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Good regulations, bad regulation: a Peruvian port case

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Abstract

Lead poisoning of Callao's population is the most severe externality port operations cause in Peru. The problem could have been tackled in 2009, after the government issued a decree regulating how mineral ore was to be handled at Peruvian ports. However, the port regulator's inability to follow the criteria contained in their own regulations led the procedure of selecting the providers of the service to continuous delays, and finally, to a complete stop. As a consequence, Callao's population will continue to be affected by this externality until 2013. The problem the regulator could not solve was to determine whether the market for 'mineral ore stevedore services' at Callao Port was monopolistic or competitive. This article re-examines the case and concludes that the market for the service has natural monopoly characteristics. Therefore, the regulator should have ordered the call of an auction to select the least-expensive provider and thus, spare the population from four more years of lead poisoning.

Key Words: Callao port, mineral, Callao's population, poisoning, regulation
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1. INTRODUCTION

The most severe externality port operations cause in Peru is the lead poisoning of the people living in the vicinity of Callao Port, the most important of the country. The consequences of this problem could have been substantially reduced in 2009, after the government issued a decree stating that mineral ore could only be handled at Peruvian ports using hermetic ship loaders, a kind of equipment that avoids pollution by encapsulating the ore when it is loaded onto the vessel. Unfortunately, the port regulator was not able to determine the right procedure to select the firms that could provide the service using this equipment. Consequently, mineral ore will continue contaminating Callao's population at least until 2013, when a new dedicated terminal is expected to start operations.

The main objective of this article is to show that this delay was unnecessary. If OSITRAN had followed its own regulations, the hermetic ship loaders could have been put in place by mid-2009, as initially planned. A second objective is to highlight the fact that having a competent regulator is as necessary for an efficient port system as having sound regulations. This issue is especially relevant in Latin American countries, where public policies typically focus in the creation, not in the enforcement, of new regulations. A third objective is to show that regulatory inaction may have worse consequences over welfare than the inefficiency regulators are meant to avoid.

The remaining of the document is structured as following: the next section describes the problem in detail. The third section explains the theory of how the problem of determining the optimum number of operators had to be settled. In the fourth section, two analyses are performed to determine whether the mineral ore loading services' cost function at Callao port is sub-additive or not. The fifth and final section presents the conclusions.

2. THE PROBLEM

2.1 Lead contamination at Callao port

Callao is Peru´s main port. It is Lima's natural gateway, the country's economic engine that generates over a third of its GDP. In 2008, the port handled 19 million MT; including 1.2 million TEU (90% of Peru's containerized traffic). An additional reason to consider this port as a strategic asset for the Peruvian economy is that mining exports account for 60% of the country's total and Callao handles 70% of the total exported through Peru's common user ports [1].

Despite its importance for the local economy, by 2009 the port did not have the necessary equipment to avoid cargoes polluting water and soil. Mineral ore (mostly zinc and lead) was still carried by dumper trucks, piled up in the quay and was loaded onto vessels using uncovered conveyor belts and ship loaders, therefore allowing the ore to pollute air and water. The service was provided by private stevedores firms. Empresa Nacional de Puertos (ENAPU), the state-owned company that managed the terminal, did not participate in this market.

The result of this situation was a large-scale social problem. Several studies show that blood-lead levels of people living in areas surrounding Callao port are alarming. A study carried out in 1999, for example, found that blood-lead levels of children attending schools located close to the port or near-by warehouses contained 25.6 ug/dL of lead, in average; a level substantially higher than the one found in other areas of the Callao Province (9.5 ug/dL) or Lima (7.1 ug/dL) [2]. The highest level recommended by the World Health Organization is 10 ug/dL. According to the organization, lead is especially harmful for children because it interferes with their normal development. A 10ug/dL increase diminishes, in average, IQ by 2.5 points and growth by 1 cm.

The problem was ignored by successive administrations. Only in 2008, the Peruvian government issued the 015-2008-MTC Decree, which stated that hermetic ship loaders will have to be used in all mineral ore stevedore operations by the end of 2009.

