Port terminal concessions: Towards a dynamic concession fee

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**Abstract**

Ports are key-nodes of the transport networks and their efficiency is strategic for regional competitiveness. Port operations are performed by a heterogeneous group of market players: in the landlord system, stevedore activities are performed in public port spaces that have been used exclusively by operators for several decades. Within this framework, several authors have discussed how differentiated rules within the concession agreements might contribute to increasing terminal performance. Despite this, few authors discuss the introduction of performance clauses in the concession agreements. Current research introduces a dynamic concession fee evaluation method and applies it to a case study.
Keywords: Port Concessions, Dynamic incentives, Port Activity, Port Policy, Port throughput incentives, Port Operations, Infrastructure management

Date of Acceptance: 21/11/2017
1.0 Introduction

The port industry is essential for the world economy: UNCTAD estimates that more than 80% of total global trade uses maritime transport (UNCTAD, 2016). Moreover, many studies show how ports contribute directly and indirectly to the regional economic development of host port regions, through their induced economic effects (Shan et al., 2014; Bottasso et al., 2013), and also to neighbouring regions thanks to positive spillovers. In this regard, several studies (Chowdhury and Erdenebiled, 2006; Wilsmeier et al. 2006) underline how landlocked regions have experienced a reduction in industrial competitiveness in comparison to port and maritime regions. The strategic role of ports has also been studied in terms of employment generation and economic effects (Gripaios and Gripaios, 1995) and both the negative effects of slowing down port activities (Clark et al., 2004) and the positive effects in terms of new generated employment in case of an increase of the port throughput (Ferrari et al., 2013) have been discussed. Despite some criticisms of this issue, port activities are often seen as beneficial for the economic growth of a certain country. The possibility to incentivise the growth of the port activity is then fundamental in order to increase benefits generated by the port.

Given the economic value of a port, and in order to better discuss the way in which ports can incentivise terminal operators, it is important to clarify that ports are regulated and managed differently, in accordance with the applied governance model. As underlined by Bottasso et al. (2013), van Reeven (2010) and Verhoeven (2010), governance models affect the local contribution of certain ports. Moreover, different governance models push ports to pursue different results as they are in charge of different duties (for example, social benefits, income generator, and investment attractor). In the literature (Suykens and Van de Voorde, 1998) a fourfold repartition of port governance models - public, tool, landlord, and private ports - is widely accepted although within these models several differences can be observed even in the same country (Cullinane and Brooks, 2008). Despite this, the majority of ports around the world
adopt the s.c. landlord model, in which a Port Authority (PA) is in charge of planning and organising port activities that are actually operated by private companies (the stevedoring operators) through a concession or a leasing contract. For the whole duration of the concession (over 20 years, on average), stevedoring operators have the exclusive use of the terminal area. As discussed by many scholars (Notteboom et al., 2012 and Notteboom and Verhoeven, 2010), the lack of clear competitive rules to auction the port terminals, the impossibility for many ports to have more than one specialised terminal per traffic category (such as in the case of full containers), and the market power of several integrated operators hamper competitiveness in awarding the terminal areas. Moreover, as reported by Ferrari et al. (2015) the lack of effective competition regulation at port level, also reduces the possibility for national and local Competition Authorities to regulate the terminal market, generating distortion in the overall awarding process. Thus, Terminal Operator Companies (TOCs) and PAs normally regulate the management of a terminal through an agreement that establishes the duration of the exclusiveness of the TOC activity in the port specific area; a fee paid by the TOC to the PA in exchange for the right to operate; and some operational conditions (investments, targeted traffic, etc.). Depending on the legislative environment this agreement can be either a leasing contract or a concession. In many cases both agreements act as rent agreements in which – despite previous statements – actual performance is often not measured and the promised goals – in terms of throughput, investments, jobs, etc. - are often not monitored due to a reduced competitive environment, as also discussed in ITTMA (2008). As mentioned by Wang and Pallis (2014) and Ferrari et al. (2015) this absence of constraints concerning the achievement of specific goals might influence the performance of the port and the possibility of attracting new investments or generating more benefits for the local economy. This lack of incentives has also been underlined by ITTMA (2008) in a report focused on current organisational issues in the European port system, while other scholars (Theys and Notteboom, 2010) have highlighted
the possibility of increasing port performance by improving the awarding processes of the terminal areas and introducing specific goals in accordance with the concession duration. As discussed in Wang and Pallis (2014), even if this issue might be easier to address for freight terminals, it could also be applied to passenger terminals, such as for the cruise market. Moreover, while all terminal operators should – in theory – aim at maximising their own handling activity, in specific contexts TOCs can actually not be incentivised to do so: an example might be where TOCs – thanks to specific operational clauses – might gain due to an extension of the dwell time, due to the end of the exemption time and then to the increase of extra-income in the renting space activities for the goods’ owner (Ferrari et al., 2013). On the other hand, depending on the renewal process, when the concession expiration time is approaching, TOCs might prefer to slow down investments (Theys and Notteboom, 2010) thus affecting both the present and the future productivity of the terminal. The possibility of incentivising TOCs to increase their performance is therefore a fundamental issue for many port systems that are currently struggling to find new financial resources (Carriou et al., 2014; Parola et al., 2012). Thus policies that can increase performance or attract private investments without new public funding can be seen as virtuous solutions for many ports.

