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Joint versus single management of large transport infrastructures

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ABSTRACT

The management of transport infrastructures has undergone major reforms in recent decades, including privatization, de-bureaucratization, and regulation. One important but often neglected issue in the management of large transport facilities is the joint governance of ports and airports, a phenomenon that is relatively frequent in the US but not in either Europe or Asia. To examine the factors explaining the joint management of ports and airports we undertake a multivariate empirical analysis in a sample of US metropolitan areas. We find that joint management of these infrastructures is more likely in the smallest and largest cities, and less likely in medium-sized cities. It is also more likely in areas with ports and airports of similar magnitude, because there is room for exploiting scope economies. Finally, we find that joint management is less likely when there is large-scale involvement of private firms in port activities, as in the landlord model.

1. Introduction

Economies of scale and economies of density in local public services have received considerable attention in the literature (e.g. Deller, 1992; Carruthers and Ulfarsson, 2003). Their study is a key element in the reform of services at local level (Boyne, 1995), and in particular in relation to management models and to public and private decision-making (Donahue, 1989; Bel and Fageda, 2007, 2009).

However, very few authors have focused on issues related to the existence of economies of scope, in spite of their significant implications for public policy. Their study has been largely based on the seminal work of Caves et al. (1980, 1984). Economies of scope take place when the production of two or more goods or services together achieves cost savings. This situation can occur when joint production allows the optimization of factors of production. The multiproduct nature of government provision is a clear example of the concept. Analyzing municipalities as multiproduct companies, Grosskopf and Yaisawarng (1990) find that they are characterized by the existence of economies of scope. The literature provides limited empirical evidence in relation to specific local services: two examples are Callan and Thomas (2001) for solid waste collection, and Farsi et al. (2007) for urban land transportation.

With regard to ports and airports, several *ad hoc* factors other than scope economies have been used to explain joint management. Fawcett (2006, p.221), for example, states that merging a port district and an airport, both placing similar demands on public transportation managers, is in some cases an essential method of securing economic development for a jurisdiction by foreclosing the option of a competing facility developed by a neighboring jurisdiction.

The main objective of this study is to empirically assess the factors that explain the existence of joint management of major transport infrastructures such as ports and airports, and to identify the advantages and disadvantages of these two alternative forms of management. The results may suggest ways of maximizing the impact of infrastructures on the land, and may shed light on the causal relationships between the existing management models and the activity of port and airport infrastructures.

We focus the attention on the US, where activities of port authorities may include, in addition to the typical maritime functions of ports, the joint management of airports, bridges, tunnels, roads, rail systems and inland maritime systems, logistics parks, etc. Indeed, the US legislation makes possible the existence of several multi-purpose port agencies, which have other functions in addition to managing ports. Port authorities in US are usually public entities that belong to the State or Local governments. In this regard, our main interest is on those cases where port authorities have taken over the management of airports. In other countries, it is less common the joint management of ports and airports. In some European cities the local governments own the management companies of both facilities but separate organizations remain in

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charge of management. Thus, it seems that multi-purpose public entities (like several port authorities in US) are the most useful tool for the joint management of large transport infrastructures.

As for the empirical analysis, this article contributes to the literature by focusing on three aspects that may influence the choice of the management model. First, we contrast the importance of the size of the metropolitan area. We find that its relationship with separate or joint management is U-shaped rather than linear; it is more likely in small and large cities than in medium-sized ones.

Second, we evaluate the degree of private participation in ports as an explanatory factor of the likelihood of joint management with other infrastructures. In US, port authorities may have different functions. Under the landlord model, they invest in the basic infrastructure (like berths) and set concessions for the use of the land. Hence, private firms invest in specific facilities like cranes and manage terminals. Under the service model, port authorities invest in the basic infrastructure but they also manage the terminals. Thus, the landlord model implies a higher degree of participation of private companies in management and investment in port infrastructure. One of the main hypotheses of this study is that joint management is less likely in cases in which the port is managed under the landlord model. Management within the service model involves a greater participation and centralization of territorial public administrations in large infrastructures, and so joint management of ports and airports should be more likely.

