Transportation Research Part A 42 (2008) 1056–1063

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Economic analysis of the Spanish port sector reform during the 1990s ☆

José I. Castillo-Manzano [a], Lourdes López-Valpuesta [a], Javier J. Pérez [b,*]

[a] Facultad de Ciencias Económicas y Empresariales, Universidad de Sevilla, Avda. Ramón y Cajal 1, 41008 Seville, Spain
[b] European Central Bank, Directorate General Economics, Kaiserstrasse 29, D-60311 Frankfurt am Main, Germany

ARTICLE INFO

Article history:
Received 14 August 2007
Received in revised form 22 November 2007
Accepted 6 March 2008

JEL classifications:
L98
C22

Keywords:
Port devolution
Maritime traffic
Time series analysis

ABSTRACT

In the matter of port legislation, the nineties was a period of maximum interest in Spain. Two laws enacted in 1992 and 1997, respectively, aimed at increasing the autonomy of individual ports in the management and organization of its activities. Before 1992 two different models of management coexisted in the Spanish port system: autonomous decision-making ports and ports controlled in its decision-making by the Central Government. The question we address in this paper is how these legislative changes have affected the evolution of the levels of traffic of the Spanish port system from 1992, date of introduction of the first law, to 2003, date of approval of a third legislative change that remains out of this analysis for lack of sufficient data. We find an important impact of legislative changes on port traffic by way of an estimated econometric model over the 1966–2003 period. We control for the effect of other variables that might have influenced Spanish maritime traffic such as international maritime flows, taken as a proxy of globalization, or gross domestic product, under the hypothesis that maritime transport is a demand derived of economic activity. We provide evidence supporting that greater port autonomy had beneficial effects for the Spanish port system as a whole.

1. Introduction

There is abundant literature on the important role played by transportation methods in the economic globalization process (Hesse and Rodrigue, 2004; Janelle and Beuthe, 1997; Veen-Groot and Nijkamp, 1999) and, in particular, on the expansion of maritime transportation (Alderton and Winchester, 2002) and the new roles of seaports (Rodrigue, 1999; Bichou and Gray, 2005). Thus, for Bichou and Gray (2005) seaports should be evaluated on the basis of their contribution to the competitiveness of the complete distribution/provisioning channel to which they are connected. This new context has forced many countries to adapt their port-related legal framework in order to give ports more flexibility in all aspects related to their daily management and their commercial strategies with a view to capture new routes and customers in an attempt to expand their hinterland and foreland.

According to Debrie et al. (2007), the conventional taxonomy of port institutional models, as regards the degree of public sector ownership, administration and labor affiliation would be the following: "service", "tool", "land lord" and "private". Nevertheless it is not rare to find hybrid institutional models that combine features of several types (Bichou and Gray, 2005). Public sector ports can be further classified depending on the degree of centralization of the adminis-

☆ The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the institutions to which they are affiliated. The main part of this research was developed while Pérez was affiliated to the University Pablo de Olavide de Sevilla, and Castillo-Manzano and López-Valpuesta were visiting the Institute of Transportation Studies (ITS) of the University of California at Berkeley. The authors thank the hospitality of the ITS.

* Corresponding author. Tel.: +49 69 13 44 57 29; fax: +49 69 13 44 78 09.
E-mail address: javier.perez@ecb.int (J.J. Pérez).

0965-8564/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.tra.2008.03.001

tration which oversees the port (local, regional or central) and to the degree of the port's decision-making autonomy. Mediterranean port systems within Europe have traditionally been quite centralized. Most have been run by public management with little autonomy of port authorities. Unsurprisingly, they have engaged into considerable legal reforms during the 1990s. The following analyses are worth mentioning: Gardner et al. (2006), Perez-Labajos and Blanco (2004) on the evolution of European maritime and port policy; Ridolfi (1995) on the Italian case; Pallis and Syriopoulos (2007) on the Greek case; Yercan (1998) on Turkey; Debrie et al. (2007) on the French case; Carvalho and Marques (2007) on the Portuguese case or Coto Millan (1997) and Suárez de Vivero and Rodríguez Mateos (2002) for a descriptive analysis of the 1992 Spanish reform.

The 90s were a very interesting period in Spain regarding port legislation. Both Law 27/1992 of National Ports and Commercial Maritime Lines and its 1997 update (Law 62/1997) produced changes in the management and organization of the old "Juntas del Puerto" (Port Assemblies) and in the various regional government administrations. Before 1992, the Spanish port system was asymmetric with two coexisting management models: on the one hand, the four "Autonomous Ports" (Barcelona, Bilbao, Huelva and Valencia), and on the other hand the remaining ports, managed by "Juntas del Puerto" and with a centralized decision-making regime. Law 27/92 sought to adapt the ports to a highly competitive environment. To do that, it favored the self financing of Port Authorities, increasing their autonomy. Thus ports had more flexibility to conduct their relations to the port community of their hinterland. There was a transition from a public system based on strictly administrative criteria to a commercial understanding of port services.