Considering the importance of port activities for the regional economy, the introduction of a proper set of incentives for terminal operators might then foster port efficiency, increasing both the throughput and related port investments. For this reason the present paper aims at inducing strategic behaviour by both the PA (the principal) and the TOC (the agent) adding dynamics to the concession fee calculation, with the final goal of incentivising traffic maximization and increasing terminal competitiveness. Several papers have discussed the critical issues related to the concession policy either in general terms (Crampes and Estache, 1998) or in relation to the port sector (Pallis et al., 2008, Notteboom and Verhoeven, 2010) and the lack of incentives related to terminal efficiency (Halkos and Tzeremes, 2015; Ferrari and
Basta, 2009), but only few of them have discussed the introduction of possible incentives in PA-TOC agreements. The originality of the proposed approach rests on the fact that few dynamic solutions have been proposed in the port industry in order to bind both TOC and PA’s goals. The described approach has been applied to a specific case study, the port of Genoa (Italy) with the goal of showing the potential benefits for both the PA and TOCs. In order to elaborate the case study, the container market was used as an example: this choice depends on the possibility of finding public and reliable data not only for the port of Genoa but also for its main competitors. Despite the current lack of public information on specific terminal activity, the introduced methodology can be easily applied to all the main terminal activities.

The paper is structured as follows: after this introduction, section 2 introduces the local environment in which the proposed methodology has been applied and Section 3 focuses on the methodological implications of the introduction of a dynamic concession fee in the port industry. Section 4 discusses the results of the application of the proposed methodology and Section 5 addresses conclusions and gives insights for further developments.

2.0 The case study

The proposed methodology is tested on the container terminals based in the port of Genoa, Italy. This port is one of the main gateway ports in the Mediterranean basin and it is the biggest port in Italy considering the overall throughput (in 2016 the volume of traffic was about 50 million tons plus over 3 million passengers, according to Assopori (2017). Considering container traffic, Genoa is the second biggest port in Italy (after Gioia Tauro) and the first one if transhipment movements are not considered. According to Ferrari et al. (2011), Genoa is the main port serving the North-West of Italy, even if its catchment area is even wider, attracting cargoes from other regions of the Po Valley and also from other European countries, such as
Switzerland and Austria. Considering administrative procedures, Genoa PA is also one of the most problematic Italian ports, with more than 1,200 operating concessions even though there are less than 30 commercial terminals (Parola et al., 2012) of which only three are container terminals\(^1\). As explained by Parola et al. (2012) the ratio between actual concession and number of terminals is mainly dependent on the fact that, according to Italian legislation, port areas are public and may be assigned to private operators only if this is justified by the possibility that the social community gains a “greater benefit”. That is why all activities within the port must be backed by a concession agreement that states all the characteristics of the performed activity, thus multiplying bureaucratic procedures (for instance a coffee shop within the port needs a concession and a terminal operator needs to ask for a new concession if it decides to build a warehouse, etc.).

An interesting issue is that the majority of concession agreements are going to expire within the next five years, giving room for potential future changes in the current agreement structure. Similarly, the Italian port law recently changed (Parola et al., 2017) leaving room for modification of the current concession structure.