The last significant finding of the article is that joint management is profoundly affected by the degree of relative importance between the port and the airport. Joint management does not usually emerge when the port's dimension is much higher than that of the airport.

The rest of the paper is structured as follows. The following section reviews the forms of port and airport management in the US in a global context and we discuss the situation in the US with some detail. We use the data from the US to carry out an empirical analysis of the factors associated with joint management. Finally, we present our conclusions.

2. Management models of ports and airports in the US

The main focus of this study is the choice of joint management models for large infrastructures, basically ports and airports. We reviewed the international experience in management models in order to assess how often these models are used, and what forms of distribution they apply.

Since we are considering both ports and airports at the same time, it is difficult to use an objective criterion that allows us to define a sufficient significant traffic threshold to consider which ports and airports to review. On the other hand, if we use an excessively high threshold, we will find ourselves with a very limited sample of urban areas. We therefore focus on those urban areas that have a large airport or port at their disposal. This means that they have an infrastructure (port or airport) which is among the ones with the highest traffic worldwide, and also have another large infrastructure (airport or port) with a significant volume of traffic.

In a review of management models of large ports and airports all over the world, the first feature to highlight is that joint management models are a hallmark of the United States. In fact, no Asian cities have joint management, while in Europe there is very little experience with this model; Genoa comes close, and to a lesser extent Hamburg and Bremen in Germany as well. Genoa's port authority has become the major proprietor of the airport. However, there are still two different management companies, one for each facility. In the cases of Hamburg and Bremen, the local governments own the management companies of both facilities, but separate organizations remain in charge of management.

Table 1 shows a summary of the information of management models in the United States, where we find a more prominent presence of joint management models for large infrastructures. This higher presence of joint management in the US reaffirms the need to evaluate the models in this country in greater detail.

Table 2 presents information on these cases of joint management in US metropolitan areas, specifying the activities involved in this joint management. Some significant cases of joint management in the US are: New York (New York & New Jersey); Boston (Massachusetts); Seattle (Washington); Portland (Oregon); and Oakland (California).

The management of ports is a more complex business than the management of airports. Airports provide airlines with the system of landing and take-off strips and the facilities associated with the terminal building. The assistance service for passengers and aircraft (billing, luggage management, aircraft cleaning, etc.), commonly known as *handling*, is carried out by one or more external operators, depending on the traffic volume of the airport, although airlines may provide this service themselves. Handling represents around 10–20% of the total cost for an airline and requires no specific specialized infrastructures. Companies that render the service are usually subsidiaries of airlines or other groups, but they are always small in size.[1]

In the case of ports, loading and unloading goods from the terminals is a much more complex and specialized activity than in the case of airports. These operations represent around 80% of the cost faced by a shipping company in the transport of goods. In addition, they require specialized infrastructure and close coordination with the land distribution of goods. As we will discuss below, whoever is in charge of the management and investments in the terminals determines the management model of the ports. Next, we briefly analyze the main features of the management of airports and ports in the United States.

2.1. Airports

The pattern of airport management in the United States differs from that in place in most of the world (OECD, 1998). Outside the US, the airport authority is usually involved in the investments made in the airfield and the terminals, and is also in charge of concessions for the provision of the aeronautical and commercial activities carried out in airport facilities. In this regard, airport authorities in Europe or Asia, whether public or private, are usually subject to tight regulation by to public authorities with responsibility for airport matters.

In the US, however, the airport authority usually adopts a landlord function. Airport authorities in the United States are responsible for investing in the infrastructure associated with airfields, and also manage concessions and coordinate the activities of the companies interested in investing in the terminals or providing services at airport facilities. However, the airport authority is often not responsible for carrying out the investments needed to develop the terminals. This means that the airlines are more heavily involved in the management of airports in the US than in other countries, and this involvement depends on contracts established between the airport authority and the airlines.