Law 27/1992 created the so-called "Ente Público Puertos del Estado" (State-owned Enterprise of National Ports) with the mandate of coordinating the operation of national ports. In case one particular port within the national port system would experience difficulties with the transition period to the new port system, the "Ente Público Puertos del Estado" would transfer funds (from the "Fondo de Financiación") from national ports experiencing operating surpluses to those experiencing hardships. In practical terms the transition to the new port system was relatively smooth, and the special funds were only needed in a very few cases, for example the ports in the north of Africa (Ceuta and Melilla).

All in all, Law 27/1992 moved the Spanish port institutional model from a "service"-type to the current "land lord" system. Services provided directly by the public sector (pilotage, towage, stowage, storage...) before the enactment of the law started to be managed by the private sector, while before Law 27/92 the private sector operators were mere intermediaries between Port Authorities ("Autoridades Portuarias") and firms demanding port services. Along these lines, the Law sought the replacement of workers with civil servant status by private sector workers.

The 1992 model was modified by the 1997 law that increased the participation of Regional Governments in port operation and management. With this modification Regional Governments could name members of a Port Authority governing board including its President. The transfer of authority from the Central Government to the Regional Governments was complete.[1] In addition, after this legal reform of 1997 the state-owned company "Ente Público Puertos del Estado" gained autonomy from the Ministerio de Fomento (Spain's Public Works Ministry). As a consequence of these and other events, one can say that a new port management model was born in Spain after these reforms.

The question we want to address is how these legal changes have impacted on the evolution of maritime traffic levels in the Spanish port system from 1992, enactment of the first law, to 2003, approval of a third legal reform[2] which we leave out of the analysis due to lack of enough data. Our sample covers the period 1966–2003 (annual data). The paper goes beyond a simple descriptive viewpoint of the legal changes in the Spanish port system by trying to evaluate the quantitative contribution of these reforms to maritime traffic growth. We estimate an econometric model to account for the quantitative impact of the reforms.[3] Compared to alternative approaches, like the ones related to the Data Envelopment Analysis (DEA), our approach presents three main advantages. Firstly, it allows us to carry out a dynamic analysis that exploits the time series structure of the series of port traffics (versus alternatives following a comparative static approach). Secondly, we take an agnostic approach insofar as we do not need to establish assumptions on the nature of the production function of the ports. Finally, to avoid spurious effects we can easily control for variables that might have influenced Spanish maritime traffic in the analyzed time period, such as the continuing growth of international maritime traffic (globalization), or gross domestic product, under the hypothesis that maritime transport is a demand derived of economic activity.

We follow a stepwise approach. First we apply our methodology to the series of total traffic of the Spanish port sector. Next we distinguish between two groups of ports, grouped according to the degree of autonomy they had at the time

[1] The French case is another example of devolution from the Central Government to the Regional Governments. Nevertheless, in the French case the transfer of authority has been only partial. Only the *Ports d'intérêt national* have been transferred, while the central Government has retained the control of the seven larger ports, the so-called *Ports autonomes* (Debrie et al., 2007).

[2] Law 48/2003 was a further step in the direction of a port model based on the principles of market competition as started by Law 27/1992, by favouring intra-port competition in the form of enhanced participation of private operators in port facilities (abolishing monopoly situations like that linked to stowage). Nevertheless inter-port competition was limited in the law as port tariffs are set by law in a homogeneous fashion for all ports. Law 48/2003 moved beyond a "land lord" model as it allowed the participation of the private sector in port infrastructure projects (as for example in the case of the port of Alicante). In addition, Law 48/2003 also allowed public subsidies to the port sector (before the port had to guarantee self-financing means), thus allowing important investment projects financed by regional Governments or the European Union (as in the cases of the new port of La Coruña or the expansion of the port of Seville).

[3] On the related subject of the analysis of the efficiency of port systems using the data envelopment analysis (DEA) methodology and related methodologies, see Estache et al. (2004), Cullinane et al. (2005), González and Trujillo (2005) or González et al. (in press).

Law 27/1992 entered into force (due to the existence of a number of ports with a high degree of management autonomy). Finally, we analyse the impact of the legal changes using a panel of the 27 Spanish port authorities.[4] In all cases, this study shows that granting greater autonomy to port authorities has been a reasonable strategy for the Spanish port system.