Figure 1 shows the container traffic of the three terminals considered\(^2\).

PLEASE INSERT FIGURE 1 ABOUT HERE

\(^1\) There is currently a fourth terminal that handles containers but its activity can be considered marginal in comparison with the other three operators.
\(^2\) Within this paper, the names of the terminals have been omitted, so the main three terminals are just numerated.
Using official data from the Port Authorities, Figure 2 shows the trend of the market share for the three terminal operators\(^3\). The market share has been calculated for each of the three terminal operators with the aim of underlining the trend in comparison with a reference market, identified as the container ports serving the same hinterland (the Po Valley). As shown in figure 2, all three terminals have registered high fluctuations over the years in terms of market share but both terminals 1 and 2 have a general tendency to decrease their share in comparison to the beginning of the period, while terminal 3, despite several fluctuations, has an increasing market share value. Moreover, as for many ports in the Northern Mediterranean basin, the transhipment activity of the Genoese terminals appears marginal and most of the cargoes are generated by the reference hinterland.

PLEASE INSERT FIGURE 2 ABOUT HERE

As discussed in several policy and scientific papers (Ferrari et al., 2011; Consulta Nazionale dell’Autotrasporto e della Logistica, 2011; MIT, 2015), one of the main critical issues of Italian ports – and also of the port of Genoa – is the relative high rigidity of the port management rules which reduce the possibility for the PA to monitor and incentivise terminal competitive positions following fast changing market conditions. This critical point, together with the low efficiency of some terminal operations, impacts on the whole transport network and the possibility of improving the whole port performance. This issue is mainly related to infrastructural dearths but also to several administrative problems (as in the case of the

\(^3\) The ports considered are the ones located in the North Tyrrhenian Sea (Savona, La Spezia, Leghorn) and the North Adriatic Sea (Venice, Ravenna, Trieste, Koper, Rijeka) that compete for the same catchment area. Transhipment activity has not been considered.
coordination among actors). Moreover, the Ministry of Transport recently began a significant revision of both the port governance model of Italian ports and the renewal method of the port concession agreements (Ferrari et al., 2015). As a consequence of this process, researchers and policy makers (Parola et al., 2017) have stressed the importance of finding a transparent procedure to award the terminal area, giving the PA the actual possibility of verifying the attainment of the agreed terminal performance (also acting as traffic promoter). According to Italian legislation, the concession fee is currently determined by an asset value given to the port area, depending on the quality of the terminal space (for example, paved yard), its endowment (as the direct access to the highway), and the related economic activity (for instance, container). This fixed value is updated annually considering inflation but no other modifications can be made. The terminal asset value was originally defined by the Italian Ministry of Transport in the late 1990s but afterwards the PAs introduced their own asset value through special legislation. Once identified, this value cannot change for the duration of the terminal concession. It is interesting to notice that the fixed structure in determining the concession fee in Italy – as well as in other European countries – is mainly due to the financial problems of many PAs in the early 1990s and then the necessity for the Central Government to strongly regulate all related aspects, even allowing for situations that were not optimal in terms of efficiency or resource distribution (Parola et al., 2012).

Given the abovementioned scenario, the introduction of a dynamic, performance-based fee, could represent an improvement to the current situation, directly connecting the fee to be paid by the TOC to its annual performance. The potential benefits of a dynamic approach to different regulatory economic problems are well discussed in the literature (Ryan, 2012) as are the potential benefits of a better determination of the current concession fee (Felicio et al., 2015).

The approach introduced in this paper will then be tested on three terminals in order to discuss the possible effects of the proposed methodology and the feasibility of the method.
In order to apply the methodology, official data of Genoa PA was collected for all three terminals for the period 1997-2012. 1997 can be considered the starting year for many private port activities in Italy, given the port reform that occurred at the end of 1994 and its implementation in subsequent years. It is interesting to note that from 1997, the terminal area for all three terminals varied significantly, with terminal 3 doubling its area while the other terminals registered small changes.

Table 1 shows the main descriptive statistics of the three terminals. As shown in the table, terminal 1 and 2 have a similar size while terminal 3 exceeds the other two in terms of both activity and physical extension. Moreover, the location also facilitates terminal 3 activity, given the fact that it is outside the historical area of the city and it is characterized by deeper waters that allow for greater draughts.

