The Subsidy Program for the Price of Diesel Oil for Fishing Vessels and its impacts on the labor market and fish production in Brazil[1]

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Abstract

The fishing industry around the world is historically leveraged by government subsidies. In Brazil, one of the main subsidies to the segment acts on the price of fuel for vessels through the Subsidy Program for the Price of Diesel Oil for Fishing Vessels (PSPO). According to the ordinances of the Federal Official Journal (DOU), the transfers foreseen for this policy, in the period from 1997 to 2018, exceeded R$ 2.0 billion in subsidized oil. However, the economic, social and environmental impacts of this type of subsidy are controversial. Regarding the effects on the labor market, there is little evidence, especially in the national literature, and the results do not indicate an effect of the Program on the number of facilities and formal jobs in the fishing sector, in addition to not indicating an effect on the increase in extractive fish production, either. These results corroborate the fact that these financial resources may be being used to cover costs inherent to the fishing activity, ensuring artificial profitability, in a relatively stable production, in a renewable natural resource, with signs of depletion.

JEL Classification: Q22, Q58.

Keywords: subsidies; fuel prices; fishing industry; fishing production; labor market.

Resumo

O setor pesqueiro, em todo mundo, é historicamente alavancado por subsídios governamentais. No Brasil, um dos principais subsídios ao segmento atua sobre o preço dos combustíveis das embarcações através do Programa de Subvenção Econômica ao Preço do Óleo Diesel para Embarcações Pesqueiras (PSPO). De acordo com as portarias do Diário Oficial da União (DOU), os repasses previstos, dessa política, no período de 1997 a 2018, ultrapassaram os R$ 2,0 Bilhões em óleo subsidiado. Entretanto, os impactos econômicos, sociais e ambientais, dessa modalidade de subsídios são controversos. No que tange os efeitos sobre o mercado de trabalho são escassas as evidências, sobretudo na literatura nacional, e os resultados encontrados não indicam efeito do Programa sobre o número de estabelecimentos e de empregos formais do segmento pesqueiro, além de não indicarem efeito, também, sobre o aumento da produção pesqueira extrativa. Esses resultados corroboram o fato de que esses recursos financeiros podem estar sendo utilizados para cobrir custos inerentes à atividade pesqueira, garantindo rentabilidade artificial, numa produção relativamente estável, em um recurso natural renovável, com sinais de esgotamento.

Palavras-chave: subsídios; preço dos combustíveis; indústria pesqueira; produção pesqueira; mercado de trabalho.

1. INTRODUCTION

From the end of the 1960s, the Brazilian government began to strongly promote fishing activity, opening lines of credit, and offering tax incentives for the development of a national fishing industry. Abdallah and Bacha (1999) point out that fishing production in Brazil increased from 281,512 tons in 1960

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to 697,577 tons in 1994 and much of this is directly related to fiscal incentives addressed to the segment in the first decade of this period.

According to Neiva (1990), this policy of tax incentives and subsidies also enabled the emergence of a quality industrial park for fish processing, allowing the occupation of new fishing areas by the national fleet and thus contributing to increased production and the consequent export of the product, something important for the period. According to data from the Brazilian Institute of Geography and Statistics – IBGE, available in the Brazilian Statistical Yearbook (1960-1994), Brazilian fish exports increased from 10,134 tons in 1970, at a price of US$ 5,808.29 per ton, to 53,250 tons in 1985, at a price of US$ 3,613.88 per ton, the year in which Brazilian production reached its maximum level within the period analyzed. However, from the beginning of the 1980s to the beginning of the 1990s, exports were around forty thousand tons per year, reaching the maximum level exported in 1992 (55,237 tons at a price of US$ 2,658.22 each). Between 1993 and 1994, the exported quantities of fish showed a decreasing trend, following the behavior of production.

In the period from 1995 to 2010, the production of fish from Brazilian extractive fishing remained somewhat stable, although there was a small growth from 1995 to 2003, mainly due to fishing in inland waters. However, the volume of fish produced by marine extractive fishing continued below that produced in the 1980s, standing at around 500,000 tons per year, and the volume of inland fishing was around 300,000 tons. These values, even being below those of the 1980s, also had tax benefits, especially due to the creation of the Subsidy Program for the Price of Diesel Oil for Fishing Vessels (PSPO), created in 1997, regulated in 2010 and still in force.

The PSPO maintains a system of incentives to national fishing activity, especially marine fishing, through two mechanisms: full ICMS exemption (State Goods and Services Tax) provided by the States of the Federation (by adherence to ICMS Protocol No. 8/96 and Agreement No. 58/96) upon purchase of diesel oil from fuel suppliers; payment of cash aid of up to 25% provided by the Federal Government (through adherence to ICMS Protocol No. 8/96 and Agreement No. 58/96) relating to the difference between the price of domestic diesel oil and the price of international diesel oil.

Thus, the main objective of the PSPO is to promote the equalization of the price of domestic diesel oil to the price of international diesel oil, thus enabling the increase in the competitiveness of Brazilian fish in the international market and, consequently, the increase in the profitability of workers involved in the fishing activity. In the period from 1997 to 2018, according to estimates provided for in the publications of the Official Journal (DOU), more than R$ 2.0 billion in subsidies to the price of diesel oil were given to fishing vessels in Brazil. Values reached their highest volumes between 2003 and 2010, especially 2007, when the program subsidized around 400 million liters of diesel oil, which translated into around R$ 200 million. On the other hand, as of 2012, there is a shorter cycle trend, which continued until 2018, in which an annual average subsidy of around R$92.34 million was observed.

According to DOU data (1997 to 2018), of the total resources allocated to the PSPO, the companies that benefited most belong to the following states: (i) Santa Catariana - SC (36.12%), (ii) Pará - PA (17.64%), (iii) São Paulo - SP (10.29%), (iv) Rio de Janeiro - RJ (10.07%), (v) Ceará - CE (8.05%), (vi) Rio Grande do Sul - RS (7.88%), and (vii) Rio Grande do Norte - RN (2.39%). These values are directly associated with the dynamism of the national fishing sector, with emphasis on the states of Santa Catarina and Pará, exponents of the activity in terms of marine and freshwater extractive fishing, respectively.

The practice of tax incentives, especially for fishing activities such as the PSPO, presents controversial results regarding economic, social, and environmental benefits (Sumaila et al., 2019; Machado et al., 2021). Over the past few years, a series of surveys have been carried out around the world in order to identify and classify subsidies to activities that involve extraction of natural resources, with special attention to fishing. As pointed out in Sumaila *et al*. (2010) and Machado *et. al*. (2021), subsidies can largely be classified as “Good, Ambiguous, or Bad”. The good ones are those that allow the incorporation of technology and enable better management of natural resources, as in the case of fishing, fish stocks. Ambiguous ones are those that do not have a clear definition about their role in the fishing activity, which in some cases may offer an incentive for sustainability and in others not. The bad ones, on the other hand, are those that encourage technologically outdated practices and intensify the overexploitation of fish stocks, by acting to reduce the cost of capture or increase the activity's revenue.

In Brazil, as in much of the world (Sumaila et al., 2016), incentives to the fishing sector are mainly through "bad" subsidies, such as reductions in fuel prices, associated with a situation of overexploitation of fishing resources (Abdallah and Sumaila, 2007; Haimovici and Cardoso, 2017; Cardoso et al., 2021). According to Carvalho *et al*. (2011), subsidies that reduce fishing costs and increase profits for the industry can mask the economic signals for fishermen, so that they do not respect the economic incentive to stop fishing when the activity is no longer naturally profitable. Government incentives in places with high fishing resource exploitation rates, especially when destined for industry, tend to encourage unsustainable and economically inefficient fishing, in addition to leading to poor allocation of public resources (Markus, 2010).