The paper is organized as follows. Section 2 lays out the econometric methodology, Section 3 the empirical results, and Section 4 presents the conclusions of the study.

2. Methodology

2.1. Structural change analysis

Standard, state-of-the-art structural change tests cannot be applied as such given the small size of the temporal sample available after the legal reform changes we are studying. It is worth noticing that the sample starts in 1966 while the legal reforms took place in the 1990s. These tests analyze whether a structural change did in fact happen at a particular date and determines the exact date in an endogenous fashion.[5] This data-imposed limitation forces us to apply methodologies that allow the estimation of a legal change (or a similar event) by choosing the date of the (supposed) structural change (by means of dummy variables). This problem has been traditionally tackled in the economics literature through the estimation of transfer function models in the tradition of Box et al. (1994).

We extend the latter approach to account for the ideas of endogenous-break-testing of Gregory and Hansen (1996). In order to prove that the dummy variables (level shifts, ramps) that we associate to the dates in which the changes in law took place (1993 and 1998[6]) are indeed related to the legal reforms that were enacted at those dates, we endogenize the breaks by shifting them in time. In this way, we control for the fact that they are not related to other events that would have happen before or after the laws. We systematically changed their starting year both towards the future and towards the past, up to 1983. In other words, the relevant equation (see Section 2.2 below) has been re-estimated for all pairs of years from 1983–1988 to 1998–2003. The chosen pair is the one that maximizes the R^2 goodness-of-fit statistic and minimizes the information criteria of Akaike and Schwartz.

2.2. The basic model

The time series used in this study for maritime traffic present characteristics that could be considered pure noise, due to frequent statistical improvements on the rudimentary compilation processes of the 1960s and the 1970s in Spain. A simple visual analysis of the evolution of total maritime traffic[7] in Spain (Fig. 1, panel A) advises us to pre-filter it. With this pre-filtered traffic series we want to avoid spurious effects of a temporary nature due to factors that the estimation procedure would (mistakenly) understand as permanent.

The pre-filtering methodology used decomposes the original series into two components. The first one is a trend-cycle component that would capture medium to long term changes in the data. The second one is an irregular component. Thus we decompose all time series of interest, say, Y_t, by means of the unobserved components model known as local linear trend model (see Harvey, 1989)

$$\begin{aligned} y_t &= \mu_t + \varepsilon_t, \quad \varepsilon_t \ Niid(0, \sigma_\varepsilon^2) \\ \mu_{t+1} &= \mu_t + \beta_t + \eta_t, \quad \eta_t \ Niid(0, \sigma_\eta^2) \\ \beta_{t+1} &= \beta_t + \zeta_t, \quad \zeta_t \ Niid(0, \sigma_\zeta^2) \end{aligned} \tag{1}$$

where $y_t = \ln(Y_t)$. The obtained slopes (β_t's) for the main variables of this study are displayed in Fig. 1, panel B, which covers the period 1966–2003.

Our hypothesis is that if the laws had any impact it would be on the slope of the trend-cycle component (β_t), that is, on the growth rate of maritime traffic after removing residual effects. Thus, the following model is designed to explain the slope of the trend-cycle component of maritime traffic in Spain

$$\begin{aligned} \beta_t &= \gamma_0 + \gamma_1 \beta_t^{\log(\mathrm{GDP})} + \gamma_2 \beta_t^{\log(\mathrm{WMT})} + \gamma_3 \xi_t^{j,1993-1997} + \gamma_4 \xi_t^{j,1998-2003} + u_t \\ u_t &= \rho_1 u_{t-1} + \rho_2 u_{t-2} + v_t, \quad v_t \ Niid(0,1) \end{aligned} \tag{2}$$

[4] In 2003 the Spanish port sector included 27 port authorities. In 2006, the port authority of Almería–Motril has been split in two, to increase the number of authorities to 28.

[5] For standard, state-of-the-art tests for endogenous break-testing (multiple breaks with unknown dates), see Gregory and Hansen (1996) and Bai and Perron (2003).

[6] Law 27/1992 entered into force on 25 November 1992, and in practical terms was implemented as of 1993. Law 62/1997 entered into force on 30 December 1997.

[7] Maritime traffic series are taken from Spain's Public Works Ministry (<http://www.fomento.es/MFOM/LANG_EN/default.htm>), in particular the Statistical Department of the "Ente Público Puertos del Estado" (<http://www.puertos.es/en/index.html>).