3.0 Methodological considerations

The theory of incentives (Prendergast, 1999) as well as auction theory (Krishna, 2010) have been both applied to a variety of economic sectors (for example electricity, tlc), but only recently have they been extensively applied to transport (Niu and Zhang, 2013; Gonçalves and Gomes, 2012; Albalete and Bell, 2009) and port sectors (Wang and Pallis, 2014; Saeed and Larsen, 2010; van Reeven, 2010). This latter application is mainly linked to the need to regulate the terminal activity. In fact, the introduction of landlord governance models necessitates fair competition in the awarding of a specific infrastructure (as in the case of a terminal area) to a private operator and then to ensure the alignment of interests between a public body (the PA) and the chosen private operator (the TOC) that has the possibility of running the infrastructure
for a long period of time. Only an efficient awarding process and proper tools (as in the case of penalties and incentives) can ensure the attainment of goals for both actors.

Concerning the port sector in Europe, it is important to underline that the majority of port systems are managed by public PAs that award the management of terminal areas to private operators, thus generating potential conflicts between public-led goals and private ones.

Moreover, it is interesting to mention that several recent studies (Theys and Notteboom, 2010) have underlined that many terminal assignments in Europe had not used competitive awarding procedures thus affecting the possibility for the PA to check terminal performance or to be sure that terminals perform well. On the other hand, operational and financial clauses and constraints are often seen as difficult to apply due to the market power of many global TOCs and increasing port competition (Ferrari et al., 2015). This issue has recently been discussed, in an attempt to introduce incentives capable of making both actors (PA and TOC) gain equally from an improvement in the terminal competitive position, as suggested by the theory of incentives. While some authors (Wang and Pallis, 2014) have tried to include incentives in the port concession agreement, applications in other transportation fields would suggest including them in the tariff paid by the terminal operator to the concessionaire in exchange for a performance improvement (Wu et al., 2011). As suggested in Kaselimi et al. (2012) and Saeed and Larsen (2010), since both terminal and port performance depends on the competition among several other ports, the interaction with other players should also be considered. Examples of these interactions have recently attracted the interest of several scholars, as also underlined by Hidalgo-Gallego et al. (2016). Moreover, some ports can easily be replaced by other ports due to increasingly overlapping hinterlands (Notteboom and Rodrigue, 2005), thus introducing the need to consider port competition in the evaluation of terminal performance.
Given the abovementioned scenario, the methodology discussed here does not take into consideration the inclusion of performance clauses – set by *a priori* standards (for example the achievement of a certain market share or traffic) - but it is based on a dynamic concession fee evaluation method capable of sharing the positive results of an increase in the terminal competitive position between PA and TOCs among the actors involved. The only condition assumed is related to the necessary financial stability that might be linked to the historical fee values or to a reasonable financial income that both the PA and the TOC should earn (that represents the minimum condition to be achieved to consider the proposed method feasible).

Similarly to what has been introduced in Ferrari et al. (2013), the method rests on a simple but effective relationship: given $C_i$ as the concession fee paid at the year $i$, and $M_i$ as the market share of a given terminal at the year $i$, the following applies:

$$C_i = C_{i-1} - \alpha (M^*_{i-1} - M^*_{i-1})$$

(1)

in which any symbol marked with * is a real historical value, otherwise the value represents estimations. Market share, in this paper, is related to the hinterland served by a given terminal (as defined in footnote 4), but different definitions of market share (including foreland) can easily be included in the formula.

Moreover, given its incentivising role, Ferrari et al. (2013) linked $\alpha$ to terminal performance, hypothesizing a positive $\alpha$ where both market share and traffic of the studied terminal are positive, and a negative $\alpha$ where either the market share or the traffic are negative$^4$.

Given (1), the following relationship is easy to ascertain:

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$^4$ To see a full discussion on the reasons behind this link, please refer to the original paper written by Ferrari et al., 2013.
\[ C_i = C_{i-1} - \alpha(M_{i-1}^* - M_{i-1}^*) = C_{i-2} - \alpha(M_{i-2}^* - M_{i-2}^*) = \ldots = C_0 - \alpha(M_{0}^* - M_{0}^*) \]  

Equation (2) represents a development of (1), highlighting the link between the value of the fee at the beginning of the evaluation period and the values of \( C \) afterwards.