There are approximately 5300 public use airports in the United States. About 10 per cent of these are commercial airports. The predominant model is the fully public owned airport authority. Only a small number of small commercial airports are managed entirely by private companies: the most important is Indianapolis Airport, which handles about eight million passengers a year.

[1] This service is provided by the airport manager only in exceptional cases, as in Germany.

Table 1
Management of port and airport authorities.

Urban area	Port authority in charge	Airport authority in charge	Joint management ports and airports
Aberdeen, Washington	Local government	Local government	YES
Baltimore, Maryland	Regional government (State)	Regional government (State)	NO
Baton Rouge, Louisiana	Regional government (State)	Local government	NO
Boston, Massachusetts	Regional government (State)	Regional government (State)	YES
Chicago, Illinois	Regional government (State)	Local government	NO
Cincinnati, Ohio	Local government	Local government	NO
Cleveland, Ohio	Local government	Local government	NO
Corpus Christi, Texas	Local government	Local government	NO
Detroit, Michigan	Local government	Local government	NO
Duluth, Minnesota	Regional government (State)	Local government	NO
Houston, Texas	Local government	Local government	NO
Jacksonville, Florida	Local government/Regional (State)	Local government/Regional (State)	NO
Lake Charles, Louisiana	Regional government (State)	Local government	NO
Los Angeles, California	Local government	Local government	NO
Memphis, Tennessee	Regional government (State)	Local government	NO
Miami, Florida	Local government	Local government	NO
Mobile, Alabama	Regional government (State)	Local government	NO
New Orleans, Louisiana	Regional government (State)	Local government	NO
New York, New York	Regional government (Bi-State)	Regional government (Bi-State)	YES
Oakland, California	Local government	Local government	YES
Philadelphia, Pennsylvania	Regional government (State)	Local government	NO
Pittsburgh, Pennsylvania	Local government	Local government	NO
Portland, Maine	Local government	Local government	YES
Portland, Oregon	Regional government (State)	Regional government (State)	YES
Providence, Rhode Island	Local government	Regional government (State)	NO
Savannah, Georgia	Regional government (State)	Local government	NO
Seattle, Washington	Local government	Local government	YES
St. Louis, Missouri	Local government	Local government	NO
Superior, Wisconsin	Local government	Local government	NO
Tacoma, Washington	Local government	Local government	NO
Tampa, Florida	Regional government (State)	Local government	NO
Toledo, Ohio	Local government	Local government	YES

Local and regional governments own the facilities of most of the commercial airports and airport authorities which exercise a landlord function. Using data from a survey that was completed by a third of the airport authorities with commercial traffic in the US, Bacot and Christine (2006) find that local governments (cities, councils) have a much greater presence than the regional government (state) in the management of airport authorities. In half of the cases, the board of the airport authorities is appointed by the local government representative while in the other half it is the representative who directly controls the board of the airport authority.

Airport authorities can be managed through committees, special departments of local or state governments, advisory committees, airport authorities with specific purposes or multi-jurisdictional regional authorities (Federal Aviation Administration, 1999). Bacot and Christine (2006) argue that airport authorities in the United States cannot be considered special-purpose governments. In general, airport authorities in the US are organized as a sub-unit of the respective territorial government and do not have the power to impose taxes.

The largest part of airport funding in the United States comes from the fees charged to users (both aeronautical and non-aeronautical), private and public bonds (which are generally exempt from taxes and bear very low interest rates), taxes charged to passengers for the use of facilities (used to finance airport expansions) and federal aid, both state and local. In contrast to other countries, air fees in the US depend on the contractual agreements established with each one of the airlines. These agreements specify the financial obligations and other responsibilities that each party assumes regarding the use of airport installations (Vasigh and Hamzaee, 1998).