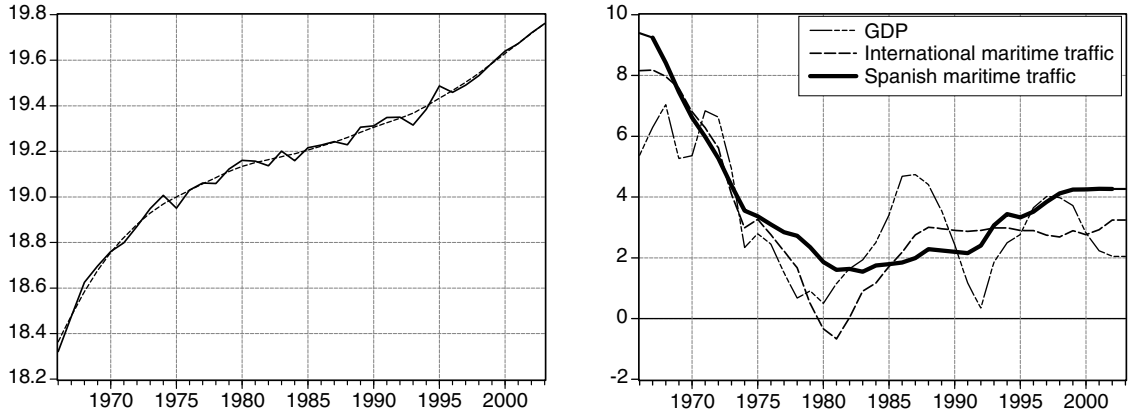

Fig. 1. Total maritime traffic of the Spanish port system: level (log) and percent change rate of the trend-cycle component. Panel A: total (log) maritime traffic of the Spanish port system (solid line) and trend-cycle component (dashed line) and Panel B: percent change rate of the trend-cycle component of total maritime traffic of the Spanish port system, total international maritime traffic, and real GDP.

where

- The constant γ_0 is a proxy that intends to capture the effect of continuous growth due to factors that are idiosyncratic to maritime traffic in Spanish ports. In short, it gathers the important role that greater commercial liberalization and economic integration, as well as technological improvements, are playing on maritime transport since the 60s. Note that estimating a constant in the growth rate equation (β_t) means estimating the effect of a linear trend in the level of the traffic series.
- $\xi_t^{j,1993-1997}$ and $\xi_t^{j,1998-2003}$ = dummy variables used to capture the effects of legal changes. To specify them we tested both level shift, $j = \{e\}$, and ramp formulations, $j = \{r\}$, defined as

$$\xi_t^{e,\text{date1}-\text{date2}} = \begin{cases} 0 & \text{if } t \notin (\text{date1}, \text{date2}) \\ x_0 & \text{if } t \in (\text{date1}, \text{date2}) \end{cases}$$

$$\xi_t^{r,\text{date1}-\text{date2}} = \begin{cases} 0 & \text{if } t \notin (\text{date1}, \text{date2}) \\ x_0 & \text{if } t = \text{date1} \\ \ldots & \ldots\ldots\ldots \\ x_0 + (\text{date2} - \text{date1}) & \text{if } t = \text{date2} \end{cases}$$

  where x_0 is a fixed number set in such a way that homogeneity of units between the two intervention variables (associated to the two consecutive changes in law) is guaranteed.
- $\beta_t^{\log(\text{GDP})}$ = slope of the trend-cycle component of the Spanish GDP (obtained from the Spanish Statistical Office, INE, <http://www.ine.es/en/welcome_en.htm>). With this variable we intend to capture the derived character of the port service and maritime transport demands from economic activity, as with any productive factors demand.
- $\beta_t^{\log(\text{WMT})}$ = slope of the trend-cycle component of the World Maritime Traffic. This variable aims at controlling for the general evolution of maritime transport over the last 40 years, that can have been affected by positive events (like containerization including the international transshipment of containers) or negative events (like the development of alternative networks to channel oil and natural gas). The data has been taken from the annual reports of the United Nations Conference on Trade and Development (UNCTAD).[8]
- We have included an error term with an order-2 auto-regressive structure AR(2) to capture the effects of additional variables not directly included in the specification, and to avoid specification problems in the estimation of the models.

3. Results

3.1. Estimation of the basic model for total traffics

Model (2) estimation by non-linear least squares led to the following results (robust standard deviations according to White's method (White, 1980) are shown in brackets)

$$\begin{aligned} \hat{\beta}_t &= \underset{(0.273)}{1.499} + \underset{(0.048)}{0.233}\,\beta_t^{\log(\text{WMT})} + \underset{(0.026)}{0.045}\,\beta_t^{\log(\text{GDP})} + \underset{(0.076)}{0.313}\,\xi_t^{r,1993-1997} + \underset{(0.074)}{0.368}\,\xi_t^{e,1998-2003} + u_t \\ u_t &= \underset{(0.098)}{1.445}\,u_{t-1} - \underset{(0.087)}{0.275}\,u_{t-2} + \hat{v}_t \end{aligned} \tag{3}$$

where $R^2 = 0.99$; Durbin Watson = 1.80; LM(1) = 0.458 (p-value).