Ferrari et al. (2013) concluded their article discussing the potential benefits of this approach for the terminal activity and the PAs, addressing also some of the critical issues related to the financial balance between public and private interests and the role of \( \alpha \). Similarly, the issues related to the needed balance between the market share (\( M \)) and the throughput (\( T \)) in defining the concession fee were discussed (Ferrari et al., 2017). In fact, the development of equations (1) and (2) determines a concession fee that is only linked to the market share – and indirectly to the throughput, which is an essential variable for market share value. Moreover, in the original formulation of Ferrari et al. (2013), \( M \) was the main variable determining \( C \) while \( T \) was used as the main variable for the determination of \( \alpha \). Nevertheless, both variables are independent from the overall financial income of any port, thus a problem of economic feasibility might arise.

Considering these issues, some further considerations might be added to the problem. In many port systems, such as the Italian case referred to (Ferrari et al., 2015), PAs’ incomes derive from both the concession fees and the traffic related taxes. Port traffic taxes – at least in Italy – depend on the typology of the handled goods. National law establishes tax amount and its variation over the time, with only a marginal role given to each single Port Authority (MIT, 2015). These taxes remain at the disposability of each PA while other collected taxes (as in the case of VAT) are collected by the PA and “immediately” reverted to the Central Government. From a legislative point of view, port traffic taxes started to be at the disposal of the PA in 2008 as a fixed tons/euro value that varies in relation to different traffic categories and changes over
the years (mainly in accordance with inflation and fiscal needs). At the beginning of 2008 the value of 0.439 €/t was established and this amount has been used in our study as a reference value in order to evaluate \( \alpha \) and its impact on the private and public financial balance\(^5\). The use of the minimum value of the tax is considered prudential and should ensure attaining a balance at least for the public authority while it has a neutral impact on the taxpayer, the private company.

In general terms if \( A_i \) represents the overall taxes paid by cargo at the year \( i \) and \( R_i \) the Port Authorities’ revenues at the time \( i \), we will have:

\[
A_i = kT^*i
\]

with \( k=0.439€/t \) and \( T \) is the traffic for the reference year

\[
R_i = A_i + C_i = kT^*i + C^*0 - \alpha (M^*i - M^*0)
\]

Thus:

\[
R_i - R_{i-1} = C_{0,i-1} - \alpha (M^*i - M^*0) + kT^*i - C_{0}-\alpha (M^*i-1 - M^*0) - kT^*i-1 = - \alpha (M^*i - M^*i-1) + k\Delta T^*i,i-1
\]

**PLEASE INSERT FIGURE 3 ABOUT HERE**

Figure 3 shows the trends of the revenues in comparison with the market share. The current low correlation between the relative performance of the two variables is clear. Since the current Italian system does not link the concession fee with the throughput - while port taxes are

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\(^5\) The value used in this study is equal to the minimum value set by the law in relation to the kind of goods moved in containerised cargoes. The choice of a constant amount at its minimum level is used for prudential purposes since it impacts on all financial considerations from the PA perspective (while it has a neutral effect on the terminal operator).
proportional to the generated cargo – it is clear that the lack of correlation is due to the missing dynamics of the concession fee evaluation method. The equations (4) and (5) would then influence (1) allowing to dynamically modify not just the concession fee, but also the value of the port revenues (R).

4.0 On the estimation of α parameter

The correct estimation of α might then follow different kinds of considerations. One of the easiest approaches might be an evaluation of α as the ratio between the throughput and the market share and then substituting it in (1) to update the concession fee. This method would not consider the financial balance constraints, but it would improve the relationship between the concession fee and the terminal performance.

Thus, the least squares method can be applied in order to minimize the distances among the real concession fees collected by the PA and the estimated fee: α is the value able to minimize these distances. This minimization is proposed in order to compare the real trend of the past with the outcomes of the proposed method, trying to understand if the discussed approach might ensure a monetary advantage to one or both the considered port players. Given that the discussed approach would offer an operational and dynamic incentive to the TOC, the possibility of being financially convenient (or neutral) might also mean the feasible application of the proposed approach.

