

PORT CHOICE ANALYSIS: AN APPLICATION TO THE SPANISH CERAMIC TILE INDUSTRY

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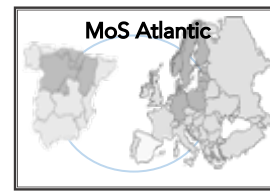
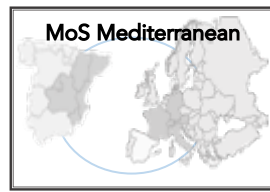
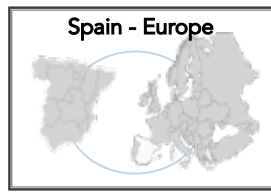
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CONTEXT AND MOTIVATION

FREIGHT TRANSPORT DEMAND MODELLING

Freight traffic between Spain and Europe



Freight traffic in Spain



Maritime freight traffic

CONTEXT AND MOTIVATION

MAIN OBJECTIVES OF THE RESEARCH LINE

To identify which **factors** determine **port choice** and thus deepen the role of **port authorities** in defining competitiveness and facilitate the design of effective investment policies.

Port choice analysis

Comparison of port choice determinants for shippers and freight forwarders

Empirical analysis

Application 1

Identify shippers' port choice criteria and heterogeneity

Empirical analysis

Application 2



Connectivity analysis

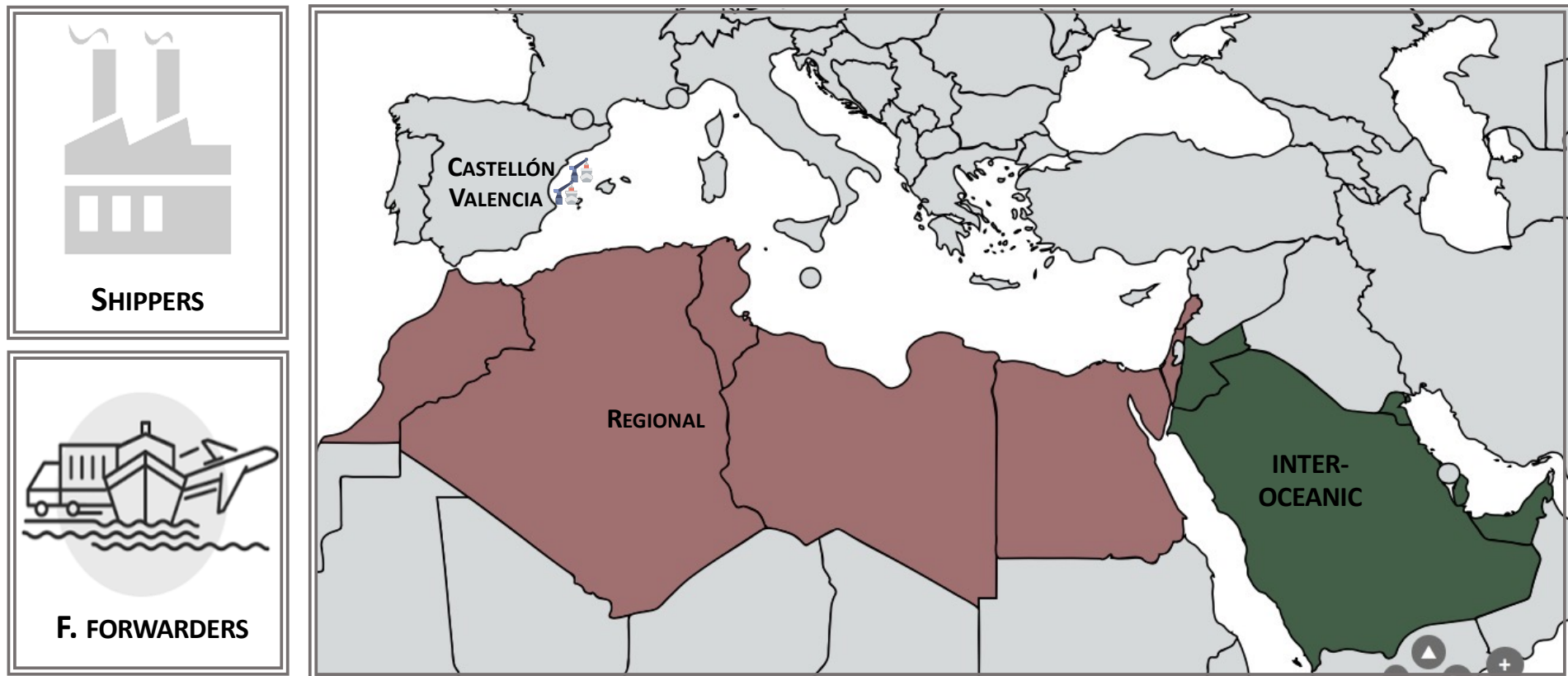
Development of maritime connectivity index



