

The Management of Environment Cost Caused by Ballast Water

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Abstract: According to classical economic theory, external cost is the indirect, and uncompensated, social or environmental cost caused to an uninvolved third party that arises as an effect of another party's activity. In light of this, the environmental cost caused by ballast water is considered as a negative externality. This paper aims to contribute by proposing that the environmental cost caused by ballast water can be determined through questionnaires, and that the imposition of a Pigouvian retributive tax is required to compensate for the environmental damage caused. The paper proceeds as follows. Firstly, ballast water management is discussed. Second, the environmental cost is discussed and it is asserted that it is important to have clear regulations and to update them frequently to prevent or minimize ballast water's negative impact on the environment. Finally, it is suggested that the environmental cost caused by ballast water can be determined by questionnaires and, more specifically, by the WTP (Willingness to Pay) method, and that a special Pigouvian corrective taxation which can internalize this cost should be imposed.

Key words: Ballast water management, external environmental cost, maritime transport, Pigouvian taxation.

1. Introduction

Shipping carries about 80% of world trade by volume and 70% by value [1]. Ships are designed and built to operate safely when carrying cargo but need extra weight when sailing unladen or partially laden to ensure proper stability and pressure management in the hull. The added weight is called ballast. In Article 1 of the Ballast Water Convention (BWM), ballast water is defined as the water with its suspended matter taken on board a ship to control the ship's course, heel, draft, stability or strains. In the past ships used stones, sand and metal as ballast, but technical developments led ships to use water as it is easier to load and unload and more economical than solid ballast. Therefore, today ballast water is essential for ships to operate efficiently and safely [2].

Environmental maritime management is a challenge of our time and is obliged to obey international and national legislation. The legal policy regulates specific issues related to ballast, ballast water treatment and

other matters, helping ship-owners to be proactive in complying with regulations. Ballast water treatment solutions provide the technical as well as other considerations for the design and production of ballast water treatment equipment to suit the characteristics of ships. Legal policy and ballast water solutions work together to effectively address the problem of ballast treatment. The International Convention on the Control and Management of Ships' Ballast and Sediments (IMO, 2004) in force sets the basic provisions for the management and treatment of ballast water on ships worldwide. Still, more specific regulations are necessary and regularly amended and supplemented to suit different marine areas.

Ballast water treatment solutions play a very important role in helping to reduce the negative impact of ballast water on the environment. Ballast water treatment requires little or no use of chemicals. This helps prevent harmful chemicals from being released into the environment after the ballast water is treated. To be able to easily complete and implement shipping activities under the BWM, countries should come up with a specific policy for each country,

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corresponding to each region based on the BWMC [3]. This will help the world's maritime countries to be able to both comply with international regulations and have their own country-tailored development policies. Handling costs are also an issue, however, in line with the current trend of sustainable development, shipowners are also being asked to be more responsible for international waters and ports. This is notable in the current development process that affects the environment. Regulatory policy and solutions for ballast water treatment have always been an open issue for regulators, researchers and environmentalists.

There are different policies and solutions for ballast water treatment, however, each different policy and solution brings with it both advantages and disadvantages when technical, environmental, and economic aspects are examined. The rapid development of industries worldwide pollutes the environment more and more. In particular, ballast water from the shipping industry has a major impact on the environment. This is why legal policies are being introduced to control ballast water for all ships in the world to ensure that ballast water from ships does not affect the environment. Achieving this also means that maritime organizations and governments must act decisively. The introduction of the WBMC in 2004 [4] and the formal entry into force of the Convention in 2017 provided clear regulations for ballast processing.

Stricter regulations on ballast water and ballast handling are needed to ensure that ballast water from ships does not have a negative impact on the environment. Along with updating and supplementing appropriate legal policies, there is also a need for more research on ballast water treatment technologies. Ballast water treatment will directly address invasive organisms, harmful chemicals and bad actors in them. If the solution is good, the ships' ballast is clean and the environment will not be adversely affected. However, current treatment technologies still have many limitations, such as high cost, existence of toxic chemicals, etc. It is necessary to find solutions so that

ships do not need to use ballast water, while ensuring buoyancy and operational stability.