2.2 The Access Regulation

Peruvian ports are considered natural monopolies, for which prices and market access conditions are regulated by Organismo Supervisor de la Inversión en Infraestructura de Transporte de Uso Público (OSITRAN)[1] OSITRAN's access regime is aimed at fostering efficiency in Peruvian common user ports where terminals are natural monopolies, by encouraging competition in as many markets as possible. In markets where competition is feasible, the allowed number of suppliers as well as the procedure to select them is determined according to the criteria contained in the Access Regulation. When competition is not feasible, the regulator sets the prices directly.

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[1] In Callao Port, the market for containerized cargo cannot be considered a monopoly since May 2010, when a second container terminal, concessioned to DP World, started operations.

Stevedoring of bulk cargo is considered an 'Essential Service' and thus, covered by the Access Regulation. According to this regulation, firms who want to provide an Essential Service must request access to a (monopolistic) terminal operator, who can only deny it for justified reasons, such as operative, safety or security limitations. When the number of access seekers is higher than the number of feasible slots, the terminal operator must call a public auction, in which main access conditions (such as access charges or final prices) are set. Otherwise, the terminal operator can negotiate conditions directly with access seekers. The regulator only intervenes to arbitrate controversies or to mandate access when parties cannot reach an agreement [3].

It is worth noting that the Access Regulation aims at increasing market efficiency by encouraging competition, not at solving problems created by negative externalities such as pollution. Dealing with environmental problems and other market failures requires policy tools of a different kind. However, since the Access Regulation requires participants in markets for Essential Services to comply with several types of standards, it is also an effective instrument to achieve environmental goals in monopolistic situations. Nevertheless, as one can see in this case, the efficacy of regulation largely depends on the efficacy of the regulator.

2.3 The frustrated access procedure

One month after the issuance of the 015-2008-MTC Decree, several firms showed their willingness to provide stevedore services according to the new environmental requirements. Given the private interest and the existence of a regulatory procedure that facilitates port investments, the service should have been provided under the new conditions by the end of 2009. Unfortunately, a controversy arose between ENAPU and one private company (COSMOS) regarding the number of firms that could provide the service, i.e., whether ENAPU could engage in direct negotiations with access seekers or had to call a public auction.

The sequence of the problem is the following:

1. In May 2008, ENAPU published a notice asking interested firms to submit access requests to provide stevedore services for mineral ore at Callao port. Given space limitations, the equipment to be used had to be mobile.

2. In July 2008, ENAPU announced that two ship loaders could operate simultaneously at the quay and therefore, it would grant access to two firms to operate one loader each. In this way, it argued, final prices would be set through competition. The state-owned firm also announced that only two firms had presented access requests, for which it would negotiate access conditions directly with them.

3. ENAPU's decision to negotiate access conditions directly was appealed by COSMOS, one of the access seekers, to OSITRAN. According to COSMOS, since two ship loaders are always required for these operations, competition would never occur if access was granted to two firms. COSMOS also argued that since firms operating ship loaders are not regulated by OSITRAN (only terminal operators are subject to economic regulation); ENAPU's decision would lead to an unregulated duopoly, thus harming port services' users. Part of the rents would be transferred to ENAPU via higher-than-necessary access charges.

4. In May 2009, OSITRAN upheld the appeal and ordered ENAPU to reinitiate the access procedure.

5. In June 2009, ENAPU asked again interested parties to submit access requests, stating this time that it would grant access to three firms, each operating a mobile ship loader. Since the quay could only accommodate two loaders operating simultaneously, one of them had to remain each time in the parking area. Redundancy would lead to competition, since none of the firms would want its equipment to remain unused.

6. In July 2009, ENAPU called a public auction to grant access to three firms to operate one mobile ship loader each.

7. In August 2009, COSMOS challenged the auction rules before OSITRAN arguing that setting up three ship loaders when only two are needed would lead to unproductive investments and higher prices for final users. It also argued that the rules did not state what would occur if less than three bids qualified for the auction or one of the winning firms leaves the market, which would convert the market into an unregulated monopoly or duopoly. COSMOS' position was that the most efficient arrangement was to call an auction to grant access to one firm to operate two ship loaders.