Martínez and Feo (2020)
Journal of Transport
Geography, 89

CONTEXT AND MOTIVATION

Exports of ceramic tiles from Castellon to
North Africa or the Arabian Peninsula



CONTEXT AND MOTIVATION



SPANISH CERAMIC SECTOR

4% of world production

5th place of top 5 producing countries

Exports → 75% / total sales

3RD largest surplus contributor to Spain's trade balance

CASTELLON PRODUCTION CLUSTER

94% of domestic production

84% of domestic manufacturers

5 92% of national exports

CONTEXT AND MOTIVATION

Exports of ceramic tiles from Castellon to **North Africa or the Arabian Peninsula**

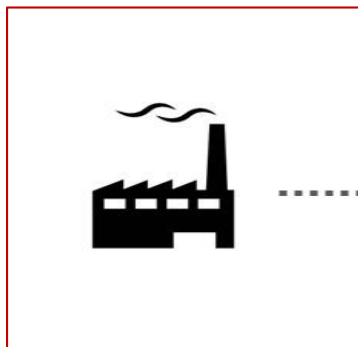


CONTEXT AND MOTIVATION

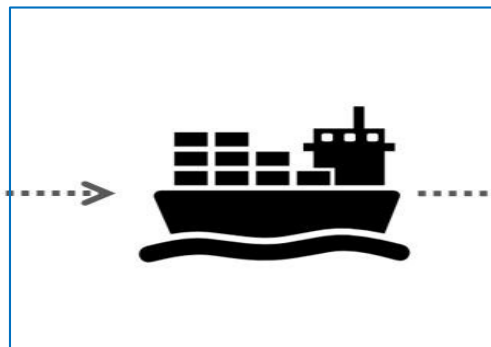
Who is the real decision-maker in the choice of port?