Finally, although the ownership and management of airports in the US are usually in the hands of local governments, the federal government also plays a crucial role through the Federal Aviation Administration (FAA). In 1958, the *Federal Aviation Act* established that this publicly owned entity would take over the airline industry in the United States. The two basic responsibilities of the FAA are the safety and efficiency of civil aviation. The FAA allocates licenses and regulates all commercial airports, and manages federal aid programs for investments aiming to improve or expand their capacity.

2.2. Ports

All major US ports are owned by public port authorities, and many are also exploited directly by these authorities. Port authorities are established by the chambers of representatives of the States, and their mission is to develop, manage and promote maritime commerce and act as catalysts for economic growth. The powers of a port authority are diverse, but they all have the power to regulate, develop plans, raise taxes, issue debt, ask for subsidies and negotiate private contracts and agreements. They are instruments of the State or local governments.[2]

However, not all US ports have public port authorities. There are privately owned commercial ports that are often tied to an industry with strong export and import needs, like metal or electricity companies. Apart from industrial ports, there are also a few privately owned commercial ports, although these are have limited opportunities for funding and their use of public services is restricted.

[2] In fact, neither the US Congress nor any federal agency has the authority to appoint board members, to resign from the port authority or amend their statutes. However, some port activities are indeed subject to federal law and jurisdiction, particularly with regard to international and interstate trade.

Table 2
Multipurpose port districts: joint management.

Port district	Jointly managed activities
Port of Aberdeen (Washington)	Port, Airport, Land, Marina.
Port Authority of New York i New Jersey (New Jersey)	Port, Airport, Tunnels, Bridges, Land, Connecting Trains
Massachusetts Port Authority (MassPort) (Massachusetts)	Port, Airport, Tobin Bridge.
Toledo-Lucas County Port Authority (Ohio)	Port, Airport, Land, Terminal trains
Port of Seattle (Washington)	Port, Airport, Land.
Port of Portland (Oregon)	Port, Airport.
Port of Portland (Maine)	Port, Airport
Port of Oakland (California)	Port, Airport, Land, Marina.

Source: Adapted from Fawcett (2006), who also included other metropolitan areas as Bellingham or Olympia in Washington State.

Among public agencies there are major institutional differences and also varying degrees of decentralization of public powers. However, the most important differences regarding the objective of this study are the ones to do with the choice of management model and in particular the level of private participation in its operation and maintenance. In fact, the greater complexity of port management means that we find a much wider variety of management models, with different degrees of private participation, than in the case of airports. Whereas the vast majority of airports are framed within the landlord model discussed above, the models of maritime port management differ according to the involvement of the port authority in the management and investment in the terminals.

Broadly, the literature distinguishes between two basic models for port management that are found in the United States. Cullinane and Song (2002) divide the organizational structure of ports into two categories or groups that are called comprehensive (or public service), and landlord. On the other hand, some authors use different terminologies and even add a third one (Liu, 1995; Baird, 2002). However, most maritime economists accept the cluster into two categories (Goss, 1990a, b; Thomas, 1994, a, b; Heaver, 1995). Therefore, ports lie on a continuum between comprehensive or public service ports at one extreme and landlord ports at the other.

Slack and Frémont (2005) provide the main distinctive features of these management models. In *service* or *comprehensive ports*, the authorities directly provide loading and unloading services, carry out the necessary investments and directly hire the staff working in the ports. This model is the most common in the United States, where port authorities of the municipal or state government still provide a wide range of services themselves in many cases. Labor law in the US is still very restrictive, making it difficult for external companies to participate in the management of the terminals.

In *landlord ports*, the authorities employ the services of an external operator for loading and unloading at the terminal. This *landlord model* is more common in Europe, where it has been favored by the introduction of privatization and deregulation processes. With higher private participation, it is the most widespread management model in the world. However, there are important institutional differences inside this general model that affect the nature of the private operator (Slack and Frémont, 2005). In one variation of the model, private participation is organized through multinational companies specialized in the management of terminals. This model is more common in Europe and its main advantage is that the capacity of the docks can be used at higher ratios. It is preferred by terminal management companies, because it allows more efficient use of the resources and a higher volume of income for a given capacity. Therefore, its control is based on a horizontal expansion process.