The rest of the paper is structured as follows. The second part provides an overview of the external, environmental cost caused by ballast water and discusses the history of the adoption, current status of the BWM Convention. The third part discusses the importance of clear regulations and of management strategy in regard to ballast water and environmental pollution. The paper concludes with the suggested proposal that the Contingent Valuation Method (CVM) and Willingness to Pay (WTP) method could be used to determine the value of the environment, and that, correlatively a Pigouvian corrective taxation should be imposed to internalize the external cost.

2. The Environmental Cost of Ballast Water

Pollution from ships is caused by emissions, oil spills, heavy metals, and cargo, a problem that presents formidable difficulties for environmental security [5]. Exhaust gases like CO₂, NO₂, and others have a detrimental effect on the atmosphere's ecosystem. Emissions from diesel engines are usually released directly into the air or water, thus causing environmental pollution [6] although intelligent control techniques to successfully lower carbon monoxide and hydrocarbon emissions in diesel engines also dramatically lower harmful pollutants released by ships [7]. Additionally, ships emit ballast water, which has a negative impact on the marine habitat. Depending on the cargo being carried, ballast water can either be accepted or rejected in order to maintain a ship's stability.

On the other hand, ballast water introduces Invasive Alien Species (IASs) that pose a severe threat to marine ecosystems all over the world. IASs are species that are introduced outside of their natural habitats and brought to places they are not typically found. Under certain circumstances, they establish themselves, and in the absence of natural predators or pests, they grow and become invasive, endangering the native ecosystem and its species.

IAS cause environmental and economic damage and can pose a threat to human health. The main concerns currently about IAS are that their impacts are already large and are rapidly becoming larger because the international movement of goods and people is increasing due to globalization. Since it is nearly impossible to completely eradicate the issue produced by IAS once they are established in the marine environment, they are regarded as one of the most significant dangers to global biodiversity [8]. The exotic invasive species directly causes huge damage to the economy. The result of negative impacts on different occupations such as fishing, aquaculture and tourism is the reduction of economic output and even other indirect effects such as human health.

Now, in regard to the estimation of the external cost discusses above, It have been provided a useful review of external costs (e.g. air and water pollution) of maritime transportation, but they do not include the effects of ballast water which, as they say, will be treated in a different paper. We, as will be discussed later, instead follow a different route, proposing that the CVM and the WTP method could be used to determine the value of the environment.

3. Regulations and Management Strategy

Shipping companies should be committed to protecting the environment and managing environmental issues as an integral part of its operations both on land and at sea. In particular, it is the policy of the Member States to ensure the environmental integrity of the processes, the equipment used and the working environment at all times. Shipping companies do this by adhering to the following principles:

- a) Recognizing environmental management among the highest corporate priorities and as a key determinant of sustainable development;
- b) Establishing policies, programs and practices to conduct business in an environmentally sound manner;
- c) Complying with all applicable legal requirements and other requirements to which the Member State

subscribes. This is done by developing, implementing and maintaining processes, plans and procedures to ensure this compliance;

- d) Minimizing any significant adverse environmental impacts of new developments. This is done by using environmental management and planning processes and through environmental impact assessment, before starting a new activity or project.

Shipping companies should develop and provide their services in a way that minimizes their environmental impact and improves its understanding at all stages by any of its customers and the international community, while ensuring that they are safe for their intended use and efficient in the consumption of energy and natural resources. They should also develop environmental performance assessment procedures and related indicators in order to measure the results of the management of environmental aspects, and should manage their activities with the objective of pollution prevention, using processes, practices, techniques, materials, products, services or equivalents, to avoid, reduce or control the generation, emission or disposal of any type of pollutants or wastes in order to reduce adverse environmental effects, always promoting and achieving zero leakage. Pollution prevention can include source reduction or elimination, changes in processes, products or services, efficient use of resources, conservation of materials and energy, reuse, recovery, recycling, restoration and treatment.

Furthermore, shipping companies should educate and motivate employees to increase their awareness of the strategic importance of environmental management, encourage interest and respect for the environment to enhance their skills and enable them to conduct their activities in an environmentally responsible manner. Moreover, they should communicate its commitment to environmental issues with all stakeholders (employees, vendors, customers and any other person or group interested in or affected by the shipping companies' environmental effects) and showcase their environmental expertise, anticipating and responding to

concerns about potential risks and impacts of operations, services or issues and encourage the use of the environmental management system by suppliers and contractors. [9].