In view of this scenario, in addition to the fiscal and economic crisis that Brazil is facing, we seek to identify the effects of the Subsidy Program for the Price of Diesel Oil-PSPO for Fishing Vessels on the dynamics of facilities and jobs in the fishing sector at the state level, in the state fishing production and finally, on the stock of jobs of companies benefiting from the program over the analyzed period. In other words, did the incentives generated by the program promote some level of change in the fishing segment, such as the labor and production market, or did they serve to cover up a direct cost inherent to the activity?

From this perspective, the relevance of evaluating this type of program is directly associated with the management of public policies aimed at the national fishing industry. Thus, it is possible to obtain parameters that allow public managers to reflect on the real cost/benefit of this expenditure for the Brazilian society, thus enabling the resizing, expansion/reduction or even extinction of the program. For a better understanding, this article is divided into five sections, including this introduction. Section 2 presents a discussion of fishing subsidies, production, and the labor market. Section 3 describes the database and the identification strategy. Section 4 presents and discusses the results. Finally, section 5 presents the final considerations of this study.

2. FISHING SUBSIDIES, PRODUCTION AND LABOR MARKET

The impacts of subsidies on fish production are widely discussed in the literature (Munro & Sumaila, 2002; Sakai, 2017, 2017; Sakai et al., 2019; Sumaila et al., 2016; Sumaila and Pauly, 2007). There is a consensus that subsidies aimed at reducing costs, such as the PSPO, classified as "bad" (Machado et al, 2021; Sumaila et al. 2010), increase fishing effort and promote the inefficiency of the activity (Markus, 2010; Clark et al., 2005; Milazzo, 1998; Porter, 2004; Sumaila et al., 2008).

The Brazilian scenario is no different, historically the fishing sector is supported by fiscal incentives aimed at increasing the fishing effort (Neiva, 19990; Abdallah and Bacha, 1999). According to Abdallah and Sumaila (2007), in the period between the 1960s and 1980s, economic policies aimed at the sector stimulated a large increase in capture without controlling the maintenance of natural resources. As a result, subsequent years were characterized by a reduction in fish production due to the low availability of the marine resource. The government response to this process repeated past practices, so that there were new incentives to the sector aimed at expanding the infrastructure, such as the expansion of the fishing fleet (Abdallah and Sumaila, 2007), as well as cost reduction policies, such as the PSPO.

On the other hand, regarding other socioeconomic impacts, such as the relationship between subsidies and the dynamics and composition of the fishing labor market, the literature is scarce. From an international perspective, studies show that artisanal fishing is responsible for generating more direct jobs than the large-scale fishing sector (Thomson, 1980; Berkes et al., 2001; Pauly, 2006). Thus, large-scale fishing, when benefited by a public policy of subsidies in volumes substantially greater than those applied to small-scale fishing, possibly does not generate a large employment multiplier effect in the fish capture segment, at least in theory. The capital-labor relationship is possibly intensified.

In this sense, Jentoft and Mikalsen (1987) argue that price subsidies tend to favor large-scale, capital-intensive operators, to the detriment of local fishermen. In other words, the way the subsidy is distributed affects the economic viability of the activity, as well as employment opportunities. Furthermore, subsidies tend to be concentrated in richer economies, where the removal of employment would generate little impact on the dynamics of the labor market.

Carvalho *et al*. (2011) verify the impacts of fishing subsidies on a series of economic indicators, including the labor market, by simulating through general equilibrium models the effects of subsidy extinction in the Azores economy in Portugal. The authors identified that the removal of subsidies would generate job losses concentrated in the fishing sector. Also, Carvalho *et al*. (2011) indicate that the resource resulting from the subsidy removal could be destined for training programs aimed at the entry of workers into other sectors of the economy or even for income transfer programs.

Similarly, according to the OECD (2006) *apud* Carvalho *et al*. (2011), Norway went through a similar process of job reduction due to the withdrawal of subsidies. However, relocation policies for workers associated with the gradual withdrawal of subsidies minimized the negative impacts on the labor market.

As in the international literature, studies related to the effects on fishing subsidy policies and their dynamism in the Brazilian labor market are generally rare. This is due to the difficulty in accessing information and the low formalization of the segment. However, Garcia, Abdallah and Sachsida (2018) made the first attempt to identify the effect of a program related to the national fishing activity, which was the impact of the National Program for Financing the Improvement and Modernization of the National Fishing Fleet (PROFROTA) on indicators of the labor market. The results pointed to the inexistence of impacts on the volume of jobs and salaries in the sector.

3.METHODOLOGY

3.1.Database

The impacts of the PSPO were investigated at two levels of aggregation. At the state level, the impacts on total fish production and labor market variables were analyzed for both the industrial sector and artisanal fishing. At the level of companies, as a result of the availability of information, the effects on the stock of employment of the beneficiaries of the Program were investigated, specifically in the industry. Also, due to the availability of data, the analyzes of the labor market comprised the period from 1994 to 2018, while for production the period was from 1990 to 2011. Thus, two data panels were built, one balanced at the state level and the other unbalanced[2] at the company level, both annually, with data from three sources.

The first consists of microdata identified from the Annual Report on Social Information (RAIS) of the Ministry of Economy. This source provides a series of indicators on the characteristics of each of the Brazilian companies, as well as their employees, enabling the collection of information such as the number of employees per company, the number of companies in the sector, the location of the company, the National Classification of Economic Activities (CNAE)[3], the National Register of Legal Entities (CNPJ), among others. In addition to providing a series of information at the individual level, the data analyzed in an aggregated form, at the state level, allow the situation of the formal labor market in the fishing sector to be characterized over the years[4].

The second source of data comes from information about the beneficiaries of the Subsidy Program for the Price of Diesel Oil for Fishing Vessels published in the Official Journal (DOU) between 1997 and 2018. These data make it possible to identify the companies benefiting from the Program each year and their region, in addition to the aggregate amounts of the subsidy and the amount of oil at the state level. It should be noted that the companies in the Program are listed by the CNPJ, in order to enable cross-referencing with RAIS data.

Finally, the third source of data used was fish production, which comprises extractive fish production from marine environments and inland waters. The database was obtained from the National Center for Research and Conservation of Southern Marine Biodiversity – CEPSUL, linked to the Chico Mendes Institute for Biodiversity Conservation – ICMBio, an agency of the Ministry of the Environment –

[2] The company-level panel is unbalanced because companies do not appear every year in RAIS' records.

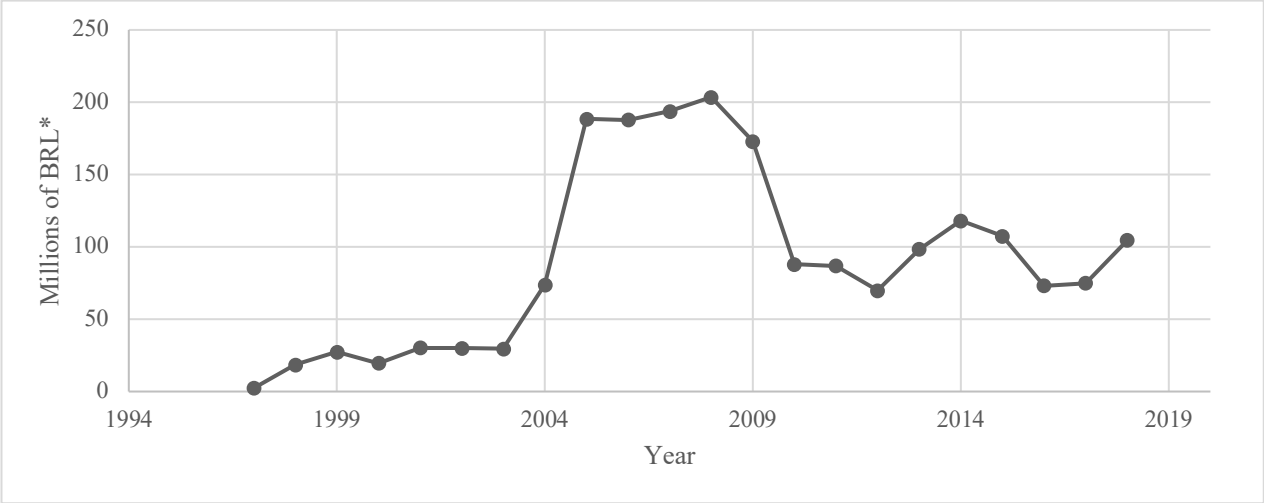
[3] Labor market information was considered only for companies belonging to CNAE-95 classification 05118 - Fishing and related services. For details about CNAE: https://concla.ibge.gov.br/concla.html

[4] It is worth noting that for the aggregated analysis, which deals with the total number of workers and the total number of companies by state, information was used only for companies that had employees, that is, those that did not complete the Negative RAIS. For the disaggregated analysis, all companies were considered, including those that completed the negative RAIS.

