow down the estimates from each study to one model for the study's entire sample and for its different sub-samples.[91] Thus, there is no within-study variation for model specifications. Instead, we focus on the effect of wind turbines on property values for properties within different distance bands from the turbines, as well as variables such as population density and the year of announcement or construction.

In our main regressions, shown in columns 1–5 in Table 6, we include distance bands for properties within 0–1 km, 1–2 km, 2–3 km, and 3–4 km from a wind turbine, relative to properties more than 4 km from the nearest wind turbine and find negative effect sizes for all distance bands. The negative effect size generally decreases as the property is further away from the wind turbine. Put more precisely, we find negative effect sizes of 5–5.9 percentage points for properties within the 0–1 km distance band, 4.2–5.4 percentage points for 1–2 km, 3.3–4.1 percentage points for 2–3 km, and 3–4.1 percentage points for properties between 3 and 4 km from a wind turbine, relative to more than 4 km.

[91] Both results from the studies' entire sample and their sub-samples are included in order to estimate whether population density and announcement/construction year affect the effect of wind turbines on property values. A sensitivity analysis is conducted when only estimates based on full samples are included.

When larger distance bands are used in our sensitivity analysis (Tables 8 and 9) we find that the effect size becomes insignificant for distance bands exceeding 4 km from a wind turbine. Furthermore, for these observations, and when values for studies with distance bands that do not fit 1 km bands are imputed, the effect size becomes less negative. In the latter case, there is a chance that precision is lost when forcing all observations into 1 km distance bands. Moreover, in our sensitivity analysis, properties within the applied distance bands are compared with estimates for properties 5, 6, or 8 km from a wind turbine.

We also test for two hypotheses: (i) that there is a larger effect on property prices for later construction and announcement years, as newer wind turbines are larger and it was easier for earlier wind power developments to avoid areas with other competing values; (ii) the effect on property prices should be higher in more populated areas. We find no support for our first hypothesis, as there is no significant effect of mean announcement or construction year. Regarding the second hypothesis, however, we find that studies conducted in more populated areas find more negative effects on property prices. Put more precisely, in study areas with one more inhabitant per km, a more negative effect of 0.01 percentage points is found.

Our analysis complements the findings of Schütt (2024). While Schütt (2024) focuses on how methodological choices such as model specification, estimation technique, and the inclusion of control variables affect estimated impacts, our contribution lies in examining variables that have received less attention. Specifically, we examine how distance bands and population density influence the estimated impact of wind turbines on property values. Taken together, the two studies provide a more complete picture of the literature: methodological design matters for the estimated effects, but so too do contextual factors such as area characteristics and proximity.

With regards to findings, Schütt (2024) reports that there is no effect of wind turbines for properties beyond 4.5 km. Similarly, we find the effect becomes zero around 4 km in our sensitivity analysis. However, this study finds a larger impact on property values within 4 km than Schütt (2024). Several possible explanations exist for these differences.

Except for the fact that we estimate the distance effects in different ways, the samples also differ. For example, while we exclude studies with only one distance band, for methodical reasons, these can be included in Schütt (2024). This study also includes some more recent studies in its sample.

Our findings have important implications for both future research and policy. Firstly, our results highlight the need for further investigation into the effects of population density and possible correlated characteristics, such as regional income and average property value, that likely influence the relationship between wind turbines and property values. Secondly, as shown by our analysis, the estimated effect size is to some degree affected by the size of distance bands and the distance they are estimated in relation to. Thus, to better understand the effect of the announcement or construction of wind turbines, we recommend using shorter distance bands when possible, and that properties at least 4 km from the wind turbine are used as control cases. Thirdly, while our meta-analysis explicitly examines wind turbine disturbance through distance bands, the effect of other potential disturbance measurements is not analyzed. Thus, future meta-analyses should consider incorporating alternative measures, such as view or number of turbines, to provide a more comprehensive understanding of how wind turbines influence property values.

From a policy perspective, our findings suggest that if compensation schemes are implemented for property owners near newly announced or constructed wind farms, both distance and population density should be considered, unless future research shows that the apparent role of population density is driven by related characteristics. Given that we observe more negative effects in study areas with higher population density, policymakers may need to design compensation structures that reflect not only proximity to turbines but also the characteristics of the surrounding area.

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Appendix A: Funnel plot

A funnel plot is a scatter diagram where the effect size is plotted against its precision, such as the inverse of the standard error. If no publication bias is present, the true effect should be mirrored by the most precise estimates. Moving down the figure, the less precise estimates should be more spread out but still symmetrically distributed around the true mean, creating the image of an inverted funnel.

Figure 2 shows the funnel plot of the included estimates in this study. The horizontal axis shows the effect size, measured as the estimated percentage change, and the vertical axis shows the precision of the estimates, measured as the inverse of the standard errors.[92] The funnel plot includes two vertical gray lines; the solid line indicates the mean percentage change, while the dashed line shows the point at which no effect occurs, i.e., where the percentage change equals zero.