Where there are significant risks, shipping companies should develop and maintain emergency preparedness plans in cooperation with the emergency services, the competent authorities and the local community with the aim of responding quickly and effectively to incidents arising from its activities. They should continue to improve policies, programs and environmental performance, taking into account technical developments, scientific understanding, customer needs and community expectations, always taking legal regulations as a starting point [10].

The top management of the company should operate the companies in a systematic and visible manner. The objective of top management is to create a customer-oriented organization by: a) defining systems and processes that can be clearly understood through management and improvement in terms of effectiveness and efficiency and b) ensuring the effective and efficient operation and control of processes and the measures and data used to determine satisfactory company performance. To achieve this goal, top management should define and promote processes that lead to improved organizational performance, acquire and use data and process information on an ongoing basis, directing progress toward continuous improvement, and utilize appropriate methods to evaluate the improvement of processes, such as self-assessments [11].

The nature and extent of the documentation is such that it meets contractual, statutory and regulatory requirements, the needs and expectations of customers and other stakeholders and is appropriate for the company and the vessels managed. The HSE (Health, Safety and Environmental) (HSE) management system documentation consists of the HSE Management System Policy Manual, HSE Procedures (Quality Procedures). These include, among others, instructions

and supporting material such as fleet instruction manual, circulars, letters, notices, operating and cargo handling manuals, forms and checklists, emergency management plan, fire training manual, waste management plan, ballast water management plan, refrigerator management plan, bilge/engine room oil waste management plan, overboard recovery plan and procedures [12].

The HSE Management system policy manual is available to all company employees and selected customers and describes the shipping company's actions regarding service quality, safety and environmental protection, states the company's policies and related principles, defines the scope of the management system and the organization of the management system, and provides brief descriptions of the responsibilities and authority of key management personnel/departments. It addresses the requirements of the International Safety Management (ISM) Code and refers to the relevant system procedures. It describes the ways in which Shipping Company completes its activities in the functional areas referred to in the HSE Management System, the assignment of responsibilities and identifies the relevant records. The HSE Management system's procedures [13] include:

- a) Procedures for preparing plans and instructions for activities affecting safety, pollution prevention and service quality;
- b) Incident and non-compliance reporting procedures;
- c) Emergency preparation and response procedures;
- d) Procedures for internal audits, management inspections and implementation of corrective and preventive actions;
- e) Procedures for maintenance of ship and equipment on board;
- f) Procedures for document control and record keeping;
- g) Procedures for ensuring the provision of qualified personnel for the various tasks involved in the basic operations ashore and on board;
- h) Procedures related to HSE issues, the objectives

and the corresponding programs of the Company;

i) Risk assessment and management procedures; and

j) Procedures to ensure compliance with trust requirements, where required by ship management agreements.

Records should be created and maintained to provide evidence of compliance with specified requirements and the effective operation of the HSE management system as well as to record the extent to which planned goals and objectives have been achieved. HSE records may include information about applicable HSE legislation or other requirements; complaint files; training records; inspection, maintenance and calibration records; incident reports; information on emergency preparedness and response; suggestions for improvement and best practices; and audit results.

The records to be kept are indicated in the respective procedures. These records must be legible, identifiable and traceable and will be retained for specified minimum periods. Authorized persons in accordance with a specified filing system and in storage facilities must keep them suitable for easy retrieval and for protection against damage, deterioration and loss. Where contractually agreed, HSE records will be available for inspection by the customer (or their representative) for an agreed period. Appropriate records are also made available when necessary and upon request to classification surveyors and port and flag authorities [14].

Shipping companies have established, implement and maintain a process for determining the environmental aspects of its activities, products and services within environmental scope of the environmental management system that can control and influence and determine those aspects that have or can have significant effects on the environment. This process takes into account [15] the following: a) the cost and time of undertaking the analysis; b) the availability of reliable data; and c) information already developed for regulatory purposes and the degree of

practical control and influence the company may have over the environmental aspects considered and planned, or over new developments or new or modified activities, products and services. The determination of the environmental aspects of a shipping company is carried out by taking into account the inputs and outputs related to its current and relevant past and future activities carried goods and services. The initial determination of environmental aspects is carried out after a thorough review of the following four main areas:

a) Legal and other requirements;

b) Review of all existing environmental management practices and procedures;

c) Evaluation of feedback from the investigation of previous incidents; and

d) Evaluation of future activities and services.