MMA. From these series it is possible to identify the behavior of extractive fishing production in relation to the emergence and expansion of the PSPO.

With regard to the evolution of the PSPO (Figure 1), it is possible to observe that between 2003 and 2008 there was the greatest increase in the granting of subsidy to the price of diesel oil. As of 2008, there is a very significant reduction in the subsidy, reaching R$ 104.54 million in 2018, an amount that is practically half of what was observed in 2008 (R$ 203.53 million).

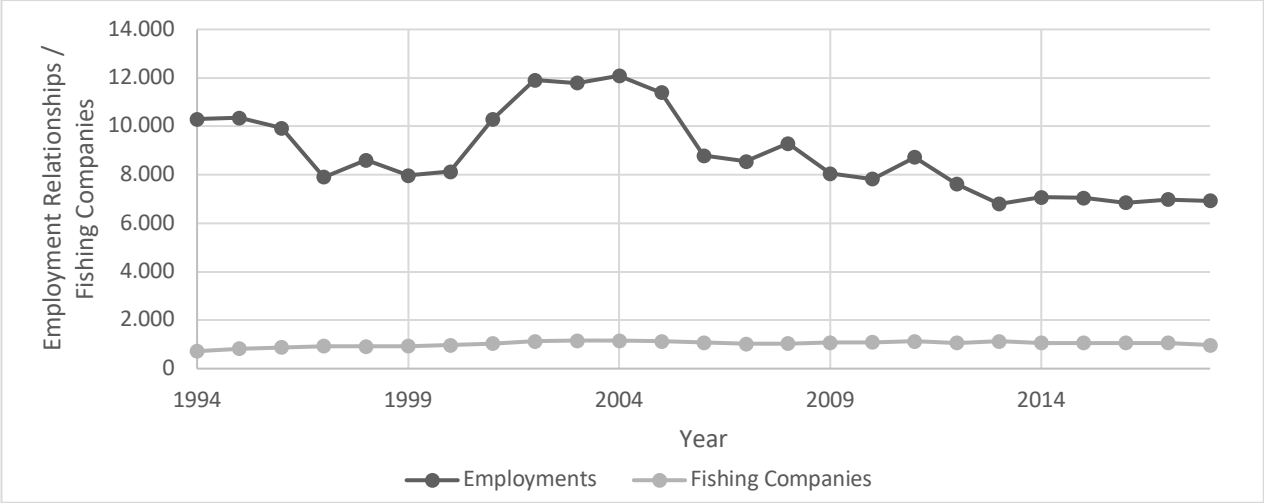
Figure 1 – Evolution of the PSPO from 1997 to 2018.



Source: DOU (1997-2019). * Values updated by IPCA (10/2020).

With regard to the labor market (Figure 2), it is possible to observe that between 2002 and 2005 was the period in which the number of workers employed in the fishing sector was higher, and from that period onwards there was a movement of reduction in the amount of employment relationships, and in 2018 there were practically half of the jobs observed in 2005.

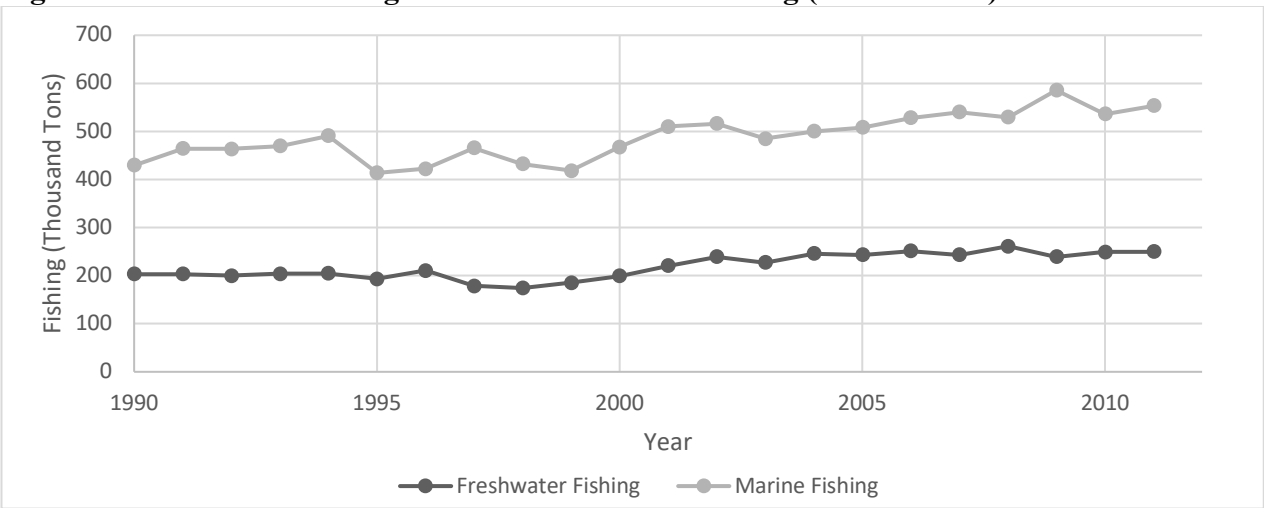
Figure 2 – Labor Market in the Fishing Sector in Brazil (1994 to 2018).



Source: RAIS (2020).

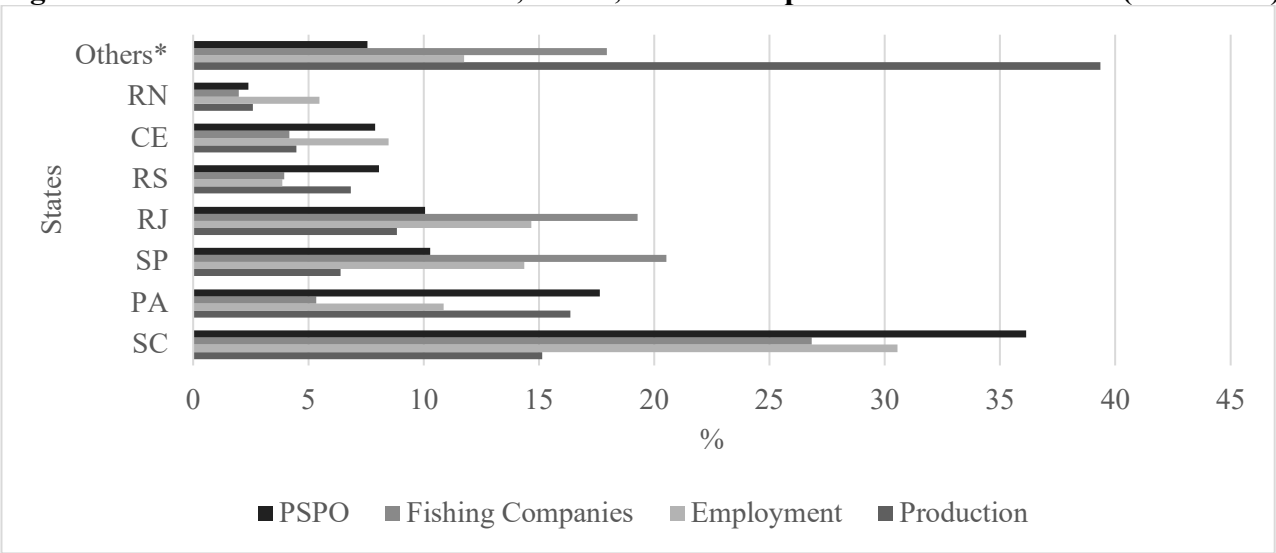
Figure 3 shows the evolution of marine and inland fishery production in the period of 1990 and 2011. Both fishing in inland waters and marine fishing showed modest evolution in the period, although the latter showed the greatest increase. Finally, in Figure 4, the percentage distributions by Federal Production Unit, PSPO, employment relationships and companies are presented. It is worth mentioning the distribution of the PSPO, in which the states of Santa Catarina and Pará were the ones that most received the subsidy, 36.12% and 17.64%, respectively.