The second model is based more on the international shipping companies, which in turn have increased their interest in operations at the terminals. Their participation is coordinated through the establishment of long-term contracts with the port authority. This model is the most common in the United States, and it is the one that the shipping companies prefer because it gives them total control over the goods. It represents, therefore, a model of vertical integration. In fact this model is very similar to the one we find at airports, where control is based on a vertical integration process. In Asia, however, there is a greater balance between the two landlord models described than in Europe and the US.

Private participation in the mostly public *service port* model is limited to the tasks of Pilotage, Towage, Mooring Services and Dredging. However, in the *landlord* model, the role of the private sector is more significant, because in addition to these tasks it is also involved in the administration of the port infrastructure – in conjunction with the port authority – and has control over the superstructure (terminals, buildings, facilities, warehouses, etc.) and handling (World Bank, 2007). This private participation is mostly based on public–private agreements (Saundry and Turnbull, 1997). The most common agreements of this kind in the United States are terminal concessions and leases.[3]

Table 3 summarizes the role of the port authority, and therefore the public sector, in both management models (*Public Service and Landlord ports*):

2.2.1. Joint or separate management

As we have already noted, one of the interesting and unique elements of the US port model is that, in addition to the typical maritime functions of ports, port agency activities may also include joint management of airports, bridges, tunnels, rail systems and inland maritime systems, logistics parks, etc. This means that port authorities are seen from a more multimodal perspective; they carry out their duties by taking advantage of the potential synergies and complementarities of the different infrastructures and modes of transport.

The joint management models allowed by the US legislation make possible the existence of several multi-purpose port agencies, which have other functions in addition to managing ports (Table 3). According to the management models described above, it seems natural that joint management will be associated more with models with a higher degree of public participation and intervention and, in particular, with the articulation of this larger-scale government intervention through the existence of multi-purpose agencies.

At this point we should recall that in the empirical analysis of the factors explaining the choice of management model (i.e., joint or separate) we need to concentrate on the type of management model of ports, and not of airports. In some cases, port authorities have taken over the management of other infrastructures such as airports, but cases of airport authorities taking over the management of seaports are far less frequent. The main reason why port managers have assumed the management of other infrastructures, particularly airports, is that port authorities have been established for many years and predate the other facilities: for example, the port authorities of Seattle, New York and New Jersey, and Oakland were set up in 1911, 1921 and 1927 respectively.

Moreover, there is little variability in the model of airport management in the United States. Most airport authorities in this

[3] In the survey conducted by Baird (2002), the vast majority of agreements worldwide (52%) were of this kind. A much smaller percentage (19%) opted for the traditional mechanisms of Build Operate and Transfer. More marginal are agreements such as joint ventures (10%) and asset sales (4%).

Table 3
Port management models.

Service port	Landlord port
- The port authority is responsible for the provision of the basic infrastructure. - The port authority directly manages the loading and unloading of goods at the terminal.	- The port authority is responsible for the provision of the basic infrastructure - The port authority negotiates contracts with private operators for the loading and unloading of goods at the terminal - Two types of terminal operators: 1. Companies specialized in the management of maritime terminals 2. Companies controlled by one of the major shipping companies worldwide. 3. Hybrid company (combination of 1 and 2).

country act according to the landlord function. They are usually in the hands of local governments, and to a lesser extent, of regional governments. In the case of ports, there is much more variability in the management model and the degree of private sector involvement. Just as in the case of airports, the port authority is usually in the hands of local government, and to a lesser extent, the regional government. However, the functions of this port authority vary substantially, from the landlord model to the public service port model. In the latter case, the degree of involvement of the private sector in managing the port is noticeably lower.

One of the main hypotheses of this study is that joint management is less likely in cases in which the port authority is managed under the landlord model. That is to say, the greater the private sector participation in port activities, the less likely the port authority will be to take over the management of other infrastructure such as airports. Management within the service port framework involves a greater participation and centralization of territorial public administrations in large infrastructures, and so joint management of ports and airports is more likely.