[8] In order to do so the authors benefited from the physical access to old reports (back to the 60s) in the Doe Library of the University of California at Berkeley.

All estimated coefficients had the expected sign and turned out to be statistically significant. The dummy variables specification that best fit the data is given by a ramp for the 1992 law (x_0 is set to one) and a level shift for the 1997 law that starts at $x_0 = 5$, the 1992 ramp's highest value. The ramp formulation makes intuitive sense given that the Port Authorities might need time to profit from the new legal framework, that is, they climbed the ramp as they learned to take advantage from their newly acquired autonomy. The dummy variables have a significant impact. An approximation to measuring the impact of the legal reforms can be obtained from Eq. (4), in which we compute the distance between the estimate of β_t given by Eq. (3), $\hat{\beta}_t$, and the estimate of β_t netting out the estimated impact of the reforms, $\hat{\beta}_t - 0.313\xi_t^{r,1993-1997} - 0.368\xi_t^{e,1998-2003}$. Thus we obtain the following law impact (LI as from now) measured in percentage growth points:

$$\mathrm{LI} = 1 - \frac{\sum_{1992}^{2003}\left(\hat{\beta}_t - 0.313\xi_t^{r,1993-1997} - 0.368\xi_t^{e,1998-2003}\right)}{\sum_{1992}^{2003}(\hat{\beta}_t)} = 0.357 \tag{4}$$

Thus it is safe to conclude that greater port autonomy had beneficial effects for the Spanish ports as a whole. The Spanish port system owed some 36% of its total growth on average over the period 1993–2003 to the enacted legislative changes.

In order to prove that the estimated impact associated to the dummy specification in (2) is indeed related to the legal reforms that were enacted we systematically changed the starting year of the dummies both towards the future (up to the end of the sample) and towards the past (up to 1983). In other words, the equation has been re-estimated for all pairs of years from 1983–1988 to 1998–2003. Table 1 shows how the pair of years made up by 1993 and 1998 as the start value of the first and second dummy variable, respectively, maximizes the R^2 statistic and minimizes the information criteria of Akaike and Schwartz. Table 1 also displays Wald tests for the hypothesis of joint significance of the dummy variables and two tests of redundancy of the dummies. In all cases the results show that the pair 1993–1998 has the best statistical properties.

3.2. Estimation of the basic model for groups of ports

We turn now to analyze how these gains are distributed among Spanish ports depending on whether they had a high degree of management autonomy before the 1992 Law (as it was the case with the ports of the cities of Barcelona, Bilbao, Huelva and Valencia) or not (all the rest ports of the Spanish port system). To do that, we implement a pool estimation approach. We estimate Eq. (1) for the two types of ports. Let $\beta_{t,A}$ be the percent growth rate of the traffic of the ports that were autonomous before 1992, and $\beta_{t,NA}$ that of those who reached autonomy at that point. We can obtain estimates of $\beta_{t,A}$ and $\beta_{t,NA}$ by estimating model (1) for the two types of ports.

We obtain the following empirical results (the standard deviations of the covariance matrix coefficients computed using the SUR cross-section method are shown in parentheses):

$$\begin{cases} \hat{\beta}_{t,A} = \underset{(0.922)}{0.447} + \underset{(0.048)}{0.106}\,\beta_t^{\log(\mathrm{DGP})} + \underset{(0.095)}{0.312}\,\beta_t^{\log(\mathrm{WMT})} + \underset{(0.163)}{0.644}\,\xi_t^{1993-1997} + \underset{(0.181)}{0.760}\,\xi_t^{1998-2003} + u_{t,A} \\ u_{t,A} = \underset{(0.163)}{1.243}\,u_{t-1,A} - \underset{(0.152)}{0.332}\,u_{t-2,A} + \hat{v}_{t,A}, \\ \hat{\beta}_{t,NA} = \underset{(0.282)}{1.317} + \underset{(0.048)}{0.106}\,\beta_t^{\log(\mathrm{DGP})} + \underset{(0.095)}{0.312}\,\beta_t^{\log(\mathrm{WMT})} + \underset{(0.077)}{0.221}\,\xi_t^{1993-1997} + \underset{(0.077)}{0.267}\,\xi_t^{1998-2003} + u_{t,NA} \\ u_{t,NA} = \underset{(0.121)}{1.199}\,u_{t-1,NA} - \underset{(0.096)}{0.418}\,u_{t-2,NA} + \hat{v}_{t,NA} \end{cases} \tag{5}$$

where $R^2 = 0.99$, Durbin Watson = 1.67.