There is no clear inverted funnel shown in Figure A1, suggesting that publication bias may be present. It is, however, important to note that the figure includes estimates of all distances, ranging from 0–0.5 km to 16–18 km. Thus, it is unclear if Figure A1 truly showcases the probability of publication bias or if it showcases the variation between different distances. To gain a better understanding of whether publication bias is prevalent, a funnel plot is created for estimates from distance bands between 0 and 2 km, as shown in Figure A2.

[92] It should be noted that for 85 of the included estimates, no standard errors are presented. When this is the case, we follow the transformation of Schütt (2024). Namely, when t-values exist, these are used to calculate the standard errors, together with the regression coefficients. When neither standard error nor t-values are reported, the p-values are used to calculate the t-value. Lastly, if the exact p-value is not reported, we use the p-value closest to the reported significance level. Lastly, if the coefficient is also insignificant, we set the p-value to 0.3, in accordance with Schütt (2024).

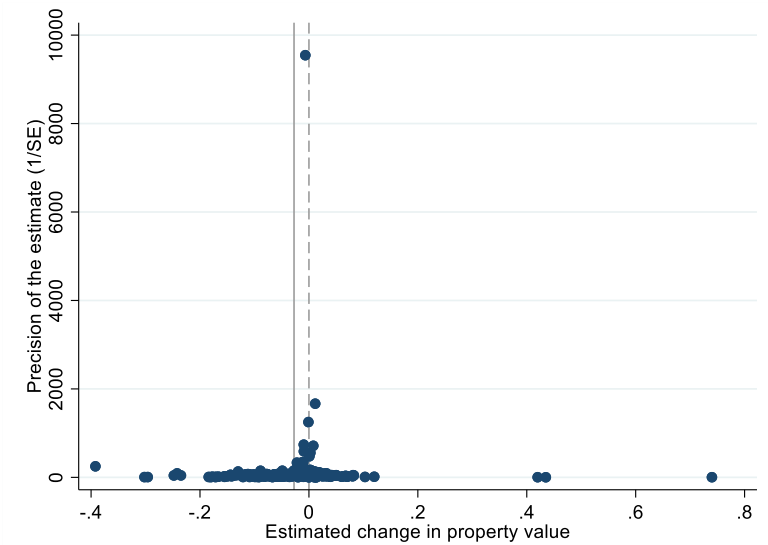

Figure A1: Funnel plot, all estimates
Note: The solid gray line indicates the mean percentage change, while the dashed gray line shows at which point no effect occurs, i.e., where the percentage change is equal to zero.

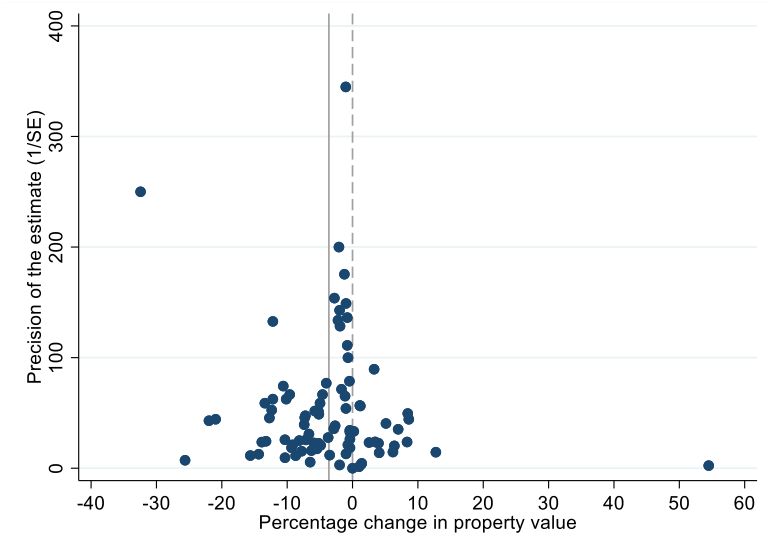

Figure A2: Funnel plot, estimates for distance bands 2 km or less
Note: The solid gray line indicates the mean percentage change, while the dashed gray line shows at which point no effect occurs, i.e., where the percentage change is equal to zero.

In Figure A2, the estimate with the highest precision is once again closer to zero, but lies between the sample mean and no effect. Furthermore, an inverted funnel is created between the mean percentage change and zero effect for estimates of a precision of 200, equal to a standard error of 0.005, and below. Indicating that there might be some publication bias present.[93]

[93] As the effect of wind turbines, if any, is expected to be higher at closer proximity to wind turbines, it is reasonable to assume that publication bias would be most prevalent within 2 km.

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