Figure 3 – Extractive Fishing Production in Millions of Kg (1990 to 2011).



Source: Cepsul/ICMBio (1990 a 2011)

Figure 4 – Distribution % Production, PSPO, Relationships and Facilities - States (1994-2018).



Source: Prepared by the authors with data from the DOU (1997-2019), Cepsul/ICMBio (1990 to 2011) and RAIS (2020).

3.2. Empirical Strategy

The empirical strategy adopted in the present work involves the estimation of a differences-in-differences model at two aggregation levels. First, an estimation will be conducted at the state level, in order to identify the effects of the PSPO in aggregate terms, on the labor market and the production of the fishing sector in the states that have companies benefiting from the subsidy[5]. Second, a company-level model will be estimated in order to identify the effect of the program on the stock of formal employment in the industrial sector.

The main problem with impact assessments lies in the fact that only information regarding the factual situation is available to the researcher. Ideally, to establish causal links, it would be necessary to simultaneously observe the factual and the counterfactual in order to compare the performance of the dependent variables of interest in the two scenarios, with and without the intervention that is the object of the evaluation. However, this is, of course, impossible. From this perspective, numerous econometric techniques were developed in order to overcome this problem. Among them, the differences-in-differences method is shown as an alternative to estimate the program's result, in order to allow the estimation of the

[5] PSPO beneficiary states: Amazonas, Pará, Amapá, Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, Rio Grande do Sul.

average effect of the economic subsidy policy on the diesel oil price on its beneficiaries. The central idea of this methodology is to observe two different groups, the treatment group (covered by the PSPO) and the control group (not covered), in two periods of time - pre-subsidy and post-subsidy (Gertler et al., 2016).

The hypothesis of identifying the effect of the PSPO on the dependent variables of the beneficiaries lies in assuming that in the absence of the policy, the trajectories of these variables would follow identical trajectories to those who did not benefit from the program. Thus, any other shocks, in addition to the PSPO, that could affect the behavior of the variables of interest to those affected (treated group) and to the others, those not covered by the program (control group), would exert the same influence on both groups. Therefore, any deviations observed in the trajectories of the variables of interest between the two groups, in periods after the adherence to the subsidy policy, can be attributed to the effect of the PSPO on the group of the directly affected[6] (Gertler et al., 2016).

3.2.1.Model estimation at the state level

The first specification to be estimated at the state level is the traditional differences-in-differences model, which will allow analyzing the average effect of the PSPO on the treated states, as shown in the following equation:

$$Y_{et} = X'_{et}\alpha + \gamma t_t + \rho PSPO_e + \beta(t_{et}PSPO_e) + \varepsilon_{et} \quad (1)$$

where the subscript et denotes the state e in period t. Y represents the dependent variables of interest, active employment relationships, number of facilities and fish production, the vector X' is the observable characteristics of the units. t_t is a binary variable of time, with $t = 1$ for periods after joining the PSPO and $t = 0$ for previous periods. $PSPO_e$ represents the comparison groups, in which $PSPO = 1$ for the beneficiary states of the program and $PSPO = 0$ for non-beneficiary states, that is, the control group, where γ is the coefficient associated with the period of initiation of treatment, ρ is the parameter that captures the effect of being from the treated states and β is the parameter of interest, which indicates the causal effect of the program on the states that joined the PSPO after the beginning of the program.

In addition to the specification presented in equation (2), a model was estimated that allows for the existence of heterogeneous effects of the program on the treated states over time, as shown in the equation below:

$$Y_{et} = \alpha + \sum_{a=1}^{A} \beta_a . PSPO_{et} + \gamma X_{et} + \theta_e + \mu_t + \varepsilon_{et} \quad (2)$$

where Y_{et} denotes the labor market and production indicators to be assessed for the state *e*, in year *t*; $PSPO_{et}$ denotes a dummy variable that assumes a value equal to 1 for the state *e* in period *t* that received the subsidy in each year from 1997 onwards; X_{et} is a vector of covariates of the state *e* in year *t*; θ_e is a fixed effect of state, which captures the unobserved and time-fixed characteristics of the state *e* that influence the dependent variables; μ_t is a fixed effect of year; ε_{et} is a random error term.

3.2.2.Model estimation at the company level

In the case of companies, as well as in the analysis at the state level, the subsidy program will be allowed to have heterogeneous effects from year to year on beneficiary companies (Rocha and Soares, 2010). Therefore, the following equation will be estimated:

$$Y_{iet} = \alpha + \sum_{j=1}^{J} \beta_j . PSPO_{iet} + \theta_i + \lambda_e + \mu_t + \varepsilon_{iet} \quad (3)$$

where Y_{iet} denotes stock of employment to be evaluated for company *i*, of state *e*, in year *t*, $PSPO_{iet}$ denotes a dummy variable that assumes a value equal to 1 if company *i*, in the state *e*, in year *t*, is participating in the program. θ_i is a fixed effect of company, which captures the unobserved and time-fixed characteristics

[6] For other examples of applications of the differences-in-differences method for impact assessments and establishment of causal relationships, see Postali (2009), Rocha and Soares (2010) and Emerson, Ponczek and Souza (2017).

of company i that influence the dependent variables, λ_e are state dummies, which seek to capture fixed effects of each state e, μ_t are year dummies, which seek to capture non-linear trends over the period t, ε_{iet} is a random error term, and β_j's are parameters to be estimated for each year j, from 1997 onwards, of company i, of the state e, in period t. Therefore, the treated group is composed of companies in the fishing and related services sector that benefit from the program, while the control group comprises companies in the same sector, which were not covered by the PSPO.

3.3. Robustness Tests

To test the validity of the results, different robustness strategies were adopted. Initially, the equations were estimated considering different compositions of the comparison groups, based on the economic activity in which the companies fall, as follows: 1 – Treated and control: Fishing and related services companies plus aquaculture companies; 2 – Treated: PSPO beneficiary companies linked to any type of economic activity[7]; Control: Fishing and related services companies plus aquaculture companies[8]. This strategy was applied only to the analysis at the company level, considering the largest number of observation units.

In addition, a temporal falsification test was applied, as described in Rocha and Soares (2010), in which the occurrence of the program for periods prior to what was actually observed is simulated. This strategy allows verifying the central hypothesis of previous parallel trends between treated and control groups, a condition of the differences-in-differences method, so that no significant differences between the treated and control groups in the simulated periods are expected. This strategy was applied to both state and company level analysis.

4. Impact of PSPO on formal labor market and extractive fishing production

The results are presented in two steps. In the first, the analysis of the effect of the PSPO on the highlighted variables in aggregated terms by state is pointed out. In the second, the analysis of the effect of the PSPO on the stock of formal employment at company level is pointed out.

4.1. Analysis of aggregated impacts

In order to investigate the effectiveness of the PSPO, the impacts of the program on the dynamics of the labor market in the extractive fishing sector and on extractive fishing production were analyzed. To this end, the effects of the PSPO on the variables of interest to the beneficiary states from 1997, the initial year of the subsidy policy, were investigated.