Table 1
Endogenous break tests

Years	R^2 statistic	AKAIKE criteria	SCHWARTZ criteria	Redundant variables tests		Wald test for the null hypothesis of $\gamma_3 = 0$, $\gamma_4 = 0$	
				F-statistic	Log likelihood ratio	*F*-statistic	Chi-square
	Maximize	Minimize	Minimize	Maximize	Maximize	Maximize	Maximize
83–88	0.9919	−0.5933	−0.2854	1.8408	4.3026	3.9815	7.9631
84–89	0.9925	−0.6598	−0.3519	2.9654	6.6986	4.4097	8.8193
85–90	0.9911	−0.4931	−0.1851	0.2824	0.6944	0.4269	0.8539
86–91	0.9914	−0.5264	−0.2185	0.7839	1.8955	0.5449	1.0899
87–92	0.9920	−0.6031	−0.2952	2.0027	4.6576	2.7612	5.5224
88–93	0.9938	−0.8629	−0.5550	6.8986	14.0104	12.3508	24.7016
89–94	0.9933	−0.7835	−0.4756	5.2650	11.1515	5.6341	11.2681
90–95	0.9940	−0.8899	−0.5820	7.4843	14.9825	7.1888	14.3777
91–96	0.9928	−0.7067	−0.3988	3.8041	8.3872	9.9917	19.9834
92–97	0.9941	−0.9109	−0.6030	7.9502	15.7374	31.5612	63.1225
93–98	0.9944	−0.9619	−0.6540	9.1238	17.5718	36.2612	72.5224
94–99	0.9926	−0.6721	−0.3641	3.1802	7.1387	5.4603	10.9206
95–00	0.9917	−0.5608	−0.2529	1.3192	3.1347	8.8993	17.7986
96–01	0.9931	−0.7527	−0.4448	4.6658	10.0433	17.2029	34.4058
97–02	0.9927	−0.6854	−0.3775	3.4180	7.6197	8.8952	17.7903
98–03	0.9918	−0.5734	−0.2655	1.5191	3.5868	14.8760	29.7520

$$H_0 : \gamma_{1,A} = \gamma_{1,NA}, \quad \gamma_{2,A} = \gamma_{2,NA} : \chi^2_2 = 0.684 \ (p\text{-val}); \quad F(2,58) = 0.685 \ (p\text{-val})$$

All coefficients are significant at the usual significance levels, with the exception of $\gamma_{0,A}$. It is also worth noticing that the estimated impact of the laws is different for the two port categories. In order to quantify that difference we have computed the impact on both port categories

$$\begin{aligned} \mathrm{LI}_A &= 1 - \frac{\sum_{t=1992}^{2003}\left(\hat{\beta}_{t,A} - 0.664\xi_t^{r,1993-1997} - 0.760\xi_t^{e,1998-2004}\right)}{\sum_{t=1992}^{2003}\left(\hat{\beta}_{t,A}\right)} = 0.601 \\ \mathrm{LI}_{NA} &= 1 - \frac{\sum_{t=1992}^{2003}\left(\hat{\beta}_{t,NA} - 0.221\xi_t^{r,1993-1997} - 0.267\xi_t^{e,1998-2004}\right)}{\sum_{t=1992}^{2003}\left(\hat{\beta}_{t,NA}\right)} = 0.274 \end{aligned} \tag{6}$$

where LI_A and LI_{NA} are estimations of the impact of the legal reforms on the autonomous and the non-autonomous ports, respectively.

3.3. Estimation of the basic model for individual ports

As a final piece of evidence, we have carried out the analysis of the previous subsections with individual ports. We have estimated model (2) using a panel of 27 port authorities.

Table 2 shows the values of the coefficients attached to the dummy variables linked to the legal changes (γ_3 and γ_4) for those ports in which the coefficients turned out to be statistically significant at the standard significance values (90%, 95% and 99%). In addition, Table 2 shows the following information related to the year 2003: the total traffic of the port, the position in the national ranking of port traffic, the number of TEUs, and the position in the national ranking of traffic of TEUs.

The results show that nine ports have been the main beneficiaries of the legal reforms, i.e. one third of the total. It is worth noticing that the positive impact was not necessarily linked to large ports (5 out of 9 were in 2003 within the 10 larger ports, but 3 out of 9 were in the group of 10 smaller ports) but rather to geographical location. Five out of eight Mediterranean ports were within the group of most favored ports, i.e. 62.5% that more than doubles the average of the national port system. Within the Mediterranean ports we find those with highest impact factors: Valencia, Castellón and Alicante.