According to the Access Regulation, in these circumstances OSITRAN has to analyze the auction rules and issue an opinion taking into account the principle of efficiency, and if necessary, modify them. According to the principle of efficiency stated in the Regulation, access conditions have to avoid 'inefficient duplicity, congestion costs and other externalities' [4]. The legal term passed, however, without the regulator issuing an opinion on how the auction should proceed.

According to Peru's legal system, in a situation like this COSMOS could go to court to force OSITRAN to issue the opinion, but that did not occur either. Few weeks before legal term passed, a consortium of logistic operators and mining companies (two of them the future main users of the service) had presented the government a proposal to build a dedicated mineral ore terminal in a different area of the port. This terminal, capable of handling in a more efficient way all of the mineral ore expected to be extracted from Central Peru, was planned to start operations by 2012, which would have given mobile ship loader operators the minimum period of three years needed to recoup investments. However, OSITRAN, by delaying the access procedure, made it unprofitable to provide the service for which access was sought.

As one can see, what caused the delay and eventual stall of the access procedure was the regulator's inability to determine the number of suppliers that could provide the service and whether conditions should be set through negotiation or an auction. The regulator's failure ultimately caused that the reduction of the effects of lead poisoning had to wait until late 2013[2], when it could have started as early as 2009.

3. THE SOLUTION'S THEORY

From an economic point of view, the solution to this problem consists on determining whether the market is competitive or naturally monopolistic. In the first case, the most efficient solution would be granting access to the highest possible number of firms. The final price would then be set through competition. In the second case, the most efficient solution would be granting access to just one provider.

[2] This project also experienced delays, for which, by June 2012, operations are not expected to start before September 2013 [5].

3.1 The natural monopoly case

When the two fundamental theorems of welfare economics[3] are met, free interaction of market forces leads to an efficient resource allocation without need of external intervention [6]. Otherwise, market failures occur.

According to Tirole [7], there are three main sources of market failures: natural monopolies, externalities and information asymmetries. When any of them occur, external intervention is needed to correct their effects on prices and welfare levels. An industry is said to be a natural monopoly when technology imposes a cost function that makes it cheaper, for a relevant demand interval, to produce a good or service with only one firm in the market [8]. In general terms, this occurs when the minimum efficient scale of supply is higher than demand.

The concept of natural monopoly was traditionally linked to the existence of economies of scale and scope. However, Baumol, Panzar and Willig [8] showed that the appropriate definition of natural monopoly lies on the concept of sub-additivity of costs.

The concepts of economies of scale, economies of scope and sub-additivity of costs are formally defined below.

Sub-additivity of costs

Formally, a cost function 'C' associated to a production vector 'Y' is strictly sub-additive if the cost of producing Y by one firm is lower than the cost of producing the same vector by two or more firms using the same technology, for any sub-group 'i' of Y.

Therefore, a cost function is sub-additive, if it satisfies the following condition for the relevant demand interval:

$$C(Y) < \sum_i C(Y_i)$$

Where:

[3]First Theorem of Welfare Economics: Under the following conditions, equilibrium in a set of competitive markets is Pareto-efficient: (i) there is no consumption externalities; and (ii), there are enough agents to ensure that each one behaves competitively.

Second Theorem of Welfare Economics: If all agents have convex preferences, every efficient allocation is a competitive equilibrium for some initial allocation of goods [6].

$$\sum_i Y_i = Y$$

An industry can be defined as a natural monopoly if the cost function is strictly sub-additive for the relevant demand interval [9].

Economies of scale

In the case of a multi-product firm, the definition of economies of scale is related to the concept of 'decreasing average multi-product costs'.

Decreasing average multi-product cost

In the case of a firm producing 'n' goods, the concept of 'average multi-product cost' (AMPC) is defined as:

$$AMPC = \frac{C(Y)}{a \cdot Y}$$

Where Y is the production vector, C is the cost function and a > 0 is a vector of relative weights. It can be said that AMPC is decreasing in Y if AMPC(tY) is a decreasing function of the scalar 't' when t=1:

$$\left.\frac{\delta \mathrm{AMPC(tY)}}{\delta t}\right|_{t=1} < 0$$

In the case of a multi-product firm, economies of scale occur if AMPC is decreasing.

