Introduction
The liberalisation process of European port markets is similar to the one implemented in most of the networks industries (telecommunication, gas, water, airlines...). The basic idea of this article is to present the main features of this process and their major implications in the case of dedicated container terminals (DTs).

A first section deals with the characteristics of port in comparison with other networks industries and stresses similarities when considering the vertical integration and liberalisation of markets. A second section, taking into example the emergence of container dedicated terminals (DTs) shows some potential implications of liberalisation (barriers to entry, foreclosure) if regulation authorities only focus on the “opening of the market” without considering the way the market is opened.

I. The liberalisation of european port systems
The vertical integration carried out by transport operators leads to consider that nowadays port systems share many characteristics with general network industry (telecommunication, gas, water, airlines...): - ports represent a set of nodes within a network of interconnecting lines; - ports have high fixed cost implying decreasing average cost leading to economies of scale; - ports are generally concerned with networks externalities as club effect or indirect network effects (Hardware/Software paradigm); - ports provides Universal Service Obligation (USO).

Furthermore, for ports as for general networks, the Community efforts to complete the single market, the pressure from both customers and competitors, the withdrawal of public funding, have induced a general move towards liberalisation. Considering those similarities, it seems interesting to analyse what can be learned from other cases of liberalisation process in other network industries (European Economy, 1999)?

First of all, it appears that “market liberalisation goes hand-in-hand with regulatory reforms”. This regulatory reform in European port markets is clearly underway since the publication of the Green Paper on Port Infrastructures in 1997 (RCEE COM 97/678) and more recently since the 2001 proposal on liberalisation of Port Services (RCEE COM 01/0047).

Secondly, that increasing returns to scale and the need of USO had historically induced local or national natural monopolies directly or indirectly controlled by public authorities (EDF/GDF for French Gas distribution, France Telecom for Telecommunication, SNCF for railways...).

Furthermore, that market segmentation has usually induced that market organisations widely differ from one country to another. Within the European port systems, the usual opposition between northern and southern European ports provides an example of this hurdle. The public/private/mixed ownership of port gives another illustration.
Apart from the previous arguments (European single market, customers and competitors requirements...), liberalisation in network industry is generally justified considering first of all the potential economies of scale on network facilities. Economies of scale can be presented in a simple case (Encaoua and Perrot - 1991) where Q represents the quantities transported and R the size of a network. If \( C(R,Q) \) is the total cost, and the activity vector \((R,Q)\) can be differentiate, economies of scale (ES) are the effect on cost of an equi-proportionate increase in traffics and network structure holding price constant.

\[
ES(R,Q) = \frac{\frac{\partial C(R,Q)}{\partial R}}{\frac{\partial C(R,Q)}{\partial R} + \frac{\partial C(R,Q)}{\partial Q}} = \frac{1}{\epsilon_R(R,Q) + \epsilon_Q(R,Q)}
\]

If \( ES(R,Q) > 1 \), economies of scale are locally increasing
If \( ES(R,Q) = 1 \), economies of scale are locally constant
If \( ES(R,Q) < 1 \), economies of scale are locally decreasing

Consequently, ports, as roads, airlines markets... should be opened in order to achieve potential economies of scale.


1. direct externalities, or "club effect", are demand-side effects stressing that the utility of a consumer depends on the number of consumers connected to the network. For instance, in the case of port activities, it can be assumed that the number of shippers or shippers using a port increase with the number of user already calling at this port.

2. indirect externalities, or "Hardware-Software Paradigm", are supply-side effects indicating that the utility of a good depends on the availability of complementary goods. For example, in the case of port activities, it can be argued that shippers and freight forwarders will choose a port because they know that many carriers may call at this port or that some "inland connections" will improved.

Those two justifications, economies of scale and positive network externalities are the two economic reasons that could explain the trend of liberalisation when considering port as a node in a network industry. In any way, no consideration is made here about ownership of ports provided that those economies might be achieved either through private, public or mixed organisations.

Assuming that those economies may exist, the question is how the market should be opened? Regulation authorities roughly follow a two step process to implement liberalisation:

1. the first step is concerned with the definition of activities that should be opened to competition in order to limit local or national natural monopolies and with the respect of USO;

2. the second step deals with interconnection and access to network to outsiders.