With regard to the effects on the labor market, two dimensions were analyzed, the number of active jobs and the number of facilities in the sector. Table 1 shows the estimates of the average effect of the PSPO on the number of jobs in the period after 1997, using the traditional estimate of differences in differences by ordinary least squares (OLS), columns (1), (2) and (3) and the approach of this model through fixed effects panel, columns (4), (5), (6) and (7). The models were estimated with different specifications, in order to verify the stability of the results.

[7] Some companies covered by the PSPO are not classified as economic activities related to fishing.

[8] Companies benefiting from the PSPO linked to CNAE-95 division 05 – Fishing, aquaculture and related services.

Table 1 - Estimates of the average effect of the PSPO on the number of active employment relationships in the fishing sector in the beneficiary states

Variables	(1) OLS	(2) OLS	(3) OLS	(4) FE	(5) FE	(6) FE	(7) FE
Post 1997 period	19.76***	-48.36	-88.46				
	(6,443)	(146.6)	(143.0)				
Beneficiaries	560.1***	560.1***	471.4***				
	(104.7)	(106.5)	(97.97)				
Effect of PSPO	-114.6	-114.6	-127.9	-94.86	-114.6	-63.67	-268.9
	(111.1)	(113.0)	(105.0)	(91.10)	(93.46)	(91.40)	(174.8)
Constant	4,074***	8,012	-70.13	383.3***	381.4***	910.4***	1.020***
	(1,352)	(104.5)	(97.96)	(53.45)	(69.35)	(125.9)	(170.9)
Observations	675	675	675	675	675	675	675
R^2	0,117	0,126	0,212	0,013	0,088	0,177	0,324
UFs	27	27	27	27	27	27	27
FE state				Yes	Yes	Yes	Yes
FE year		Yes	Yes		Yes	Yes	Yes
Controls			Yes			Yes	Yes
FE region-year							Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population.

Thus, based on Table 1, the PSPO did not have a statistically significant average impact on employment contracts in any of the estimated models (PSPO Effect). In order to investigate possible effects in specific years, models with heterogeneous effects of the Program over the post-treatment period were estimated[9]. However, as in the previous estimates, it was not possible to show consistent, statistically significant effects on the stock of active employment relationships in the years after the implementation of the PSPO.

The same analysis strategy applied to employment relationships was adopted to investigate the effects of the policy on the number of facilities in the fishing sector. Table 2 presents the average results, using the differences in differences model by OLS and by fixed effects. The results indicate the lack of impact of the PSPO on the number of companies in the sector.

Table 2 - Estimates of the average effect of the PSPO on the number of companies in the fishing sector in the beneficiary states

Variables	(1) OLS	(2) OLS	(3) OLS	(4) FE	(5) FE	(6) FE	(7) FE
Post 1997 period	6,663***	6,473	-1,021				
	(0,929)	(15.26)	(14.27)				
Beneficiaries	41.93***	41.93***	25.34***				
	(10.05)	(10.22)	(8,049)				
Effect of PSPO	3,791	3,791	1,320	10.45	3,791	10.71	3,881
	(10.96)	(11.15)	(9,084)	(10.60)	(11.03)	(12.54)	(14.16)
Constant	1,852***	-1,284	-15.89**	31.76***	26.67***	98.53***	135.7***
	(0,614)	(9,392)	(7,833)	(6,218)	(7,479)	(23.17)	(28.16)
Observations	675	675	675	675	675	675	675
R^2	0,088	0,090	0,323	0,017	0,036	0,210	0,505
UFs				27	27	27	27
FE state				Yes	Yes	Yes	Yes
FE year		Yes	Yes		Yes	Yes	Yes
Controls			Yes			Yes	Yes
FE region-year							Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population.

[9] Results not presented due to space restriction, but available upon request to the authors.

When investigating possible heterogeneous effects over the years, model (1) of Table A.1 (Appendix) shows some indications of positive impacts between 2001 and 2003 on the number of companies in the sector. However, when controlling for the effects of time, population size in the state and specific trends for large regions over time, there is no evidence of PSPO effects on the number of companies in the fishing sector. Therefore, the results indicate that the PSPO did not show significant effects on the labor market dynamics of the extractive fishing sector in the states benefited by the policy, with no signs of changes in the number of employment relationships, as well as companies, as a result of the financial benefits from the policy.

However, as the purpose of the PSPO is to subsidize one of the main inputs to the fishing activity, that is, to provide access to diesel oil at lower prices for vessels, one can imagine possible effects on the amount captured by extractive fishing. Thus, Table 3 presents the estimates of the impact of the PSPO on the fish production (tons) of the beneficiary states. The results suggest that the subsidy did not affect, on average, in a robust way, for the period analyzed, the total amount of fish in the states covered by the program, regardless of the model of analysis applied.

Table 3 - Estimates of the average effect of the PSPO on the total fishing production of the beneficiary states (tons)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	OLS	OLS	OLS	FE	FE	FE	FE
Post 1997 period	0.0797	0.0803	0,292				
	(0,187)	(0,358)	(0,338)				
Beneficiaries	2,391***	2,390***	2,332***				
	(0,193)	(0,195)	(0,215)				
Effect of PSPO	0,118	0,119	-0.0349	0,198*	-0.0749	-0,144	-0,107
	(0,228)	(0,230)	(0,243)	(0,104)	(0,190)	(0,194)	(0,293)
Constant	7,438***	7,598***	7,158***	9,066***	9,152***	9,457***	9,594***
	(0,158)	(0,279)	(0,265)	(0.0476)	(0,215)	(0,171)	(0,271)
Observations	588	588	536	588	588	536	536
R^2	0,499	0,503	0,568	0,038	0,133	0,244	0,353
UFs	27	27	27	27	27	27	27
FE state				Yes	Yes	Yes	Yes
FE year		Yes	Yes		Yes	Yes	Yes
Controls			Yes			Yes	Yes
FE region-year							Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population. Models in logarithm.

When investigating the heterogeneous effects of PSPO on total production (tons) of each year, Table A.2 (Appendix), model (1) suggests the existence of positive effects on capture between the periods from 2002 to 2011. However, when analyzing the more robust models, with controls, fixed effects of year and region-specific trends, the results are no longer significant and do not show consistent behavior.

In order to circumvent possible production scale effects associated with the size of each state, the models were also estimated on the production in kilograms (kg) per capita of the state. Table A.3 (Appendix) identifies that, as with total production (tons), the results show that the PSPO did not have significant average impacts on the production of the states benefiting from the policy. The same can be seen in the year-to-year effects of the PSPO, Table A.4 (Appendix), on production in kg per capita. Thus, based on the results, it appears that there is no consistent evidence of program effects in the period from 1997 to 2011, regardless of the estimated econometric specification.

Finally, to verify the robustness of the estimated results, estimates were carried out considering the trends prior to the treatment of the group of states benefited by the PSPO and the control group. To meet the central hypothesis of the differences-in-differences method, which requires that the treatment and control group have parallel trends with regard to the variable of interest in the period prior to the policy, it is essential that there are no significant effects on the variables related to the effect of the PSPO in the period prior to 1997. As can be seen in the estimates (1), (2), (3) and (4) of Table A.5 (Appendix) for both the labor market and production variables, there are no significant effects in periods prior to the policy.

Therefore, the evidence suggests the validity of the experiments and indicates the robustness of the results found in the previous estimates.

Thus, in general, at the aggregate level, based on the analyzed estimates, it was not possible to show a consistent effect of the PSPO on the labor market indicators (employment relationships and enterprises), nor on the national extractive fishing production. However, in order to make the analysis more specific, in the next section, the effects of the PSPO on the employment stock of beneficiary companies in the industrial sector will be evaluated, since it was not possible to obtain information on fish production per company.