Economies of scope

Economies of scope exist in the production of a combination of goods, when the cost of producing such a combination by a single firm is lower than the cost of producing it by two or more firms that do not produce the same good. In the case of a multi-product firm, economies of scope refer to the existence of synergies in the production of two or more goods derived, for example, from the shared use of a production factor. This situation would allow a single firm to produce goods cheaper than firms not sharing production factors, even if economies of scale are not present.

In the case of a multi-product firm, the definition of economies of scale is related to the concepts of ´incremental cost of production' and 'average incremental cost'.

Incremental cost of production 'j'

The incremental cost (IC) of producing 'j' is the difference between producing a bundle of goods and producing the same bundle minus 'j', where Y-j is the production vector 'Y', but placing '0' instead of 'j':

$$IC_j(Y) = C(Y) - C(Y_{-j})$$

Average incremental cost

The average incremental cost of 'j' is:

$$AIC_j = \frac{IC_j(Y)}{Y_j}$$

In the presence of economies of scope, a firm's cost function is sub-additive if for any good Y_j belonging to the production vector Y, the average incremental cost is decreasing.

As it can be seen, the concepts of sub-additivity of costs and natural monopoly are mutually implied [8].

3.2 The 'Demsetz approach'

According to Demsetz [10], an efficient alternative to regulate a natural monopoly is to franchise it to the bidder that in an auction offers to charge the lowest price to consumers. In the absence of collusion, with equal access to essential inputs and symmetric information among the bidders, an auction would induce prices to approach the average cost of the most efficient firm, thus minimizing simultaneously productive and allocative inefficiencies. This would also eliminate the need of a regulator setting prices, thus reducing the potential of regulatory failures and avoid incurring the costs of producing regulation.

4. NATURAL MONOPOLY OR COMPETITIVE MARKET?

Two analyses can be made to determine whether the 'mineral ore stevedores services' cost function in the case of Callao is sub-additive: (i) a comparison between the demand and the minimum efficient scale of the market (the cost function is sub-additive if the former is smaller than the latter) and (ii) a comparison of the resulting prices in two scenarios: considering the market competitive and naturally monopolistic. A higher price in the former scenario would indicate unexhausted economies of scale or scope, i.e., cost sub-additivity.

4.1 Comparison between the demand and the minimum efficient scale of supply

Demand size

As shown in figure 1, the volume of mineral ore handled in Callao port increased from 1.5 million MT in 2000 to 2.27 million MT in 2008. Assuming an average annual growth rate of 4.24%[4], the port would handle a throughput of 2.8 million MT of mineral ore in 2013.

Around 50% of this cargo is loaded onto 25 000 MT vessels. The remaining 50% is loaded onto ships ranging between 20 000 MT and 40 000 MT of capacity. The average batch size is 20 000 MT [11].