The two equations that can be derived from the abovementioned considerations (the minimization of the differences for each single referenced year or the minimization of the overall value during the whole period) can both be solved by:

\[ \alpha = \frac{N C_1 - C_T}{\sum M_i - M_1} \]  

(6)
with $C^*_T$ as the sum of the value of concession fees collected since the end of the referenced period. (6) was derived by posing the condition of having an $\alpha$ that minimize the squared distance among the historical collected $C$ and the ones found by the application of (2). The resulting parameter $\alpha$ is the value that minimizes the distance between the two distributions.

Table 2 summarizes the value of $\alpha$ estimated through (6). This value differs very much from different terminals with a peak for terminal 3.

PLEASE INSERT TABLE 2 ABOUT HERE

Considering the overall port and terminal payments and incomes, figure 4 summarizes the main results of this methodology. Revenues ($R$) of the PA vary over time with increasing tendencies for the two smallest terminals, while they fluctuate for terminal 3. As the port taxes ($A$) were introduced only in 2008, they are hypothesized also for the previous years. Given the least squares techniques, no variations appear in the financial balance of the private companies – considering the whole period – but the terminals should pay less when they perform better than the market. In general, equation (6) estimates a value of $\alpha$ that generates a benefit for the terminal operator (as suggested by figure 4) but also high fluctuations in terms of both the concession fee ($C$) and the port revenues ($R$). Moreover, in case of market shocks, the use of the market share does not reduce the impact on the fee, as demonstrated by the high volatility of the value for terminal 3. Thus (6) assures an incentive but the absence of constraints might reduce the benefit of the proposed methodology.

PLEASE INSERT FIGURE 4 ABOUT HERE
Given the impossibility for (6) to provide a constraint in terms of general financial
equilibrium, the same formula does not provide any guarantee concerning the final value of R
that can be either growing or decreasing. This critical issue is well summarized in the terminal
3 case in which both estimated revenues and concession fees would fall below zero, generating
a loss for the PA and a high subsidy from the PA to the private operator. This result might
appear acceptable in some contexts but it is not generally welcome in many port systems,
especially in Europe.

Moreover, despite the fact that (6) is based on market share variations, the comparison
between the trends of $M$ and $C$ underlines how the effect of the throughput on the concession
fee estimation is the one that mostly affects annual variations: while $M$ has been introduced to
link the changes of $C$ to terminal competitiveness, this element actually increases the
importance of the terminal traffic value ($T$) on the paid fee. This latter effect cannot be easily
observed in Figure 4 for terminal 1 and 2, while it is easily underlined by the trend of terminal
3: shocks in $T$ lead $C$ to its maximum or minimum peaks. The negative aspects related to this
fact rest on i) a weak effect of the competitive position and ii) a strong effect of occasional
shocks. Moreover, since the decrease in $C$ represents the incentive given by the PA to the TOC
- and the increase of $C$ represents a “fine” – the relationship should be linked to structural
circumstances (competitive position) and not to occasional ones (annual throughput).

4.1 A second alternative

An alternative acceptable solution is the estimation of $\alpha$ aiming at maintain $R_i$ equal to a
certain planned value in order to guarantee an agreed amount of revenue for the PA. In this case
$\alpha$ would be equal to:
\[ \alpha_i = k \frac{\Delta T_{i-1}}{\Delta M_{i-1}} - \frac{\delta R_{i-1}}{\Delta M_{i-1}} \]  

(7)

According to (7), when \( \delta \) equals to zero, \( R_{i-1} \) would be equal to \( R_i \) for each referenced year. In this latter case \( \alpha \) would represent a threshold able to discriminate, for each financial year, the positive and negative revenues for the port.

Using (7) and then evaluating \( \alpha \) for each of the studied periods several results can be found. In this case the value of \( \alpha \) varies annually and it ensures an incentive – given the terminal performance – that guarantees a pre-determined value for the overall port revenues in each reported year. Given this method, two possible financial outcomes are presented in figure 5. The first graph shows the case in which the PA sets an average growth rate for each reported year. In this case \( \delta \) would be different from zero. In figure 5a an example of \( \delta \) equal to 2\% is given for the terminal 1. This example underlines the possibility of stabilizing the revenues for the PA, with potential advantages for both the TOC and the PA itself. A comparison between the historical income of the PA (\( C^*+A^* \)) and the foreseen one (R) might also be useful in order to plan the revenue trend.