Land decision-makers

Shippers / F.forwarders

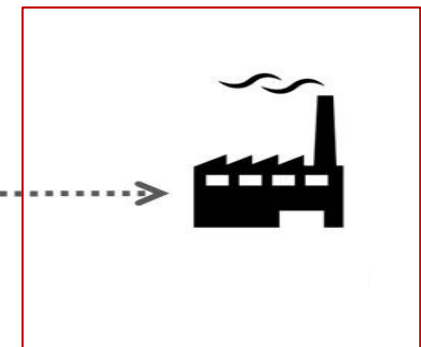


Shipping lines



Land decision-makers

Shippers / F.forwarders



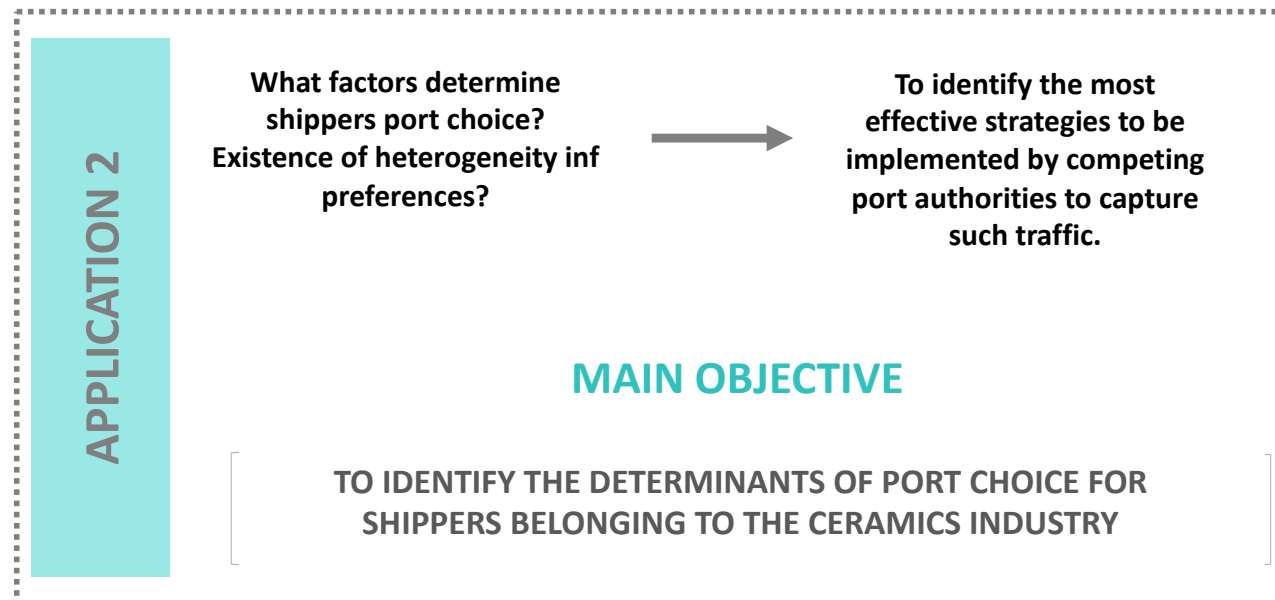
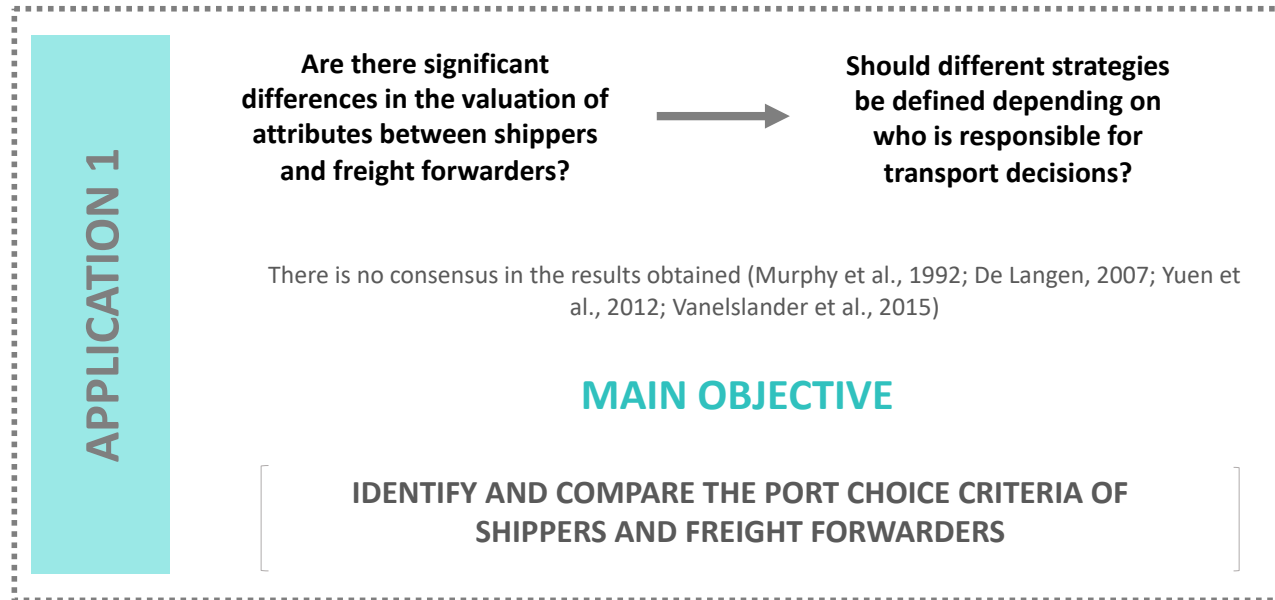
Is the shipping line that conditions shippers choice through the connectivity it provides ?