3. Empirical analysis

In this section we analyze the factors that explain the different management models for major infrastructures in the sample of urban areas considered. Our analysis focuses on the joint or separate management of large infrastructures.

3.1. Empirical model

The empirical analysis is based on the estimation of an equation of the determinants of the choice of joint or separate management of major transport infrastructures. Our multivariate empirical analysis is based on the following formula:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 .... + \beta_k X_k + \varepsilon$$

where Y is the variable of interest (the dependent variable) and the Xs are variables that explain or determine the level of Y (the independent variables). The βs are impact coefficients, each respectively indicating the degree by which Y changes given a one unit change in the corresponding X variable, α is known as the intercept term and gives the predicted value of Y if the Xs are all equal to 0. Finally, ε is known as the disturbance term. In particular, we estimate the following equation for the sample of US urban areas:

$$D^{\text{joint}} = \alpha + \beta_1 \text{Population} + \beta_2 \text{Population}^2 + \beta_3 \text{GDP\_per} - \text{capita} + \beta_4 \text{Ratio\_Traffic} + \beta_5 D^{\text{landlord}} + \varepsilon$$

where the dependent variable is a dummy that takes value 1 in those urban areas where the management of ports and airports is carried out jointly, and 0 in the other case. The explanatory variables refer to the economic and demographic characteristics of urban areas, plus a variable for the management model and the degree of private participation in the ports. The explanatory variables in the equation of the determinants of the choice of joint or separate management of large infrastructure are as follows:

1.*Population and squared Population:* Number of inhabitants in the urban area of reference of the major infrastructures considered. The squared population variable is included to take into account the possible nonlinear relationship between the choice of model and the population of the urban area.
2.*GDP per capita:* Gross Domestic Product per capita in the urban area of reference.
3.*Traffic_Ratio*: The ratio between the volume of traffic in the port (in terms of tons) and the volume of traffic at the airport (in terms of passengers).
4.D^{landlord}: Dummy variable that takes the value 1 in urban areas where the port is managed under the landlord model, and the value 0 in cases where the management fits the model of service port or limited service port.

If the coefficient associated with the explanatory variable takes a positive value, then higher values for this variable imply a greater likelihood of choosing joint management. For example, if the coefficient associated with the population variable takes a positive sign, then joint management is more likely in the most populated urban areas.

In relation to the expected effect of the different explanatory variables, it is appropriate to begin with two of the main hypotheses of our analysis. The first one is represented by the dummy variable of the landlord model in ports – and which reflects the importance of the management model – as well as the variable indicating the relative importance of the port regarding the airport, as an approximation of the exploitation of the economies of scope and coordination improvements that arise from managing complex infrastructures.

On the one hand, as we mentioned above, the landlord model implies a higher degree of participation of private companies in management and investment in port infrastructure. We therefore expect a negative relationship between the probability of joint management of large infrastructures and the prevalence of landlord models in ports. A higher involvement of local government authorities in the management of the port may reflect a higher interest of these authorities in the control and centralization of large infrastructure located in the territory.

On the other hand, the relative importance of the port vis-à-vis the airport indicates the existing margin for the exploitation of scope economies and the complexity of infrastructure management. In areas with a large port and an airport with low mobility (and therefore with higher values in the traffic ratio variable), the margin for the exploitation of economies, and therefore for efficiency gains under joint management, is more restricted. In addition, the management of infrastructures in the area is less complex and can be guided by individualization. In contrast, in places where the importance of the port and the airport is more balanced there will be more room for efficiency and coordination gains through integrated management.

This leads us to expect a negative relationship between the traffic ratio variable, which will indicate that joint management is less likely in urban areas where the port is much larger than the airport. Note that in our sample only Chicago has an airport relatively larger than the port (only in this case the traffic ratio variable takes a value lower than one).