PLEASE INSERT FIGURE 5 ABOUT HERE

In figure 5b, \( \delta \) is set equal to zero and then the Port Authority achieves a balanced trend of the total revenues in comparison to the historical values. In this latter case, despite the stability of the revenues, the volatility of other financial figures increases over the years, also with a negative value – from the PA perspective – for the last referenced year for terminal 3.
In relation to the previous method, this second evaluation ensures a constant $R$, greater incentives in relation to annual traffic performance but much greater volatility in terms of possible strategic planning for the terminal operators considering the fee value. Nevertheless, the perfect symmetry of $A$ and $C$ reflects the relationship between performance and the concession fee. The possibility of setting $\delta$ higher than zero, can also ensure a stable revenue growth for the Port Authority.

4.2 A third way

As seen above, (6) enables finding a single $\alpha$ for the whole period, while (7) provides a specific $\alpha$ for each referenced year. Moreover, while (6) does not provide any guarantee concerning the final value of $R$, (7) ensures a stable path in which the PA would be able to promote traffic with a foreseen trend in its revenues (but also with high volatility in terms of collected fee or traffic tax). It is important to underline that the positive difference between $C^*$ and $C$ represents a potential discount applied to TOC while a negative value might represent a loss for the PA. Despite this scenario, both actors might gain considering their own total revenues ($R$ for the Port Authority). Thus the minimization of $(C^* - C)$, leaving $\alpha$ dependent on the terminal performance, represents a potential reduction of the risk in comparison to the historical trend. Then a third – more balanced – way is to insert in the results of (6) some thresholds based on historical data that are able to guarantee high incentives to the TOC, without huge financial losses or gains for any of the two actors.

In order to test this hypothesis, two bands have been introduced for each terminal, giving the possibility for $C$ or $R$ to vary by a given percentage in comparison to the historical value. The thresholds given by the bands create a maximum and a minimum value that cannot be surpassed by the variation given by the new $C$ estimation method. These bands can obviously be set
symmetrically (for example both at 10% variation) or asymmetrically (for instance a lower bound at 5% and an upper bound at 10%) in relation to the willingness of the PA to promote traffic or to be prudential in terms of income generation from the concession fee. Figure 6 shows an example related to the terminal 1, with the upper bound set at around 20% of the actual value and the lower one around 40% of the actual value. The introduction of the bands guarantees a potential gain for both the PA (such as in the case of port taxes rebalancing the concession fee reduction) and the TOC (as in the case of discounts on the concession fee whenever there is an increase in the competitive position) with a reduced risk.

PLEASE INSERT FIGURE 6 ABOUT HERE

Figure 7 shows the sum of the values of the overall paid concession fee by a terminal operator along the analysed period. This value can be easily compared to the historical fee generated by the terminal (represented by the rectangular plain in the figure) in order to see whether the PA and the TOC benefit from this method.

Thresholds can be applied to both C (as in figure 7) and R. In both cases thresholds might guarantee an advantage to both the private operator and the PA, depending on how they are set. Figure 7 shows how thresholds led to a high rate of variation of C but after a certain value of the lower and upper bounds, the limits stop having an effect. In the case shown in figure 7, below the minimum of 50% and above the maximum of 35%, no variations can be related to the sum of concession fees paid by the terminal operator.

PLEASE INSERT FIGURE 7 ABOUT HERE
As shown in the figure, depending on the variation of the bands, the overall amount due by the terminal operator to the PA varies from a minimum of about 12.4 million euro to a maximum of about 15.6 million euro with the highest variations in between bands set at around 20% of both the lower and higher values. The rectangular plain in figure 7 represents the historical value paid by the terminal operator. The figure underlines the high variations between the fees generated by the terminal and the potential discounts (or “fines”) related to good (or bad) terminal performance. Bands guarantee that differences between consecutive years are limited to an agreed amount.