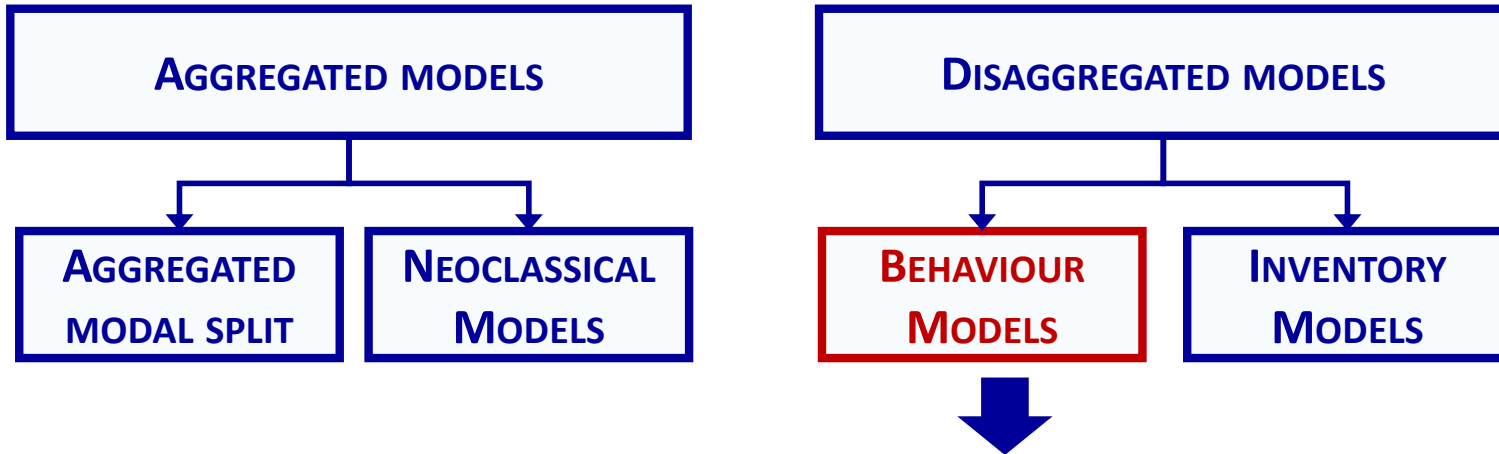
Is the shipper that conditions shipping lines choice with his cargo?



CONTEXT AND MOTIVATION



WINSTON 1983



RANDOM UTILITY THEORY (Mansky, 1977)
 DISCRETE CHOICE MODELS (McFadden, 1974; 1981)

$$U_{in} = V_{in} + \varepsilon_{in}$$

$$P(i|C_n) = \Pr [V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}] = \Pr [\varepsilon_{jn} - \varepsilon_{in} \leq V_{in} - V_{jn}] = \Pr [\varepsilon_n \leq V_{in} - V_{jn}]$$

Data can be obtained by means of 2 techniques:

- ✓ Revealed preferences (real choices)
- ✓ Stated preferences (hypothetical choices)

} Obtain information on relative valuation of transport attributes



Data obtained by experimental design: **EFFICIENT vs ORTHOGONAL**

DATA

CHARACTERISTICS OF THE QUESTIONNAIRE

- **Choice of level:** market analysis and expert consultation
- **Choice of attributes:** maritime chain approach (Robinson 2002)
- **Face-to-face interviews:** 52 companies = 39 shippers (28%) + 13 f.forwarders (8%)

ATTRIBUTE		CURRENT ALTERNATIVE	NEW HYPOTHETICAL ALTERNATIVE
COST	Total door-to-unloading port. Cost, € per shipment.	Current level	1) + 10% current cost 2) - 15% current cost 3) - 10% current cost
FREQUENCY	Departures per week to the destination country	Current level	1) 0.5 weekly departures 2) 1 weekly departure 3) 2 weekly departures
DELAYS	Percentage of the shipments significantly delayed (more than 24 hours)	Current level 1% shipments	1) 0% shipments delayed 2) 5% shipments delayed 3) 7% shipments delayed
		Current level 5% shipments	1) 1% shipments delayed 2) 7% shipments delayed 2) 10% shipments delayed
		Current level 10% shipments	1) 5% shipments delayed 2) 7% shipments delayed 2) 15% shipments delayed
CLOSING TIME	Maximum period of time to accept export cargo, in days	Current level (2 days prior to the expected call of the vessel)	1) 1 day 2) Current level 3) 3 days