In all cases, normal and abnormal, operation on board and the possible emergency situation are taken into account. The process for identifying significant environmental aspects takes into account both the company's on-board and offshore activities. In addition to those environmental aspects that the Company can directly control, the company also examines aspects that it can influence, such as packaging and transportation of supplies used by the company and environmental performance and practices of contractors and suppliers.

In relation to each identified environmental aspect, as many actual and potential positive and negative environmental impacts as possible are identified by the Environmental Team, consisting of the Chief Executive Officer (CEO), Designated Person Ashore (DPA), HSE Director and Technical Director. To determine the significance of each of the identified environmental impacts, an assessment is carried out taking into account, among others, environmental concerns such as the scale and severity of the impact; the duration of impacts, business concerns such as potential regulatory and legal exposure; and impact change costs and stakeholder concerns.

4. Discussion and Concluding Remarks

Having discussed ballast water management, environmental cost, and the importance of regulations regarding environmental management, we should not turn out attention to the determination of the environmental cost and the corresponding Pigouvian retributive tax that, according to our view, could compensate for the environmental damage caused, which is the main thrust of the paper.

When markets work efficiently, using the market price is a good approximation of social cost. When it comes from inefficient markets, the price does not reflect the true social costs. With Cost-Benefit Analysis (CBA) all critical parameter problems are attributed to a single basic evaluation which facilitates the decision-making process. The basis of the evaluation is the comparison of benefits and costs [16-20]. If the gains are greater, then the program or activity is socially desirable. Otherwise, they are considered socially beneficial.

From the point of view of the public interest, a policy or program is justified and contributes to social welfare if the benefits received exceed the estimated costs. This approach is consistent with Kaldor-Hicks' principle of potential compensation, a widely accepted variation of the Pareto criterion. The Weak Pareto Condition refers to a program or policy measure that is socially acceptable when it improves the well-being of every member of society, while the Strong Pareto condition refers to a program or policy measure that is socially acceptable when it ensures improved welfare of even one person without reducing the welfare of another person [21-24].

The Pareto principle is based on the individual perception of well-being, where people are seen as the best interpreters of their personal well-being through their choices. It has limited use as there is almost no action to improve it as one can continue while making others worse off. Furthermore, it does not include concepts such as social justice or redistribution of

income [25-30]. Finally, cost-benefit analysis supporters frequently view it as a method for enacting either Pareto-efficiency or Kaldor-Hicks efficiency, two standards that many welfare economists consider to be normatively fundamental [31].

Environmental taxes help implement the polluter pays principle since they make polluters face the full cost of their polluting activities [32-35]. In practice, there are a lot of data on the economic costs of externalities or their distribution, thus policymakers set the price of environmental taxes at those levels that they believe will achieve their policy goals [36, 37]. The impact of environmental taxes on competitiveness is a subject of constant debate. The potential adverse effects on international competitiveness are of concern to environmental policy makers when considering their application to energy and other products related to environmental problems. Some factors that influence the effectiveness of environmental policy and outcomes in international trade are: the size of each economy and its influence on pricing internationally, and the homogeneity or variety of products produced in areas affected by taxation. Certainly, environmental taxation, especially for heavily polluting industries results in losses and demands for technical innovation, pollution reduction, and energy conservation, which raise production costs and harm the enterprise's financial performance and profitability [38-40]. However, it has been argued that in the long run, they will have a positive impact on the economic benefits of enterprises [41].

The method proposed for the determination of this retributive tax is the CVM [41, 42]. This method adopts the circulation of a questionnaire with the question of WTP, i.e. the maximum amount that someone is willing to pay in order to compensate for the inaction caused to the environment by his activity.

The solution proposed by the authors is the imposition of a Pigouvian retributive tax to compensate for the environmental damage caused. The solution to the present problem of environmental

management cannot be given by the market mechanism (supply and demand) which fails to internalize the external environmental cost. Notwithstanding the limitations of classical economics and of WTP [42], government intervention is required through taxation of the activity in question in order to reach the socially optimal point of well-being.

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