Such a twofold achievement is one of the most difficult tasks. First of all because liberalisation within port systems is fairly recent and is difficult to analyse. Secondly, because it is not easy to clearly distinguish between gains due to the actual or to the potential entry of newcomers in an industry, and those coming from an improvement of technology.

Finally, it can be concluded from the observation of several liberalisation processes that the difficulty of regulatory reforms comes from two requirements:

- to achieve a "public acceptance" of reforms in determining in a clear way what could be the main effects of liberalisation;

- to combine efficiency, competition and the provision of USO.

An other way to present those requirement in port environment is how to create conditions for entry (ex ante) and make sure that those entries will not reduce the level of competition and USO (ex post)? In the next section the case of DTs in container market is analysed with respect to this question of access to the market.

II. Access and interconnection to port systems: the case of dedicated container terminals (DTs)

DTs is a recent phenomenon that started in Asia and North America a few decades ago (Benacchio and al., 2000, 2001). In Europe it was introduced by Maersk in the early nineties, with the transshipment facilities of Algeciras (figure 1). Basically, DTs are interconnecting points in the East-West and North-South trades. The level and scope of accessibility to a DT is determined by private agreement between one or more carriers and a port operator or authority.

DTs can lead shippers to have a direct control on the stevedoring company -through a joint-company such as Maersk Espona in Algeciras-, or indirect control leaving port operations to the stevedoring company such as MSC and CP Ships with Hessenatic in Antwerp. DTs entail both a geographic -the use of facilities in a defined part of the terminal- and a temporal dimension -the use of facilities for a certain period of time. The deal usually involves exclusivity in the use of a berth and can be extended to include every element of port services such as stacking areas and railway connections.

DTs is close to vertical integration issues from carrier strategy (Caves et al., 1984), Bittlingmayer (1989), Brueckner and Spiller (1991, 1994), Oum et al. (1995)). The objectives are:
1. developing economies of scope in trade routes as a result of increase in inter-hub flows (supply-side effect);

2. increasing the frequency and quality of service between inter-hubs and spokes network (demand-side effect).

Under which assumptions the potential integration of DTs by shipowners will imply a higher efficiency for maritime-port services? To tackle this issue, an hypothetical queuing model is developed (Cariou, 2000). The occupancy rate is defined according to the arrival rate $\lambda$ and service times $\mu$ (Poisson and negatively exponential distribution). The lay out of the terminal is assumed to be a one stage process and the length of the queue is infinite with a First in First Out ruling. The question is whether or not it is beneficial to maintain a multi-user terminal in its initial configuration with m servers, or to split it into (d) dedicated servers and (m-d) multi-user servers (figure 2)?

From the port's point of view, the effect of moving from the first (pure multi-user) to the second situation (multi-user and dedicated) can be assessed by comparing the respective occupancy rates ($\phi_1$) and ($\phi_2$):

$$\phi_1 = \frac{\lambda m}{m \mu m}$$

$$\phi_2 = \left( \frac{\lambda m}{m \mu m} \right) + \left( \frac{\mu d}{\mu (m-d)} \right)$$

assuming that:

$$(\lambda m = \theta m \lambda m) \quad \text{and} \quad (\mu d = \theta d \mu m)$$

with:

$\theta$: arrival rate change for a server from the first to the second situation;

$\sigma$: service rate change for a server from the first to the second situation.

From all users point of view, the desirability (overall effect) of a DT can be derived from the value of queuing time with ($W m V m + W m V m d$) and without ($W m V m$) a DT where $W m$ is queuing time and $V m$ its value per unit of time.

$$\phi = \frac{\lambda m}{m \mu m} \quad \phi m = \frac{\theta m \lambda m}{\sigma m \mu m} \quad \phi m d = \frac{\theta m \lambda m}{\sigma m \mu m}$$

$$W m V m = \frac{\phi m m}{\mu m (1-\phi m)} \quad W m V m d = \frac{\phi m m d}{\mu m (1-\phi m d)}$$

Three cases can be considered for carriers choosing for a DT.

1. if $W m > V m$, the dedicated terminal implies an increase in queuing time value;

2. if $W m = V m$, the dedicated terminal implies no change in queuing time value;

3. if $W m < V m$, the dedicated terminal implies a decrease in queuing time value.