AVERAGE CHARACTERISTICS OF THE SAMPLE

		SHIPPERS		F. FORWARDERS	
		Mean	Stand. Dev.	Mean	Stand. Dev.
CHARACTERISTICS OF THE COMPANY	Nº of employees	167,05	214,51	141,23	409,21
	% exports / total produced	66,70%	23,28%	-	-
	% ceramic / total shipments managed	-	-	52%	26,96%
		Number	% / Total	Number	% / Total
	Location: Castellon	39	100%	4	30,77%
	Location: Valencia	0	0%	9	69,23%
CHARACTERISTICS OF THE SHIPMENT OF REFERENCE		Number	% / Total	Number	% / Total
	Destination North Africa	26	66,67%	9	69,23%
	Destination Arabian Peninsula	13	33,33%	4	30,77%
	Years managing the shipment of reference				
	Years managing the ref. ship. (< 1 year)	2	5,13%	1	7,69%
	Years managing the ref. ship. (1 - 5 years)	10	25,64%	4	30,77%
	Years managing the ref. ship. (> 5 years)	27	69,23%	8	61,54%
		Mean	Stand. Dev.	Mean	Stand. Dev.
	Shipment size (Tn)	22,78	4,43	24,46	0,78
	Value (€/shipment)	11256,41	6767,64	15311,54	13102,17
Nº of annual shipments	24,51	26,8	304,3	456,59	
% N.Afr- & Arab. P. / total ceramic exports	9,06%		35,84%	23,90	
CHARACTERISTICS OF THE TRANSPORT CHAIN		Number	% / Total	Number	% / Total
	Loading port: Castellon	19	48,72%	4	30,77%
	Loading port: Valencia	20	51,28%	9	69,23%
		Mean	Stand. Dev.	Mean	Stand. Dev.
	Cost (€ per shipment)	1067,94	304,88	992,3	257,91
	Delays (% of ship. significantly delayed)	2,56%	3,1	4,61%	3,44
	Closing time (days)	48	0	48	0

SPECIFICATION APPLICATION 1

Error Components' Mixed Logit Model

$$U_{nA} = \beta_1 \text{COST}_A + \beta_2 (\text{DDEC} \times \text{COST}_A) + \beta_3 \text{FREQ}_A + \beta_4 \text{DEL}_A + \beta_5 (\text{DVAL} \times \text{DDEST} \times \text{DEL}_A) + \beta_6 \text{CLOS}_A + \beta_7 \text{DDEC} + \mu_n + \varepsilon_{nA}$$

$$U_{nB} = \beta_1 \text{COST}_B + \beta_2 (\text{DDEC} \times \text{COST}_B) + \beta_3 \text{FREQ}_B + \beta_4 \text{DEL}_B + \beta_5 (\text{DVAL} \times \text{DDEST} \times \text{DEL}_B) + \beta_6 \text{CLOS}_B + \varepsilon_{nB}$$

VARIABLE	DEFINITION	TYPE	EXPECTED SIGN
Attributes of the alternatives			
Cost (COST)	Total door-to-unloading port cost	Continuous	-
Frequency (FREQ)	Departures per week	Continuous	+
Delays (DEL)	% of shipments significantly delayed	Percentage	-
Closing Time (CT)	Maximun period of time to accept export cargo	Continuous	-
Socio-economic variables			
Decision-maker (DDEC)	Dummy indicating if the decision-maker is shipper or freight forwarder	DDEC = 1 if freight forwarder	
Value (DVAL)	Dummy indicating the value of the shipment	DVAL = 1 if the value of the shipment is > 10.000€	
Destination (DDEST)	Dummy indicating the destination of the shipment	DDEST = 1 if the destination is Arabian Peninsula	