This study also aims to contrast empirically the relationship between the size of the metropolitan areas (measured in terms of population) and the management model chosen. Fawcett (2006) argues that joint management is usually set in mid-sized cities because scale economies can be achieved by integrating the management of airport and port infrastructures. We use a multivariate analysis to evaluate the relationship between the probability of joint management and the population of the territory.

Finally, as control variables, we do not expect the relationship between the choice of joint or separate management and the level of relative wealth in the urban area of reference to be clear *a priori*. However, this economic activity variable is of interest in the study of infrastructure management.

3.2. Data

Economic and demographic data refer to the metropolitan statistical areas. Population data and gross domestic product per capita were obtained from the website of the statistical agency of the United States Census. Airport traffic data were obtained from the website of the Federal Aviation Administration, while the port traffic data were obtained from the US Department of Transportation. Finally, information related to the management model of ports (landlord or service) was obtained by Fawcett (2006).

The time period (2005–2008) was chosen in view of the availability of information on the variables used in the empirical analysis.

3.3. Estimation and results

Table 4 shows the estimation results of the choice of separate or joint management. Given the binary nature of the dependent variable, the estimation was carried out using a binary probit. Column 1 in table 4 shows the coefficients estimated and their respective standard errors, which are robust to any heteroscedasticity problem. Column 2 shows the predicted change in the probability of an outcome taking place (i.e., joint versus single management of large transport infrastructures) as each independent variable changes from its minimum to its maximum value (i.e., from 0 to 1 for discrete variables) while all other independent variables are held constant at their mean values.

All the variables considered are statistically significant, as is the joint model we used (χ-test). The change in the predicted probabilities is high for all the variables. Thus, all the explanatory variables are relevant in explaining the move from single to joint management both from a statistical and an economic point of view.

The demographic variables in our model indicate that joint management is less likely in medium-sized cities, in disagreement with Fawcett (2006). Indeed, the coefficient associated with the population variable is negative and statistically significant at 1%, implying that smaller towns in the sample are more likely to choose joint management. However, the coefficient associated with the population squared variable is positive and statistically significant at 1%. Therefore, we also obtain evidence that in very large cities the probability of joint management is higher than in medium-sized cities. In fact, our results suggest that medium-size cities may have infrastructure with an optimal size for separate management. In cities of this size, neither the exploitation of economies of scope nor the complexity of management can benefit from the joint management of ports and airports.

Table 4
Results for the estimations of the choice of separate or joint management (probit).

	Coefficient (1)	Change in the predicted probabilities (2)
Population	−5.82e-07 (1.45e-07)***	−78%
Squared population	3.50e-14 (7.74e-15)***	97%
GDP per capita	0.00018 (0.000041)***	92%
Traffic ratio	−0.0029 (0.0013)***	−20%
$D^{landlord}$	−0.59 (0.30)**	−14%
Constant	−4.37 (1.12)***	–
N	128	
pseudo-R^2	0.31	
χ test of joint significance	36.38***	

* significance at 10%, **significance at 5%, and ***significance at 1%.

As for the hypothesis associated with the relative importance of the port and the airport, we find that the greater the difference between the port and airport traffic, the less likely integrated management will be. Hence, our results suggest that only in the case of infrastructure of similar dimensions can joint management induce efficiency improvements related to economies of scope and joint coordination. In large cities, with large ports and airports, complexity of management may be particularly important, and may favor joint management of mobility and infrastructure located in the territory. This hypothesis is confirmed through a coefficient associated with the variable traffic_ratio which is negative and statistically significant at 5%.

As regards the role of private participation in the management model, our results show the first clear evidence that joint management is less likely in the case of a port managed under a landlord model. Indeed, the coefficient associated with the dummy variable which takes value 1 in urban areas where the port is managed under the landlord model is negative and statistically significant at 1%. Therefore, our empirical analysis suggests the existence of a negative relationship between the degree of private involvement in management and joint management of ports and airports.