4.2. Impact analysis at the company level

To analyze the effect of the PSPO at the company level on the stock of formal employment, beneficiary and non-beneficiary companies belonging to the fishing sector and related services were analyzed. Thus, the effects of the PSPO on 260 beneficiary companies were investigated. Specifically, we considered, on average per year, 41 companies belonging to the treated group and 2,151 companies belonging to the control group. The results in Table 4 were estimated through different specifications, considering the average effect of the PSPO in the period analyzed, columns (1), (2) and (3), as well as the year-to-year effect, in column (4), after the implementation of the policy.

Column (1) considers the average effect of the PSPO on beneficiary companies, without the insertion of fixed effects control of state, nor the possibility of different trends over the years. In the second model, (2), the average effect of the PSPO was estimated, with the insertion of year-specific trends. In the third column, column (3), the PSPO's average effect model was used, with fixed effects control for federative unit (UF) and year. Column (4) presents the heterogeneous effects of the program over the years, controlling for the different fixed effects. According to the estimated results, for the different specifications, it is not possible to identify consistent effects of the PSPO on the stock of formal employment of beneficiary companies, indicating that the PSPO did not significantly influence the generation of employment in the sector.

Finally, the temporal falsification test was applied, column (5) of Table 4. As can be seen, there are no statistically significant results in the simulated periods, prior to the beginning year of the PSPO (1997). Thus, we believe in the validity of the experiments and, consequently, in the robustness and consistency of the results. Furthermore, as indicated in the empirical strategy, section 3.3, regarding robustness tests, alternative models were estimated, with different compositions of treated and controls, related to different CNAEs[10]. The results are in line with those presented in Table 4, in the sense of not showing any effect of the PSPO on the stock of employment of companies benefiting from the program. Furthermore, the temporal falsification tests of these estimates (Table A.6 of the Appendix) generate robustness to the experiments and the results.

[10] Results not presented due to space restriction, but available upon request to the authors.

Table 4 - PSPO Effect on Beneficiary Companies' Employment Stock

Variables	(1)	(2)	(3)	(4)	(5)
Effect of PSPO (Average)	1,202	3,414	3,453		
	(5,836)	(5,845)	(5,862)		
PSPO 1994					-9,782
					(13.48)
PSPO 1995					-21.60
					(18.03)
PSPO 1996					-16.84
					(13.84)
PSPO 1997				-22.80	-39.73**
				(13.96)	(19.47)
PSPO 1998				-	-
				-	-
PSPO 1999				0,654**	0,654**
				(0,269)	(0,269)
PSPO 2000				-	-
				-	-
PSPO 2001				5,849	-10.87
				(5,220)	(12.49)
PSPO 2002				3,218	-13.41
				(5,999)	(12.40)
PSPO 2003				6,764	-9,875
				(8,806)	(13.77)
PSPO 2004				15.09*	-1,543
				(8,793)	(12.59)
PSPO 2005				10.22	-6,420
				(7,033)	(11.52)
PSPO 2006				6,102	-10.53
				(7,265)	(11.71)
PSPO 2007				5,779	-10.84
				(7,900)	(11.66)
PSPO 2008				6,694	-9,911
				(7,505)	(10.78)
PSPO 2009				-4,470	-21.07*
				(7,793)	(11.07)
PSPO 2010				-1,398	-18.00*
				(8,142)	(10.61)
PSPO 2011				-1,896	-18.50*
				(7,723)	(9,491)
PSPO 2012				6,593	-10.14
				(11.45)	(6,419)
PSPO 2013				1,362	-15.29*
				(8,001)	(8,860)
PSPO 2014				2,465	-14.17
				(9,946)	(8,804)
PSPO 2015				6,156	-10.50
				(9,796)	(7,813)
PSPO 2016				8,899	-7,751
				(9,786)	(8,090)
PSPO 2017				16.04	-0,618
				(13.45)	(10.03)
PSPO 2018				16.72	-
				(15.02)	-
Constant	3,940***	9,799***	-38.80	-39.07	-39.36
	(0,103)	(1,128)	(35.07)	(35.09)	(35.07)
Observations	51.307	51.307	51.307	51.307	51.307
R^2	0,000	0,007	0,019	0,030	0,031
Number of companies	12.878	12.878	12.878	12.878	12.878
FE Company	Yes	Yes	Yes	Yes	Yes
FE UF	No	No	Yes	Yes	Yes
FE Year	No	Yes	Yes	Yes	Yes

Source: prepared by the authors Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1.

Thus, in summary, at a specific level per company, based on the analyzed estimates, it was not possible to statistically show in a robust way the effect of the PSPO on the variation in the stock of formal employment of beneficiary companies over the period evaluated. These results, added to the aggregated analysis, find support in the international literature, in line with what was pointed out by Carvalho *et al*. (2011), who indicates that subsidies that reduce fishing costs and increase profits for the industry can mask the economic signals for fishermen, so that they do not respect the economic incentive to stop fishing when the activity is no longer naturally profitable. In other words, in the sense identified by Markus (2010), the government incentive can disguise or aggravate the economic, social, and environmental damages of overfishing and reduce the adoption of sustainable economic, social, and environmental management strategies, which may be materializing in the Brazilian case. In addition, for the specific case of the results on the Brazilian labor market, they follow the line of evidence highlighted by Garcia, Abdallah and Sachsida (2018), which point to the inexistence of impact of another sectorial fishing policy, the Prorota, on the volume of formal jobs generated in the national fishing sector. According Sumaila et al. (2021), ocean resources are "rarely equitably distributed", and many of their benefits are captured by a few (Österblom, et al., 2020). This inequity is exemplified by the provision of subsidies as PSPO, not being effective in financing a sustainable ocean economy, avoid the reaching specific goals of SDGs (Sustainable Development Goals), in particular those focusing on Poverty (2), Reduced Inequalities (10) and on Live Below Water (14).

5. Final Considerations

This study aimed to analyze the impact of the Subsidy Program for the Price of Diesel Oil for Fishing Vessels-PSPO in Brazil on labor market and extractive fishing production indicators in recent decades. To do so, specifically, we sought to organize and contrast information about the PSPO, the labor market and relevant production, through data about the program disclosed in the DOU, in addition to information from RAIS and ICMBio. The results were estimated both at the state level, in which fish production and employment in the sector were considered, and at the level of companies, a specific analysis of the employment stock.

Regarding the aggregate and individual effects of the program on the labor market and on the production of extractive fishing, based on the analyzed estimates, it was not possible to show a consistent effect of the PSPO on the labor market indicators (employment relationships and enterprises), nor in the national extractive fishing production. The absence of results from the Program on production indicates that the subsidy may have contributed to the maintenance of production levels, an unsatisfactory reality in terms of economic and environmental sustainability of the activity, given the panorama of overexploitation of fishing resources in Brazil (Abdallah and Sumaila, 2007).

This evidence, which contributes to the scarce literature on the impacts of the PSPO, is supported by the international literature. Thus, they are in line with what was highlighted by Carvalho *et al*. (2011), reinforcing the fact that the financial resources from the PSPO may be being used to cover costs inherent to the fishing activity, ensuring a relatively stable level of production on a renewable natural resource, with signs of depletion, which makes the program an inefficient instrument in its proposition and in the allocation of public resources. Furthermore, the absence of results on the dynamics of the sector's labor market minimizes the social benefit of the policy.

In this way, policy redirection becomes fundamental. One of the alternatives for allocating resources in the national fishing segment would be to direct investments to the segment's infrastructure, especially the recovery of specific piers for transshipment of the fishing segment, thus having the possibility of greater control and inspection of the volume of fish generated by the national fishing activity. In addition, another possibility of efficient allocation of resources in the segment would be the formation of a network of managers and researchers, which enables the organization of the segment, with regulation instruments, generation of data and relevant information for the efficient management of the segment. Last but not least, these investments can also be directed to income transfer programs, as in the Brazilian case, the Seguro-Defeso (a kind of unemployment insurance for professional artisanal fishermen), which can be associated with the formation of human capital and professional courses to add value to products from the fishing,

especially artisanal, which also involves a range of traditional communities, mainly in the north and northeast regions of Brazil.