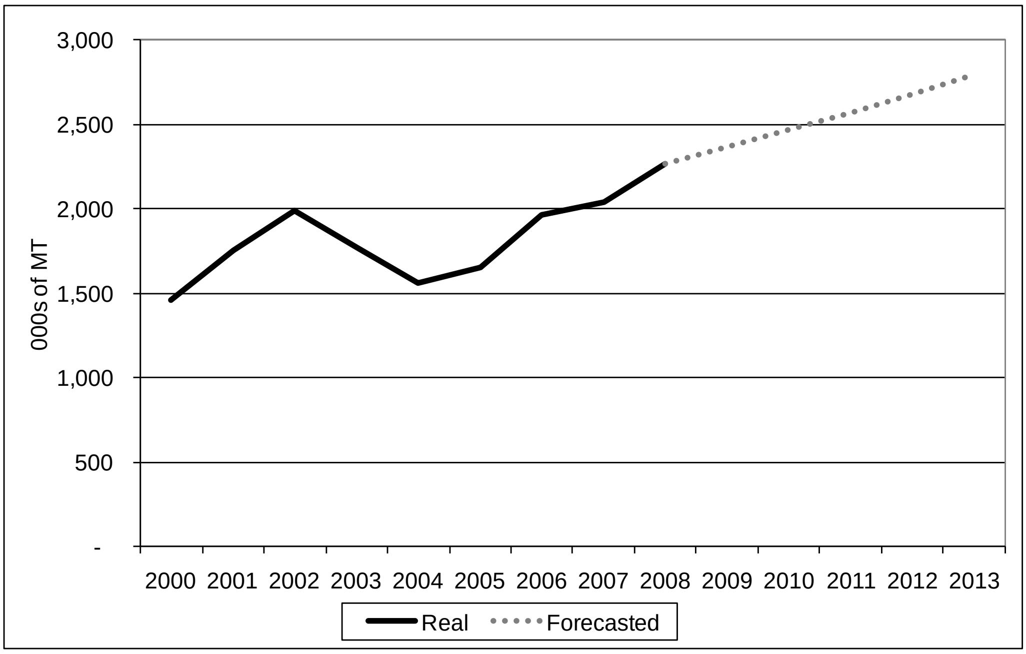

Figure 1: Mineral ore exported through at Callao Port 2000- 2013

[4] This figure was estimated averaging the average growth rates of the periods 2003-2008 (2.86%) and 2004-2008 (5.63%).

Source: ENAPU [11]

Minimum efficient scale

According to ENAPU, given the dimensions of the quay used to load mineral ore at Callao Port and the size of the batches (around 20 000 MT each), this cargo can only be loaded efficiently using two ship loaders simultaneously. The quay is too narrow to use a third one and it is not economical using just one (the time the vessel would have to be at port would be excessive). This rationale was not disputed by OSITRAN, COSMOS or any of the other access seekers [12].

An engineering model was used to determine the terminal's maximum loading capacity using standard equipment. It was supposed that two B&W standard ship loaders that comply with the 015-2008-MTC Decree would be used. The terminal's maximum loading capacity was determined as follows:

1. According to the manufacturer specifications, these ship loaders are able to operate 252 days a year (6 048 hours).

2. As shown in table 1, each ship loader's average loading capacity is 514 MT per hour (supposing each is fed by two 30 MT dumper trucks simultaneously).

Movement	Minutes per truck	Nr. Of trucks	Maximum loading per truck
Truck transfers to reception hopper	2	2	30 MT
Positioning at the reception hopper	2		
Unloading	3		
Total	7 minutes		
Average hourly loading capacity per ship loader	**514 MT**		

Table 1: Average hourly loading capacity per ship loader

3. Assuming 20 000 MT batches, each would require approximately 20 hours to be loaded onto the vessel.

4. In addition, every time a vessel calls approximately four hours are required for mooring, unmooring, hatch opening and closing, among other activities. This implies the ship loaders can operate only 20 of every 24 berth-hours (5 040 hours a year), assuming 20 000 MT batches.

5. As one can see, the total loading capacity of two ship loaders operating 5 040 hours a year, loading each 514 MT of mineral ore per hour, amounts to 5.18 million MT a year. This is the service's minimum efficient scale.

The fact that the 2008 demand represents only 43% of the minimum efficient scale and it was not expected to increase substantially in the near future, is a strong indicator that the service's cost function is sub-additive. It implies that there will be unexhausted economies of scale or scope until demand approaches 5.18 MT a year.

4.2 Comparison of resulting prices considering the market competitive and naturally monopolistic

To perform this analysis, two scenarios were considered. In the first, it was assumed that the market is competitive. In the second one, it was assumed the market is naturally monopolistic. In both scenarios, income, costs, and investments were projected. Demand projections are those shown in Figure 1. An operation period of three years was supposed.

Scenario 1: The market is competitive

As seen before, each operation requires two ship loaders working simultaneously. For this reason, competition for this service can only occur if there are at least three mobile loaders in the market. In this case, each would be owned by a different firm. Since the quay could only accommodate two loaders operating simultaneously, one of them had to remain each time in the parking area. To simplify the analysis, it was assumed that each firm has a market share of 33.3%.