Moreover, joint management seems more likely in regions with a higher level of development, and in richer areas with more production per capita. Indeed, the associated coefficient with the variable GDP per capita is positive and statistically significant at 1%.

4. Concluding remarks

A review of management models throughout the world shows that, unlike other regions, the US presents numerous cases of joint management of ports and airports. This model has been run by port authorities that, in some cases, have taken over the management of other infrastructure such as airports and roads. The greater age of port authorities and the higher variability in management models (and private sector involvement) of ports are the reasons for our emphasis on seaports rather than airports.

In this study, we empirically examine the factors that explain why a port authority assumes a joint management model of major transport infrastructures. In doing so, we have placed special emphasis both on the role of private participation as a conditioning factor of management models and on the potential exploitation of economies of scope, and therefore efficiency gains, which make joint management possible in this situation.

Our results show that joint management seems more likely in urban areas where private participation in port management is less important and therefore where the management model in place is the service port or limited service port model. This result indicates that these integrated models are usually developed under public management, perhaps due to the improvements in coordination that management by a single operator can bring. The introduction of private agents into the operation makes this coordination more difficult and introduces priorities other than the ones set by local governments. This is an interesting result in view of the growing presence of private sector in port operations, and in view of the

current tendency towards the concentration of companies in the management of terminals.

A second contribution of this study is that joint management is less likely in urban areas in which the port is larger than the airport. Thus, the relative size of large infrastructure matters. One policy implication that can be derived from our analysis is that joint management may be recommended in urban areas where the size of the port and the airport are similar. Only in this situation can the synergies and economies of scope be exploited and improvements in the coordination of mobility be achieved. A significant imbalance in the importance of these infrastructures can make the gains from the economies of scope irrelevant, thus weakening the incentives to promote integrated management models.

A third important result of the study is that the relationship between population and joint management is not linear. In fact, the analysis shows that joint management seems more likely in large urban areas or in small urban areas with a high demand for transport (rich urban areas or with a large weight of manufacturing activity). This result contrasts with some of the reports published in the literature on management models in the US but which lacked empirical contrast. Further research is necessary to identify the mechanisms which discourage joint management in medium-sized cities, but which disappear in small and large cities. The greater complexity of mobility and management of infrastructure, as well as the necessary coordination of transportation services, may explain the presence of these models in highly populated areas, such as the case of New York.

Finally, this paper has shown that the joint management of major transport infrastructure is a field of analysis in which relevant questions remain to be solved. This article presents some of the first empirical evidence on the issues that determine the choice of joint management models for large infrastructures. However, our research has only focused on the relationship between ports and airports, although other infrastructures and facilities may be included in further analysis on the determinants of joint management decisions. In fact, authorities in charge of joint management of ports and airports are sometimes also responsible for the management and provision of roads, rail connections and other facilities within and/or outside its logistics area. For instance, the Port Authority of New York manages the PATH rail transit system, six tunnels and bridges between New York and New Jersey, the Port Authority Bus Terminal in Manhattan, and the World Trade Center, On the contrary, others just manage ports and airport without bearing any other responsibility.

Another alternative model may include joint management of one of these large infrastructures (one port or one airport) together with other facilities or smaller infrastructure such as roads, rail connections, parks, promenades, etc. The motivation behind the joint management decision for smaller infrastructure, or the combination of one large infrastructure and one or several smaller facilities appears to be another challenging scope for future investigation.

From the economic and management perspective, our analysis focuses on the role of the private sector, on the exploitation of economies of scope – which promotes joint management – and the size of the metropolitan areas served by the infrastructures. Apart from these first results, other interesting questions that arise include the analysis of the hypothetical superiority of the joint management formula in terms of efficiency, and the direct contrast of the exploitation of economies of scope, which requires detailed information about costs that is currently unavailable. Future research should address these issues to improve our understanding of management models for large transport infrastructures. Moreover, it is important to consider how the introduction of other infrastructure and facilities in the joint management of ports and airports may improve or enhance the exploitation of scale and scope economies.

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