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Appendix

Table A.1 - Heterogeneous effects over time of the PSPO on the number of fishing facilities in the beneficiary states

	(1)	(2)	(3)	(4)
Variables	FE	FE	FE	FE
PSPO 1997	5,222	2,519	3,308	5,270
	(3,332)	(3,609)	(4,282)	(4,833)
PSPO 1998	4,056	0,352	1,631	2,146
	(3,644)	(3,975)	(5,165)	(7,399)
PSPO 1999	5,333	1,741	3,510	0,805
	(5,200)	(5,554)	(6,858)	(8,284)
PSPO 2000	8	5,074	7,335	5,496
	(5,728)	(6,053)	(7,467)	(8,008)
PSPO 2001	10.89*	6,852	10.84	8,394
	(6,285)	(6,709)	(9,483)	(10.70)
PSPO 2002	15.06*	9,907	14.42	9,084
	(8,395)	(8,886)	(11.42)	(12.40)
PSPO 2003	16.56*	10.96	16.01	12.88
	(8,879)	(9,319)	(11.84)	(15.65)
PSPO 2004	16.56	10.52	16.60	10.54
	(10.67)	(11.11)	(13.69)	(16.74)
PSPO 2005	14.67	7,852	14.59	7,080
	(10.14)	(10.75)	(13.85)	(16.79)
PSPO 2006	12	6,741	14.10	8,473
	(11.37)	(11.77)	(14.20)	(19.25)
PSPO 2007	9,556	4,519	10.95	1,902
	(12.38)	(12.75)	(13.97)	(18.98)
PSPO 2008	9,722	3,463	11.39	0,270
	(12.75)	(13.17)	(14.91)	(19.00)
PSPO 2009	11.11	3,963	12.33	0,244
	(13.91)	(14.41)	(15.72)	(15.50)
PSPO 2010	11.61	3,019	10.97	-2,005
	(14.61)	(15.27)	(16.17)	(16.30)
PSPO 2011	13.72	5,574	13.88	2,444
	(15.02)	(15.67)	(16.89)	(16.86)
PSPO 2012	10.61	2,685	11.36	3,371
	(13.97)	(14.54)	(15.29)	(18.95)
PSPO 2013	13.61	5,130	15.56	3,943
	(16.28)	(16.79)	(17.69)	(19.03)
PSPO 2014	9,722	0.0185	10.77	-2,214
	(16.22)	(16.85)	(18.03)	(23.49)
PSPO 2015	9,056	-0,981	10.07	0,548
	(15.14)	(15.70)	(17.06)	(18.59)
PSPO 2016	9,778	0,296	11.65	2,033
	(14.89)	(15.43)	(17.35)	(18.52)
PSPO 2017	9,111	-1,370	10.24	0,826
	(15.34)	(15.91)	(17.32)	(17.43)
PSPO 2018	4,056	-5,426	6,389	1,389
	(14.59)	(15.16)	(16.14)	(22.57)
Constant	31.76***	26.67***	99.57***	135.2***
	(6,318)	(7,603)	(23.33)	(28.53)
Observations	675	675	675	675
R^2	0,034	0,043	0,217	0,508
UFs	27	27	27	27
FE state	Yes	Yes	Yes	Yes
FE year		Yes	Yes	Yes
Controls			Yes	Yes
FE State-year				Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population.

Table A.2 - Heterogeneous effects over time of the PSPO on the total fish production of the beneficiary states (tons)

Variables	(1) FE	(2) FE	(3) FE	(4) FE
PSPO 1997	0.0426	-0.0686	-0,168	-0,197
	(0.0757)	(0,230)	(0,184)	(0,261)
PSPO 1998	-0.0287	-0,195	-0,291**	-0,354**
	(0.0793)	(0,190)	(0,130)	(0,165)
PSPO 1999	-0.00582	-0,163	-0,255	-0,110
	(0,108)	(0,236)	(0,190)	(0,323)
PSPO 2000	0,102	-0.0979	-0,187	-0.0966
	(0,102)	(0,204)	(0,182)	(0,259)
PSPO 2001	0,152	-0.0879	-0,164	-0.0726
	(0,111)	(0,206)	(0,194)	(0,279)
PSPO 2002	0,180*	-0.0671	-0,139	-0.0373
	(0,105)	(0,208)	(0,198)	(0,306)
PSPO 2003	0,141	-0,150	-0,218	-0,181
	(0.0958)	(0,195)	(0,201)	(0,308)
PSPO 2004	0,207*	-0,111	-0,171	-0.0958
	(0,108)	(0,204)	(0,220)	(0,343)
PSPO 2005	0,272**	-0.0690	-0,124	-0,164
	(0,125)	(0,242)	(0,285)	(0,469)
PSPO 2006	0,314**	0.0357	-0.0149	-0.0154
	(0,124)	(0,234)	(0,280)	(0,454)
PSPO 2007	0,284**	0.0490	-0.00849	0.0261
	(0,130)	(0,239)	(0,286)	(0,440)
PSPO 2008	0,265*	-0,125	-0,172	-0.0804
	(0,146)	(0,217)	(0,241)	(0,346)
PSPO 2009	0,373**	0.0731	0.0301	-0.0186
	(0,146)	(0,221)	(0,236)	(0,347)
PSPO 2010	0,313**	-0.0580	-0,104	-0.0788
	(0,123)	(0,199)	(0,211)	(0,331)
PSPO 2011	0,354***	-0.0880	-0,131	-0,108
	(0,116)	(0,194)	(0,199)	(0,309)
Constant	9,066***	9,152***	9,487***	9,617***
	(0.0482)	(0,218)	(0,171)	(0,271)
Observations	588	588	536	536
R^2	0,085	0,139	0,256	0,359
UFs	27	27	27	27
FE state	Yes	Yes	Yes	Yes
FE year		Yes	Yes	Yes
Control			Yes	Yes
FE State-year				Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population. Models in logarithm.

Table A.3 - Estimates of the average effect of PSPO on fish production in kg per capita of beneficiary states

Variables	(1) OLS	(2) OLS	(3) OLS	(4) FE	(5) FE	(6) FE	(7) FE
Post 1997 period	-0.0386	-0.0237	0.0397				
	(0,194)	(0,349)	(0,323)				
Beneficiaries	1,480***	1,478***	1,673***				
	(0,212)	(0,216)	(0,200)				
Effect of PSPO	0.0577	0.0596	0.0932	0.0190	-0,132	-0.0986	-0,175
	(0,242)	(0,246)	(0,228)	(0.0973)	(0,204)	(0,202)	(0,290)
Constant	-0.0474	-0.00904	0,173	0,937***	0,920***	1,334***	1,726***
	(0,170)	(0,270)	(0,252)	(0.0490)	(0.0880)	(0,189)	(0,319)
Observations	536	536	536	536	536	536	536
R^2	0,287	0,288	0,383	0,001	0,029	0,055	0,207
UFs	27	27	27	27	27	27	27
FE state				Yes	Yes	Yes	Yes
FE year		Yes	Yes		Yes	Yes	Yes
Controls			Yes			Yes	Yes
FE State-year							Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population. Models in logarithm.