The panel estimation also shows that there seems to be a positive relationship between ports taking advantage of the new laws and the specialisation of those ports in container traffic. Again, 5 out of the 9 ports with a significant impact of the legal reforms were within the group of 10 ports with the highest number of containers, and the rest ranked 11th, 14th and 17th (out of 27 ports in the sample). The nine ports with an estimated significant impact of the laws comprised 66.2% of the total number of TEUs, while presenting some 47.4% of the total traffic of the port system in 2003.

Table 2
Panel estimation of Eq. (2) with data of the 27 ports of the Spanish port system (in 2003)

	Law 27/92 (coefficient γ_3)	Law 62/97 (coefficientγ_4)	Total traffic (2003)	*National ranking (1–27)*	Traffic of containers in TEUs (2003)	*National ranking (1–27)*
Algeciras	0.247*	0.221*	60,916,192	*1*	2,517,318	*1*
	(0.127)	(0.134)				
Valencia	0.792***	0.886***	35,301,451	*3*	1,992,903	*2*
	(0.180)	(0.197)				
Las Palmas	0.523**	0.565**	21,769,196	*6*	990,937	*4*
	(0.232)	(0.257)				
Cartagena	1.607***	1.795***	21,347,143	*7*	36,918	*13*
	(0.279)	(0.308)				
Gijón	0.437*	0.501*	19,165,080	*8*	10,397	*17*
	(0.264)	(0.293)				
Castellón	0.247*	0.292*	9,984,994	*13*	33,103	*14*
	(0.141)	(0.153)				
Sevilla	0.454**	0.515**	4,846,402	*18*	102,854	*11*
	(0.219)	(0.243)				
Vigo	0.206*	0.243*	4,485,046	*21*	165,973	*8*
	(0.116)	(0.127)				
Alicante	0.836***	0.914***	3,299,545	*22*	146,477	*10*
	(0.172)	(0.192)				

Only those ports with statistically significant coefficients γ_3 and γ_4 are shown.
The standard deviations of the covariance matrix coefficients computed using the SUR cross-section method are shown in parentheses.
* Significance at the 90% level.
** Significance at the 95% level.
*** Significance at the 99% level.

4. Conclusions

This study shows by means of an econometric model that granting greater autonomy to port authorities has been a reasonable strategy for the Spanish port system. It provides empirical evidence in favor of management and decision-making decentralization for strongly centralized port systems, such as was the Spanish one. Our results show that the enacted legislative changes would help explaining some 35% of the total growth in the Spanish port traffic on average over the period 1993–2003, i.e. without the legal reforms the Spanish port system would have grown at a much lower pace over this period. In the decade of the 1980s the "service" model seemed to need a reform. Over the 1980s the Spanish port system reached a bottom after having followed a strong deceleration path (Fig. 1, panel B), with annual growth rates stabilised at around 2%. In addition, since 1985, the growth rate of the Spanish maritime traffic was below the growth rate of global maritime traffic.

The 1990s reverse this poor record, with growth rates of total maritime traffic almost doubling compared to the previous decade. In addition, Spanish port traffic series started to grow above world maritime traffic rates. The legal reforms of the 1990s were not strangers to this process. Our results show that the Law enacted in 1992 implied a quite steep change (we estimated a change in trend, summarised in the ramp specification) as the port system changed from a quite centralised and bureaucratic system ("service" system) to one with greater participation of the private sector ("landlord"). In sum, a priori our work could serve to support decentralization processes in port systems similar to the Spanish one, in particular for some Mediterranean countries.

Our results show that the positive effects of the increased autonomy of ports brought about by Law 27/1992 were immediate, taking place already in 1993. Nevertheless Port Authorities needed time to fully profit from the new legal framework, that is, they climbed a ramp (local trend) as they learned to take advantage from their newly acquired autonomy. The fast learning process was most likely influenced by the quick replacement of workers with civil servant status by highly skilled private sector workers.

Another interesting conclusion is that, even in asymmetric situations, as it was the case of the Spanish port system before 1992 (in which only four large ports – the autonomous ones – had managing autonomy), a global autonomy policy would benefit all ports. Furthermore, after the legal reforms, profit distribution has been especially generous with ports which already had autonomy in the past. Our results show that the impact of the legal changes was more important in the case of autonomous ports than in the case of non-autonomous ports. In particular, our results show that while autonomous ports owed some 60% of its total growth on average over the period 1993–2003 to the enacted legislative changes, non-autonomous ports (ports with more limited autonomy before 1992) only owed 27% of their overall growth.