RESULTS APPLICATION 1

VARIABLE	COEFFICIENT	T-TEST
CLOSING TIME	-0,4090	-2,48
COST	-0,0076	-2,59
COST * DDEC	-0,0125	-2,59
FREQ	0,9490	5,65
DELAYS	-0,0702	-0,78
DELAYS*DVAL*DDEST	-0,1910	-1,72
DDEC	1,4100	3,51
SIGMA	1,0800	4,70

Nº of individuals: 52
 Nº of observations: 624
 Rho²: 0,17
 Rho² adjusted: 0,152
 Log. L = -358,32
 Draws: 1000

- *Freight forwarders are more price-elastic.*
- *Freight forwarder greater inertia to keep using his port of reference*
- *Delays only relevant for high-value shipments to inter-oceanic markets*
- *Closing time and frequency relevant for both decision-makers.*

RESULTS APPLICATION 1

CURRENT CHOICE	DECISION-MAKER	COST		FREQUENCY		DELAYS		CLOSING TIME	
		+1%	-1%	+1 weekly sailing	-1 weekly sailing	+1 perc. point	-1 perc. point	+0.25 days (6 hours)	-0.25 days (6 hours)
CASTELLÓN	SHIPPER (share 36.66%)*	-1.47	1.49	18.48	-12.09	-0.21	0.22	-1.87	1.91
	F. FORWARDER (share 39.82%)*	-2.12**	2.33	10.74	-5.99	0***	0***	-0.95	0.99
VALENCIA	SHIPPER (share 40.38%)*	-1.56	1.58	19.33	-13.26	-1.84	1.18	-2.03	2.05
	F. FORWARDER (share 44.74%)*	-2.32	2.52	10.11	-6.13	-0.86	0.89	-0.95	0.98

* Shown in parentheses is the share opting for the reference alternative in the SP experiment

** The interpretation of this table is as follows: In the case of freight forwarders that actually used the port of Castellón for their reference shipment, when presented with the SP scenarios proposed in the experiment (base scenario), 39.82% of them claimed that they would continue to use their reference alternative, while 60.18% stated that they would change to the hypothetical alternative proposed. If the cost of the reference alternative increased by 1%, the share of those still opting for said alternative would decrease by 2.12 percentage points, from 39.82% to 37.7%.

*** There are no freight forwarders in our sample that use Castellón as the departure port when managing high-value shipments destined for the Arabian Peninsula.

- Greater sensitivity of freight forwarders to cost measures
- Freight forwarders' greater inertia → key when implementing policies oriented towards qualitative factors (frequency, closing time and delays) → they show less sensitivity than shippers to variations in the current service levels offered by each port → compared to shippers, freight forwarders require greater improvements in the current level of service in qualitative factors in order to have enough of an incentive to change their departure port.

SPECIFICATION APPLICATION 2

Latent Class Model

$$U_i = \beta_1 \text{COST}_i + \beta_2 \text{FREQ}_i + \beta_4 \text{DEL}_i + \beta_5 \text{CT}_i$$

$$\text{Prob} = \beta_1 \text{DEMP}_i + \beta_2 \text{ENV_AN}_i + \beta_4 \text{DVAL}_i + \beta_5 \text{DDEST}_i$$

	VARIABLE	DEFINITION	TYPE	EXPECTED SIGN
CHOICE PROBABILITY	Attributes of the alternatives			
	Cost (COST)	Total door-to-unloading port cost	Continuous	-
	Frequency (FREQ)	Departures per week	Continuous	+
	Delays (DEL)	% of shipments significantly delayed	Percentage	-
	Closing Time (CT)	Maximum period of time to accept export cargo	Continuous	-
CLASS MEMBERSHIP PROBABILITY	Socio-economic variables			
	Company size (DCOM_SIZE)	Dummy indicating the size of the company, in number of employees	DCOM_SIZE = 1 if the company > 49 employees	
	Annual shipments (DSHIP_AN)	Dummy measuring frequency of shipments	DSHIP_AN = 1 if the number of shipments exported by the company is >= 24 per year	
	Value (DVAL)	Dummy indicating the value of the shipment	DVAL = 1 if the value of the shipment is > 10.000€	
	Destination (DDEST)	Dummy indicating the destination of the shipment	DDEST = 1 if the destination is Arabian Peninsula	