Moreover, the variations between the historical value and the bands can be used by the PA to set a policy that might be both prudential from a financial point of view, and promotional for a performance point of view. In this situation, both players might gain from the different equilibria set by different maximum and minimum thresholds, depending on market development.

Tests on other terminals and thresholds have been developed, guaranteeing different sets of incentives by differentiating the maximum and minimum variation of the concession fee or the total revenues. Final results underline how both actors can be pushed to achieve their own goals in terms of port traffic and (/or) revenues.

5.0 Conclusion

The current paper develops and discusses a methodology proposed in Ferrari et al. (2013) and further discussed in Ferrari et al. (2017), and attempted to improve the proposed method by introducing two thresholds that can bring financial stability to the PA and – at the same time – increase the convenience of a growing market position for the terminal operator. This
methodology implies a win-win strategy in which a terminal operator would pay a reduced concession fee in relation to a gain in the relative market share while the port authority can re-balance its income thanks to the growing traffic tax due to the better competitive position of the terminal.

Therefore the proposed application of a new methodology underlines how port concessions can incentivise improvements in terminal performance. Moreover, depending on the evaluation methods, incentives can guarantee an economic advantage for both port players, the PA and the TOC.

The proposed methodology might then help to bind the private and public goal of the PA and the stevedores, pushing both players to achieve common operational and financial targets. Moreover, the dynamic method for the evaluation of the concession fee acts as an anti-cyclical tool able to promote better performance even during crisis periods. This strategic role of the method can be ensured by the comparison between the historical trends and the foreseen fee values: the use of the bands can then guarantee both a fair income for the PA and an incentive to the terminal operator.

The authors are aware of the possible limitation of the proposed study, mainly due to the estimation of the market for each terminal and the possibility that a decreasing traffic scenario might be “paid for” by the port authority with the possibility of raising anti-trust issues, as happened for the port of Antwerp during the period 2009-2012 (Informare, 2016).

Further research might widen the application of the discussed method in order to demonstrate the potential generalization of the proposed concession fee estimation method. Concerning this issue, while the current analysis compares historical values to a given hypothesis using the few available data, the actual application of the methodology could be harder, given the low level of information produced by several port actors. Thus, the
generalization of such “what-if” analysis can encounter different obstacles. Apart from the investigation of potential generalization methods, future research will also be linked to the potential application of the proposed methodology in the case of changed competitive conditions (for instance, new infrastructure) and establishment of new agreements.
References


Assoporti (2017): www.assoporti.it


Informare (2016): [www.informare.it](http://www.informare.it)


Figure 1: Traffic in TEU of three container terminals

Source: own elaboration from Port Authority of Genoa’s data, 2015.
Figure 2: Market share of the three terminals within the Northern West Med market

Source: own elaboration from Port Authorities’ data, 2015.
Figure 3 – Trend in Market Share and Revenues

Source: Own Estimation from Port Authority of Genoa’s data, 2015. Primary axis represents the market share while secondary axis refers to the revenues.
Figure 4\textsuperscript{6}: Preliminary results from the first set of equations

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Terminal_1.png}
\caption{Terminal 1}
\end{figure}

\textsuperscript{6} In 2004, Terminal 2 enlarged its terminal area under concession and this modification affected the overall concession fee value.
Figure 5: Preliminary results from the second method, using terminal 1 as a case study (data in millions of €).
Figure 6: Bands and concession fee variation for terminal 1
Figure 7: Total collected fees for the terminal 1
Table 1: Descriptive statistics for the period 1997-2012.

<table>
<thead>
<tr>
<th>Terminal Area (sqm)</th>
<th>Market Share (%)</th>
<th>TEU</th>
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<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
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<tr>
<td>Terminal 1</td>
<td>165,938</td>
<td>185,735</td>
</tr>
<tr>
<td>Terminal 2</td>
<td>162,400</td>
<td>254,068</td>
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<tr>
<td>Terminal 3</td>
<td>512,000</td>
<td>974,091</td>
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</table>
Table 2: Preliminary results from the first set of equations

<table>
<thead>
<tr>
<th></th>
<th>Terminal 1</th>
<th>Terminal 2</th>
<th>Terminal 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>14,730,883</td>
<td>21,689,578</td>
<td>664,190,538</td>
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</tbody>
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