Several reasons, among others, could explain this result. Firstly, the pre-1992 experience accumulated by autonomous ports managing their autonomy might have helped them take greater advantage of the new legal framework. This legal framework has fostered greater intra-port and inter-port competition within the Spanish system and discouraged commercial policies based only on wide captive hinterlands. Secondly, three of the so-called autonomous ports (Barcelona, Bilbao and Valencia) have tried, with varying success, to develop a role of hub for container traffic, with feeder lines for other Spanish ports. Therefore their greater growth is partly due to their ability to add spoke port growth to their own.

The results show that nine ports have been the main beneficiaries of the legal reforms, i.e. one third of the total. The positive impact was not only in the case of large ports (5 out of 9 were in 2003 within the 10 larger ports, but 3 out of 9 were in the group of 10 smaller ports) but rather to their geographical location. Mediterranean ports seemed to be favoured, and within this group Valencia, Castellón and Alicante. Nevertheless, the main result arising from a deep look at the panel results is that we find evidence for a positive relationship between ports taking advantage of the new laws and the specialisation of those ports in container traffic. Five out of the nine ports with a significant impact of the legal reforms were within the group of 10 ports with the highest number of TEUs, and the rest ranked 11th, 14th and 17th (out of 27 ports in the sample).

References

Alderton, T., Winchester, N., 2002. Globalisation and de-regulation in the maritime industry. Marine Policy 26, 35–43.
Bai, J., Perron, P., 2003. Computation and analysis of multiple structural change models. Journal of Applied Econometrics 18, 1–22.
Bichou, K., Gray, R., 2005. A critical review of conventional terminology for classifying seaports. Transportation Research Part A 39, 75–92.
Box, G.P., Jenkins, G.M., Reinsel, G.C., 1994. Time Series Analysis: Forecasting and Control, third ed. Prentice-Hall, New Jersey.
Carvalho, M., Marques, R.C., 2007. Economic regulation in the Portuguese seaport sector. IAME Conference 2007, Greece.
Coto Millan, P., 1997. Maritime transport policy in Spain (1974–1995). Transport Policy 3, 37–41.
Cullinane, K., Ji, P., Wang, T., 2005. The relationship between privatization and DEA estimates of efficiency in the container port industry. Journal of Economics and Business 57, 433–462.
Debrie, J., Gouvernal, E., Snack, B., 2007. Port devolution revisited: the case of regional ports and the role of lower tier governments. Journal of Transport Geography 15, 455–464.
Estache, A., Tovar de la Fé, B., Trujillo, L., 2004. Sources of efficiency gains in port reforms: a DEA decomposition of a Malmquist TFT index for Mexico. Utilites Policy 12, 221–230.
Gardner, B., Marlow, P., Pettit, S., 2006. Full cost recovery in EU port operating as commercial undertakings. Transport Policy 13, 2–21.
González, M.M., Trujillo, L., 2005. Reform and infrastructure efficiency in Spanish's containers ports. The World Bank, Policy Research, Working Paper WPS3515.
González, M.M., Perelman, S., Trujillo, L., in press. Tracking the stepwise effects of regulatory reforms over time: a 'back-door' approach. Applied Economics.
Gregory, A.W., Hansen, B.E., 1996. Residual-based tests for cointegration in models with regime shifts. Journal of Econometrics 70, 99–126.
Harvey, A., 1989. Forecasting, Structural Time Series Models, and the Kalman Filter. Cambridge University Press, New York.
Hesse, M., Rodrigue, J.P., 2004. The transport geography of logistics and freight distribution. Journal of Transport Geography 12, 171–184.
Janelle, D.G., Beuthe, M., 1997. Globalization and research issues on transportation. Journal on Transport Geography 5 (3), 199–206.

Pallis, A.A., Syriopoulos, T., 2007. Port governance models: financial evaluation of Greek port restructuring. Transport Policy 14, 232–246.
Perez-Labajos, C., Blanco, B., 2004. Competitive policies for commercial sea ports in the EU. Marine Policy 28, 553–556.
Ridolfi, G., 1995. Public policy and port development: the Italian case. Ocean and Coastal Management 27 (1–2), 73–91.
Rodrigue, J.P., 1999. Globalization and the synchronization of the transport terminals. Journal of Transport Geography 7, 255–261.
Suárez de Vivero, J.L., Rodríguez Mateos, J.C., 2002. Spain and the Sea. The decline of an ideology, crisis in the maritime sector and the challenges of globalization. Marine Policy 26 (3), 143–153.
Veen-Groot, D.B., Nijkamp, P., 1999. Globalisation, transport and environment: new perspectives for ecological economics. Ecological Economics 31, 331–346.
White, H., 1980. A heteroskedasticity-consistent covariance matrix and a direct test for heteroskedasticity. Econometrica 48, 817–838.
Yercan, F., 1998. Maritime transport policy of Turkey. Transport Policy 5, 259–266.