RESULTS APPLICATION 2

Attributes	MNL		LATENT CLASS					
			Class 1		Class 2		Class 3	
	Coefficient	z-value	Coefficient t	z-value	Coefficient t	z-value	Coefficient t	z-value
COST	-0.008	4.76	0.0369	5.24	0.0052	2.00	0.0217	4.03
FREQ	0.766	4.8	1.1472	3.16	1.107	3.22	1.2634	2.72
DEL	-0.228	4.78	0.2853	2.32	0.4913	4.70	0.7155	4.33
CT	-0.148	-0.8	-1.424	2.50	0.4691	1.44	0.0717	0.13
<i>Socio-economic in Class probability model</i>								
Intercept			0.3063	0.56	0.73	1.35	-	-
							1.0363	1.16
DDEST			-	-	-	-	1.3092	1.64
			1.1635	2.36	0.1456	0.32		
DCOM_SIZE			1.3552	1.92	1.294	1.83	-	-
							2.6492	2.02
DSHIP_AN			-	-	-	-	3.1362	2.01
			1.3626	1.68	1.7736	2.14		
DVAL			-	-	-	-	1.8919	1.80
			1.0676	1.85	0.8243	1.46		
<i>Class size</i>			41.18		40.39		18.43	
			%		%		%	
N. Obs.	468							
N. Ind.	39							
R ²	0.4676							
R ² (0)	0.4723							
Log.L	-216.75							

- *Class 1: cost-sensitive*
- *Class 2: least cost-sensitive*
- *Class 3: qualitative attributes*

RESULTS APPLICATION 2

Class 1 (41%)

SOCIO-ECONOMICS

- **Regional** destination
- Medium and large companies
- **Low-value** shipments
- **Low-frequency** shipments

Class 2 (41%)

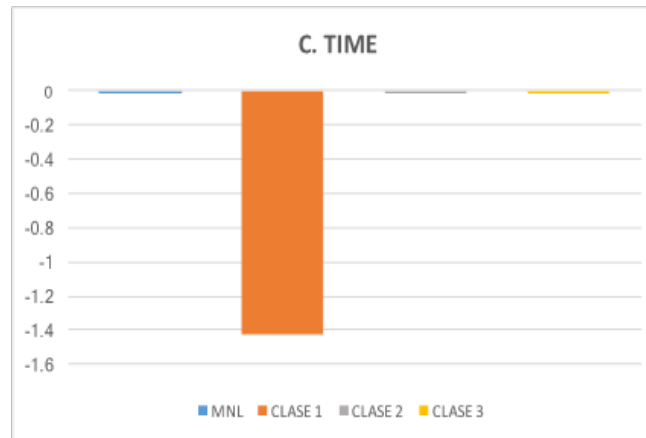
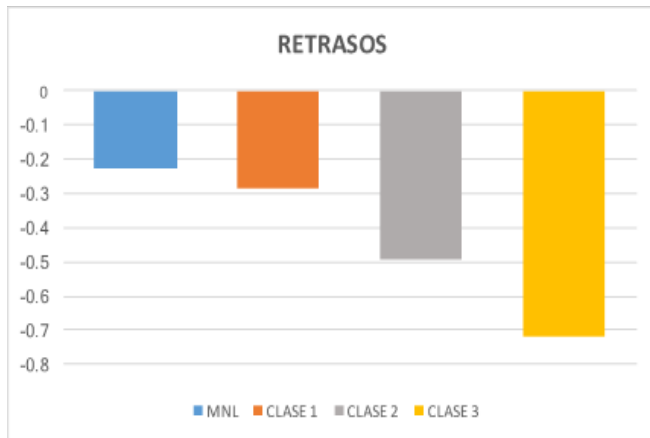
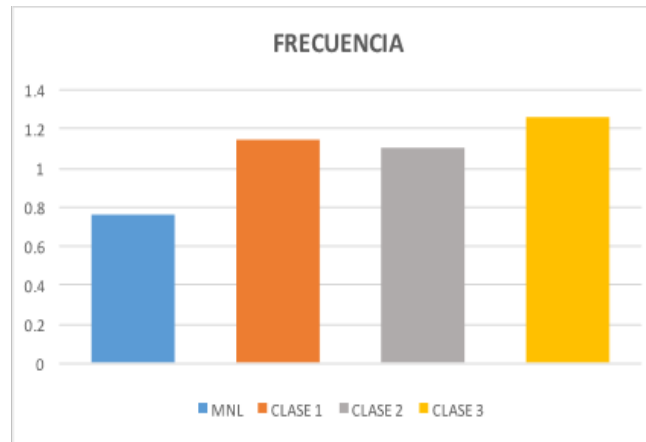
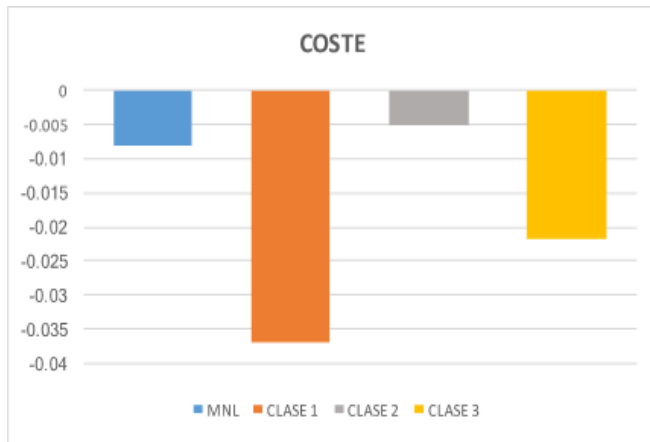
SOCIO-ECONOMICS