For $d(m-d)<m$, if we assume that there is no change in the arrival rate ($\theta m = 1$) and if some economies of scale in port production exist ($\sigma m < \sigma m d < 1$), the final result of DT would automatically implies an increase in queuing time value for shipping lines. At the same time, the assumption of increasing returns to scale in port production could not be relevant in DTs if it gives the opportunity to port operators and shipping lines using a DT:

• to reduce the arrival rate of all ships and plan schedules in a more efficient way;

• to schedule in a more efficient way and improve service rate, notably as a result of better co-ordination between mother and feeder vessels.

Now, turning to the case of shipping line that does not call to the DT, it can be assumed that the hypothesis of increasing returns to scale holds and therefore, that they will bear the consequences of DT. Those losses can be analysed as a barrier to entry or exit because of the exclusive used of essential facilities. To internalise such costs, the price that the shipowner will have to pay for a DT must include not only the direct gains or losses of the port, but also the potential losses born by all the other shipowners calling at the port.

This example shows that liberalisation will not automatically induced an improvement in welfare as long as it could induced a reduction in the level of competition (market power). At the same time, it does not induce that liberalisation should not be implemented but that it should consider an internalisation process similar to that of other network industries, such as railways, aviation and telecommunications in order to limit "foreclosure".

The Efficient Component Pricing Rule (ECPR) is one of the most common rules applied for access pricing (Baumol (1983), Baumol and Sidak (1994), Economides and White (1995), Armstrong et al (1996), Armstrong and Vickers (1998)). The ECPR rule states that the price of an exclusive use of essential facilities has to include both Direct Access Costs (DAC) and Opportunity Costs (OC). Direct access costs (DAC) are the costs of providing a DT to a shipping line (inland connection, dredging, land costs, etc.). The opportunity costs (OC) can be summarised as the potential losses and gains born by the port and the other shipowners.

Optimal Access Price $= DAC + \left[ \frac{CT_{port}}{\phi_1 - \phi_2} + \frac{1}{\mu_1 - \phi_1} + \frac{1}{\mu_2 - \phi_2} \right] \times YT_{term}$
With:
\[ C_d \] : the direct cost of providing exclusive access;
\[ C_{\text{port}} \] : the total cost for the port;
\[ \phi_1 \] : the initial occupancy rate of the port;
\[ \phi_2 \] : the occupancy rate of the port following the choice of DT;
\[ \mu_1 \] : the initial global service rate of the port;
\[ \mu_2 \] : the service rate of the port following the choice of DT;
\[ V_{\text{user}} \] : the total value of time for users.

The second term in the right hand side gives the losses or gains born by the port, and the third term the losses or the gains for all port users. Although this interconnection pricing rule is still in its early development, at least in port pricing, it gives a particular focus on DTs and deregulation process. It stresses, for instance, that the relevant question is not whether liberalisation should be promoted or not, but whether liberalisation include the definition of market mechanisms able to limit potential barriers to entry.

Conclusions
The aim of this paper was to show that the European port reform is a direct consequence of market liberalisation. Liberalisation appears to be a complex process already under scrutiny by the European Commission. We feel that the ongoing deregulation process of port markets has not paid enough attention to carry out a cost-benefit analysis of widening the access and increasing competition in port markets. In this paper, we did not answer to this complex question. We only tried to show, taking into account the case of DTs, that liberalisation could only have potential benefits under very specific assumptions. It shows that liberalisation will not automatically induced an improvement in welfare as long as it does not induce a reduction in the level of competition in the long run (market power).

The final conclusion that comes from the example of DTs is that liberalisation when combining with vertical integration process appears to be a complex process. It requires both to select the infrastructures and services opened to competition to “protect” the USO and at the same time, to analyse the impact of liberalisation on different geographic and economic markets. In that respect, the XXIIIrd report on competition (1994) from European commission seems still to be valid by stating that liberalisation should be only justified considering its long run effect on growth, welfare and employment.

**Note**

1. Economies of scale differ from economies of density (ED) which deal with the effect on cost of an increase in traffic (ED) holding price and network structure constants.

\[
ED(R,Q) = \frac{C(R,Q)}{Q} = \frac{1}{\frac{\partial C}{\partial R}(R,Q)} + c_Q(R,Q)
\]

If \( ES(R, Q) > 1 \), economies of scale are locally increasing
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**Figure 2:** A hypothetical DT in a port

**Figure 1:** Main dedicated terminals in Northern America, Asia and Europe in ha

Source: Bank of Japan, Containerisation International, Lloyd's List
BIBLIOGRAPHY