The price of a ship loader with characteristics as those required by the 015-2008-MTC Decree is of US$ 2.73 million (including transport and setting up costs). Ancillary equipment would also be required. Total investments amount to US$ 2.80 million [12]. It has been assumed that each ship loader's average loading capacity is 514 MT per hour. Each firm's cost structure is shown in the appendix.

It has been assumed that 70% of the investment will be financed at 10% a year, and that the loan will be repaid in three years. If we assume an opportunity cost of capital of 15% a year and a tax rate of 30%, we obtain a weighted average cost of capital (WACC) of 9.4%

Given these assumptions, if we believe the market for the service is competitive, the minimum price firms can charge to cover costs, investments and their shareholder's opportunity cost is US$ 2.43 per MT.

Scenario 2: The service is a natural monopoly

In this scenario, it is assumed access is granted to only one firm that operates two ship loaders. The firm is selected in an open auction where the competition factor is the price charged to final users. Assumptions regarding demand, unit costs and investments are similar to those of the Scenario 1. In this scenario, however, one firm covers 100% of the demand.

As a result, if we assume the market is a natural monopoly, the price that covers costs, investments and shareholder's opportunity cost is US$ 1.59 per MT.

Scenario comparison

It can be seen that the price obtained assuming the service is a natural monopoly is 52% lower than assuming it is a competitive market. In these circumstances, considering the market competitive would have required users to pay extra costs for US$ 6.76 million[5] during the three-year period.

These results also constitute a strong indicator that there are unexhausted economies of scale or scope for the relevant demand range.

5. CONCLUSIONS

The results of the analysis carried out indicate that the market for 'mineral ore stevedoring services' at Callao port is a natural monopoly. Therefore, OSITRAN had to modify the rules of the auction called by ENAPU so that the access was granted to one firm to operate two ship

[5] Obtained by multiplying the volume expected to be handled between 2011 and 2013 (8 million MT), times the price difference between scenarios (US$ 0.84 per MT).

loaders. Following Demsetz [10], in these circumstances the most efficient solution would have been turning the price charged to final users into the auction's competition factor.

The analysis also indicates that that the solution was at the regulator's reach. To solve the problem, OSITRAN only had to follow the criteria and procedures contained in its own regulations. By not doing so, and therefore, delaying the access procedure, it discouraged the private sector to invest in a technology that would have reduced the effects of a problem as serious as lead poisoning four years earlier. As studies show, this externality, the most severe that port operations cause in Peru, has large and permanent effects over the population [2]. The outcome of this case constitutes evidence that regulatory inaction may have worse consequences over welfare than the inefficiency regulators are meant to avoid.

Lastly, the case shows that an efficient port system does not only require regulations aimed at fostering economic efficiency, but also authorities with the knowledge and will necessary to tackle the complex problems port regulation poses.