Table A.4 - Heterogeneous effects over time of PSPO on fish production in kg per capita of beneficiary states

Variables	(1) FE	(2) FE	(3) FE
PSPO 1997	-0.0142	-0,173	-0,258
	(0.0721)	(0,192)	(0,263)
PSPO 1998	-0,100	-0,293**	-0,424**
	(0.0756)	(0,139)	(0,156)
PSPO 1999	-0.0914	-0,255	-0,191
	(0,102)	(0,200)	(0,322)
PSPO 2000	0.00252	-0,184	-0,187
	(0.0984)	(0,196)	(0,278)
PSPO 2001	0.00738	-0,159	-0,172
	(0,108)	(0,206)	(0,296)
PSPO 2002	0.0219	-0,133	-0,144
	(0,100)	(0,210)	(0,322)
PSPO 2003	-0.0313	-0,211	-0,296
	(0.0913)	(0,211)	(0,319)
PSPO 2004	0.00945	-0,155	-0,207
	(0,100)	(0,225)	(0,337)
PSPO 2005	0.0572	-0,110	-0,295
	(0,117)	(0,285)	(0,452)
PSPO 2006	0.0840	0.000319	-0,154
	(0,117)	(0,278)	(0,434)
PSPO 2007	0.0686	0.00388	-0,118
	(0,121)	(0,277)	(0,409)
PSPO 2008	0.0188	-0,167	-0,234
	(0,138)	(0,238)	(0,316)
PSPO 2009	0,117	0.0340	-0,180
	(0,138)	(0,241)	(0,325)
PSPO 2010	0.0524	-0.0731	-0,247
	(0,116)	(0,217)	(0,316)
PSPO 2011	0.0832	-0.0991	-0,283
	(0,110)	(0,211)	(0,305)
Constant	0,937***	0,920***	1,129***
	(0.0497)	(0.0893)	(0,193)
Observations	536	536	536
R^2	0,023	0,046	0,188
UFs	27	27	27
FE state	Yes	Yes	Yes
FE year	Yes	Yes	Yes
FE State-year		Yes	Yes
Controls			Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population. Models in logarithm.

Table A.5 - Robustness test, previous trends, for estimated models

Variables	(1) Total Production (kg)	(2) Production kg per capita	(3) Relationships	(4) Facilities
PSPO 1992	0.0825	0,252		
	(0,328)	(0,342)		
PSPO 1993	0.0767	0,263		
	(0,319)	(0,327)		
PSPO 1994	0,127	0,314	422.2	-4,482
	(0,334)	(0,341)	(271.5)	(22.68)
PSPO 1995	0,244	0,429	290.9	-3,230
	(0,387)	(0,380)	(229.2)	(22.89)
PSPO 1996	0.0109	0,159	101.4	3,526
	(0,350)	(0,312)	(280.7)	(22.46)
PSPO 1997	-0.0891	0.0253	-41.33	3,875
	(0,235)	(0,202)	(197.4)	(20.09)
PSPO 1998	-0,245	-0,141	-101.6	0,751
	(0,239)	(0,222)	(222.3)	(19.10)
PSPO 1999	-0.00184	0.0922	-95.19	-0,589
	(0,200)	(0,172)	(239.2)	(18.11)
PSPO 2000	0.0116	0.0959	-56.06	4,102
	(0,149)	(0,116)	(228.2)	(18.46)
PSPO 2001	0.0356	0,111	58.38	7,001
	(0,133)	(0,109)	(162.7)	(17.30)
PSPO 2002	0.0709	0,139	-9,575	7,691
	(0,137)	(0,117)	(176.6)	(15.35)
PSPO 2003	-0.0726	-0.0123	110.2	11.49
	(0,119)	(0,110)	(76.47)	(12.93)
PSPO 2004	0.0124	0.0767	199.5	9,148
	(0.0546)	(0.0610)	(117.3)	(11.90)
PSPO 2005	-0.0559	-0.0113	184.4	5,688
	(0,200)	(0,217)	(120.1)	(11.37)
PSPO 2006	0.0928	0,129	188.7	7,081
	(0,190)	(0,205)	(114.8)	(9,479)
PSPO 2007	0,134	0,165	105.9	0,509
	(0,216)	(0,224)	(76.71)	(7,035)
PSPO 2008	0.0278	0.0491	207.6	-1,122
	(0,121)	(0,125)	(127.9)	(6,023)
PSPO 2009	0.0896	0,103	8,393	-1,148
	(0.0766)	(0.0728)	(67.33)	(8,961)
PSPO 2010	0.0294	0.0358	3,722	-3,396
	(0.0760)	(0.0773)	(57.36)	(8,128)
PSPO 2011			-353.0	1,053
			(209.1)	(6,911)
PSPO 2012			60.16	1,981
			(62.91)	(7,710)
PSPO 2013			-82.17	2,553
			(119.8)	(5,888)
PSPO 2014			-103.1	-3,604
			(122.9)	(3,337)
PSPO 2015			-76.18	-0,842
			(108.9)	(4,559)
PSPO 2016			-71.86	0,643
			(113.0)	(4,206)
PSPO 2017			-114.2	-0,563
			(141.0)	(5,589)
Constant	9,555***	0,952***	758.8***	137.4***
	(0,373)	(0,340)	(241.5)	(30.89)
Observations	536	536	675	675
R^2	0,360	0,190	0,356	0,508
UFs	27	27	27	27
FE state	Yes	Yes	Yes	Yes
FE year	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes
FE State-year	Yes	Yes	Yes	Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and significance levels *** p<0.01, ** p<0.05, * p<0.1. Controls: Population. Models (1) and (2) in logarithm.

Table A.6 – Temporal falsification test

Variables	(1) Employment Stock	(2) Employment Stock	(3) Employment Stock
PSPO 1994	5,669	-8,861	-9,782
	(22.71)	(13.43)	(13.48)
PSPO 1995	-6,506	-20.02	-21.60
	(26.03)	(17.92)	(18.03)
PSPO 1996	-2,426	-15.28	-16.84
	(23.02)	(13.77)	(13.84)
PSPO 1997	-41.79	-38.31**	-39.73**
	(35.99)	(19.38)	(19.47)
PSPO 1998	-33.88	-	-
	(34.10)	-	-
PSPO 1999	-31.70	1,171***	0,654**
	(33.62)	(0,310)	(0,269)
PSPO 2000	-34.55	-	-
	(34.01)	-	-
PSPO 2001	-0,399	-10.55	-10.87
	(23.30)	(12.42)	(12.49)
PSPO 2002	-3,423	-13.52	-13.41
	(23.43)	(12.34)	(12.40)
PSPO 2003	2,431	-10.31	-9,875
	(23.53)	(13.76)	(13.77)
PSPO 2004	9,749	-1,971	-1,543
	(23.76)	(12.53)	(12.59)
PSPO 2005	8,649	-6,233	-6,420
	(23.28)	(11.44)	(11.52)
PSPO 2006	6,373	-9,765	-10.53
	(22.51)	(11.61)	(11.71)
PSPO 2007	12.02	-9,732	-10.84
	(21.74)	(11.56)	(11.66)
PSPO 2008	13.32	-8,465	-9,911
	(20.73)	(10.66)	(10.78)
PSPO 2009	9,775	-19.52*	-21.07*
	(19.52)	(10.96)	(11.07)
PSPO 2010	4,647	-16.63	-18.00*
	(15.24)	(10.48)	(10.61)
PSPO 2011	8,833	-17.23*	-18.50*
	(15.00)	(9,372)	(9,491)
PSPO 2012	5,574	-8,897	-10.14
	(13.09)	(6,373)	(6,419)
PSPO 2013	-9,010	-14.39*	-15.29*
	(9,873)	(8,734)	(8,860)
PSPO 2014	-11.03	-9,932	-14.17
	(9,879)	(9,514)	(8,804)
PSPO 2015	-11.82	-6,442	-10.50
	(8,780)	(8,613)	(7,813)
PSPO 2016	-6,585	-13.17	-7,751
	(5,291)	(9,427)	(8,090)
PSPO 2017	-0,966	0.0217	-0,618
	(6,531)	(9,957)	(10.03)
Constant	8,531**	8,270*	-39.36
	(4,284)	(4,267)	(35.07)
Observations	110.303	109.867	51.307
R^2	0,017	0,016	0,031
Number of companies	26.965	26.868	12.878
FE Company	Yes	Yes	Yes
FE UF	Yes	Yes	Yes
FE year	Yes	Yes	Yes

Source: Prepared by the authors. Note: Robust standard deviation in parentheses and levels of significance *** p<0.01, ** p<0.05, * p<0.1.