- Medium and large companies
- **Low-frequency** shipments

Class 3 (18%)

SOCIO-ECONOMICS

- **Deep sea** destination
- **Small** companies
- **High-value** shipments
- **High-frequency** shipments



RESULTS APPLICATION 2

CURRENT CHOICE	CLASS	AVERAGE COST (€ per shipment)	COST			FREQUENCY		DELAYS		CLOSING TIME	
			-5 €	-25 €	-50 €	+1 weekly sailing	-1 weekly sailing	+1 perc. point	-1 perc. point	- 0.25 days (6 hours)	- 0.5 days (12 hours)
CASTELLÓN	CLASS 1 (share 34.95%)*	936	1.96**	10.16	20.96	12.76	-8.58	3.04	-2.95	3.82	7.77
	CLASS 2 (share 65.63%)*	1,240	0.44	2.21	4.35	16.18	-15.3	7.95	-8.8	-	-
	CLASS 3 (share 50.22%)*	1,625	1.27	6.33	12.6	14.62	-10.93	8.35	-8.28	-	-
VALENCIA	CLASS 1 (share 33.65%)*	1,050	1.69	8.83	18.5	11.12	-7.45	2.63	-2.55	3.3	6.74
	CLASS 2 (share 65.95%)*	1,054	0.45	2.26	4.46	16.7	-15.4	8.17	-8.98	-	-
	CLASS 3 (share 61.05%)*	1,010	1.82	8.75	16.42	18.67	-16.71	11.32	-12.55	-	-

* In parentheses is indicated the quota resulting for the reference alternative in the SP experiment.

** The interpretation of this figure is as follows. In the case of shippers classified in class 1 for which Castellón was the port actually used for their reference shipment, given the SP scenarios proposed in the experiment (base scenario), we obtained that the quota of those who would continue to use their reference alternative was 34.95%, while 65% stated that they would change to the hypothetical alternative proposed. If the cost of the reference alternative were decreased by 5€ the share of those still using the reported transport chain would increase by 1.96 percentage points, from 34.95 to 36,91%.

Class 1 (regional shipments): the variation in Castellon's market share is higher for any of the scenarios considered.

Class 3 (deep-sea shipments): the variation in Valencia's market share is higher for any of the scenarios considered.

CONCLUSIONS

- Port choice study of land-based decision-makers in the ceramics industry
- Capture heterogeneity in preferences using a Latent Class model.
- Identify existing differences in choice criteria between shippers and forwarders.
- Integrated port approach within the chain in the definition of variables.



- More industries to compare results.
- Shipping lines' perspective.
- Link between service supply and trade demand