6. BIBLIOGRAPHY

1. DEFILIPPI, E., 2004, Intra-Port Competition, Regulatory Challenges and the Concession of Callao Port, *Journal of Maritime Economics and Logistics*, 6, 279-311.
2. HERNÁNDEZ-AVILA, M., ESPINOZA R. and CARBAJAL L., 1999, Estudio de Plomo en Sangre en Población seleccionada de Lima y el Callao (Junio 1998 – Marzo 1999, prepared for the USAID Mission to Peru under EHP Activity No. 428-CC.
3. FLOR, L. and DEFILIPPI, E., 2003, Port Infrastructure: An Access Model for the Essential Facility, *Maritime Economics and Logistics*, 5, 116-132.
4. ORGANISMO SUPERVISOR DE LA INVERSIÓN EN INFRAESTRUCTURA DE TRANSPORTE DE USO PÚBLICO, 2003, Reglamento marco de acceso a la infraestructura de transporte de uso público, aprobado por Resolución de Consejo Directivo Nº 014-2003-CD-OSITRAN.
5. AGENCIA PERUANA DE NOTICIAS ANDINA, 2012, APN aprobó expediente técnico para construcción de muelle de minerales en el Callao, 7 June.
6. LASHERAS, M. A., 1999, *La Regulación Económica de los Servicios Públicos,* (Editorial Ariel, Barcelona).
7. TIROLE, J., 1990, *La Teoría de la Organización Industrial*, (Editorial Ariel, Barcelona).
8. BAUMOL, W., PANZAR, J. and WILLIG R., 1982. *Contestable Markets and the Theory of Industrial Structure* (Harcourt Brace Jovanovich, New York).
9. GALLARDO, J., 1999, Disyuntivas en la Teoría Normativa de la Regulación: El Caso de los Monopolios Naturales, Documento de Trabajo 164, Pontificia Universidad Católica del Perú.
10. DEMSETZ, H., 1968, Why Regulate Utilities?, *Journal of Law and Economics*, 11, 55-65.
11. EMPRESA NACIONAL DE PUERTOS, www.enapu.gob.pe.
12. INTELFIN, 2009, Opinión técnica sobre las condiciones de acceso para la prestación del servicio de embarque de minerales mediante fajas herméticas móviles en el Terminal Portuario del Callao. Document presented to OSITRAN during the access procedure.

7. APPENDIX: COST STRUCTURE IN BOTH SCENARIOS

Scenario 1

	Unit	2011	2012	2013
Volume	MT/year	2 572 572	2 681 724	2 795 507
Market share	%	33%	33%	33%
Cargo loaded	TM/ year	848 949	884 969	922 517
Average loading capacity	TM/hour	514	514	514
Ship loaders per firm	und	1	1	1
Labor costs				
Administrative	US$/ year	306 841	306 841	306 841
Operative (fixed)	US$/ year	51 348	51 348	51 348
Operative (variable)	US$/shift	716	716	716
Shifts	Und	138	143	149
Operative (variable)	US$/ year	98 464	102 642	106 997
Operative expenses				
Maintenance	% investment	2%	2%	3%
Maintenance	US$	55 979	55 979	83 969
Fuel price	US$/ Gallon	3.23	3.24	3.26
Working hours	hour	1 651	1 721	1 794
Fuel	Gallon	42 311	44 105	45 976
Fuel consumption	Gallons/ hour	26	26	26
Fuel expenses	US$/ year	136 487	142 985	149 795
Insurance	% income	7%	7%	7%
General expenditures	% expenses (w/o depr)	5%	5%	5%
Access charges	US$/ year	97 020	97 020	97 020
Others				
Exchange rate (S/. per US$)		3.00	3.00	3.00
VAT		19%	19%	19%
Tax rate		30%	30%	30%

Scenario 2

	Unit	2011	2012	2013
Volume	MT/year	2 572 572	2 681 724	2 795 507
Market share	%	100%	100%	100%
Cargo loaded	TM/ year	1 286 286	1 340 862	1 397 754
Average loading capacity	TM/hour	514	514	514
Ship loaders per firm	und	2	2	2
Labor costs				
Administrative	US$/ year	306 841	306 841	306 841
Operative (fixed)	US$/ year	102 697	102 697	102 697
Operative (variable)	US$/shift	967	967	967
Shifts	Und	417	435	453
Operative (variable)	US$/ year	403 193	420 300	438 133
Operative expenses				
Maintenance	% investment	2%	2%	3%
Maintenance	US$	111 958	111 958	167 937
Fuel price	US$/ Gallon	3.23	3.24	3.26
Working hours	hour	5 004	5 216	5 436
Fuel	Gallon	128 240	133 673	139 311
Fuel consumption	Gallons/ hour	26	26	26
Fuel expenses	US$/ year	413 676	433 358	453 894
Insurance	% income	2%	2%	2%
General expenditures	% expenses (w/o depr)	5%	5%	5%
Access charges	US$/ year	291 060	291 060	291 060
Others				
Exchange rate (S/.per US$)		3.00	3.00	3.00
VAT		19%	19%	19%
Tax rate		30%	30%	30%