Equity joint ventures and new partnerships formation in terminal management: a Stochastic Actor Oriented Model

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Background: Terminal management and Equity Joint Ventures

Container terminals are **capital-intensive assets** that require investments for their construction, expansion, and maintenance.

After the privatization and deregulation of the port industry, these strategic assets have increasingly attracted the interest of **International Terminal Operators (ITO)**, who aim to consolidate their market position through horizontal and vertical integration processes.

Equity joint ventures (EJVs) represent the main collaborative scheme in the container terminal management. It offers the opportunity to **diversify risk**, to raise capital, **reduce barriers to entry**, and create **economies of scale**, while establishing a definitive time for the joint venture to exist.

Background: New Approaches of Analysis

The large number of EJVs worldwide generated **complex relationship networks** where each company tries to be engaged in new partnerships for facing international competition.

These complex relationships network has attracted the interest of scholars, and an emerging group has applied the **Social Network Analysis (SNA)** in the study of international terminal operators' corporate strategies.

Parola et al (2014) studied EJVs among 250 ITOs in managing 427 terminal facilities

However, no study until now has investigated the embeddedness of equity joint ventures in **regional and local dynamics**, and specifically in the container terminal industry.

OBJECTIVES

OBJ 1

To provide a new interpretation of TOC as **decision making entities (social structure)**, characterized by strategic choices, relational patterns, seeking to maximize its own performance.

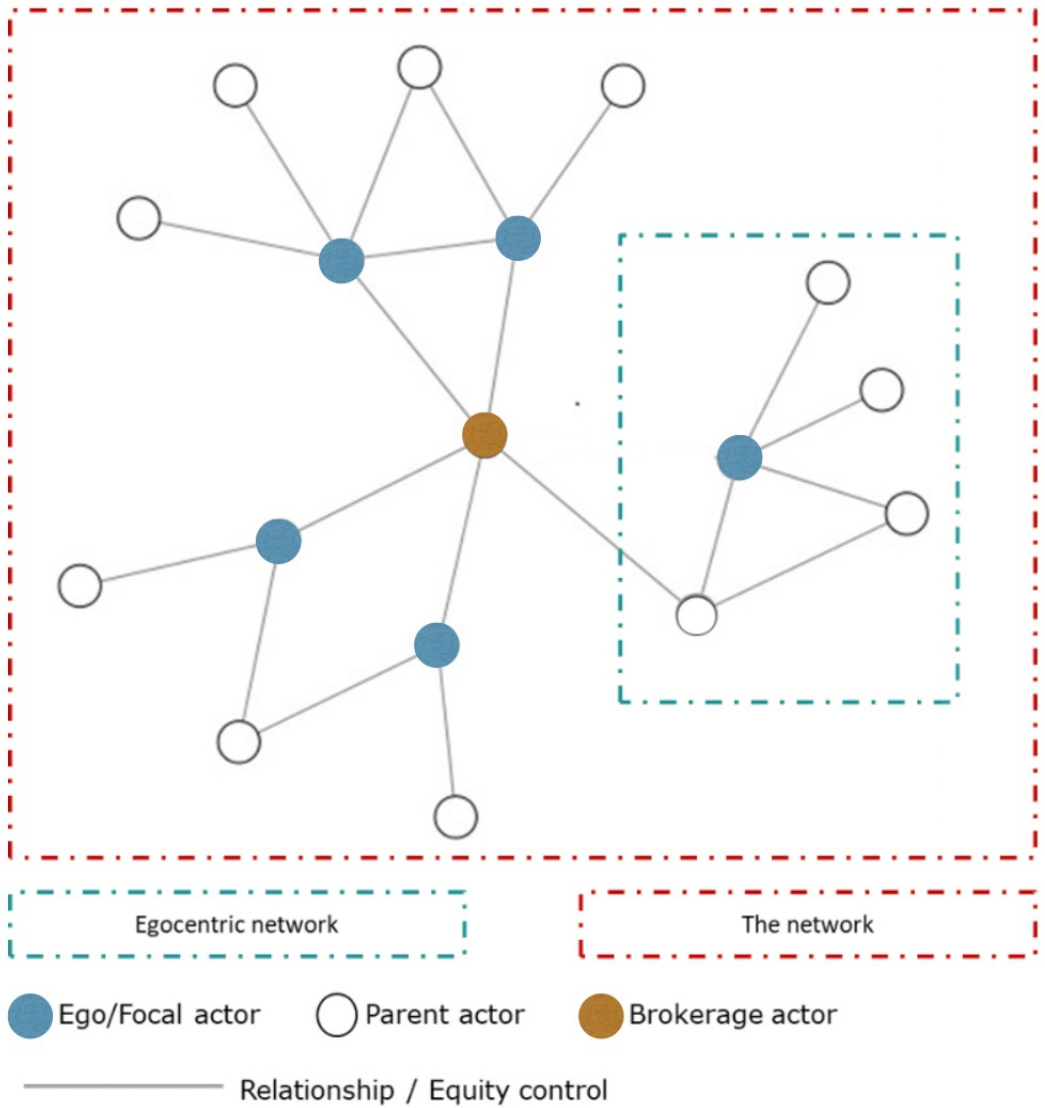
OBJ 2

To investigate factors influencing **strategic choices and relational patterns** of TOCs as result of actors' interactions in the domestic market. Drawing on Network theory, the study focuses on ownership, organizational and operational changes of TOCS in the **Italian container terminal market.**

Network Analysis and Ego-network

Ego network is a portion of the network formed by a single actor (ego) together with the actors they are connected to (alters) and all the links among those alters.

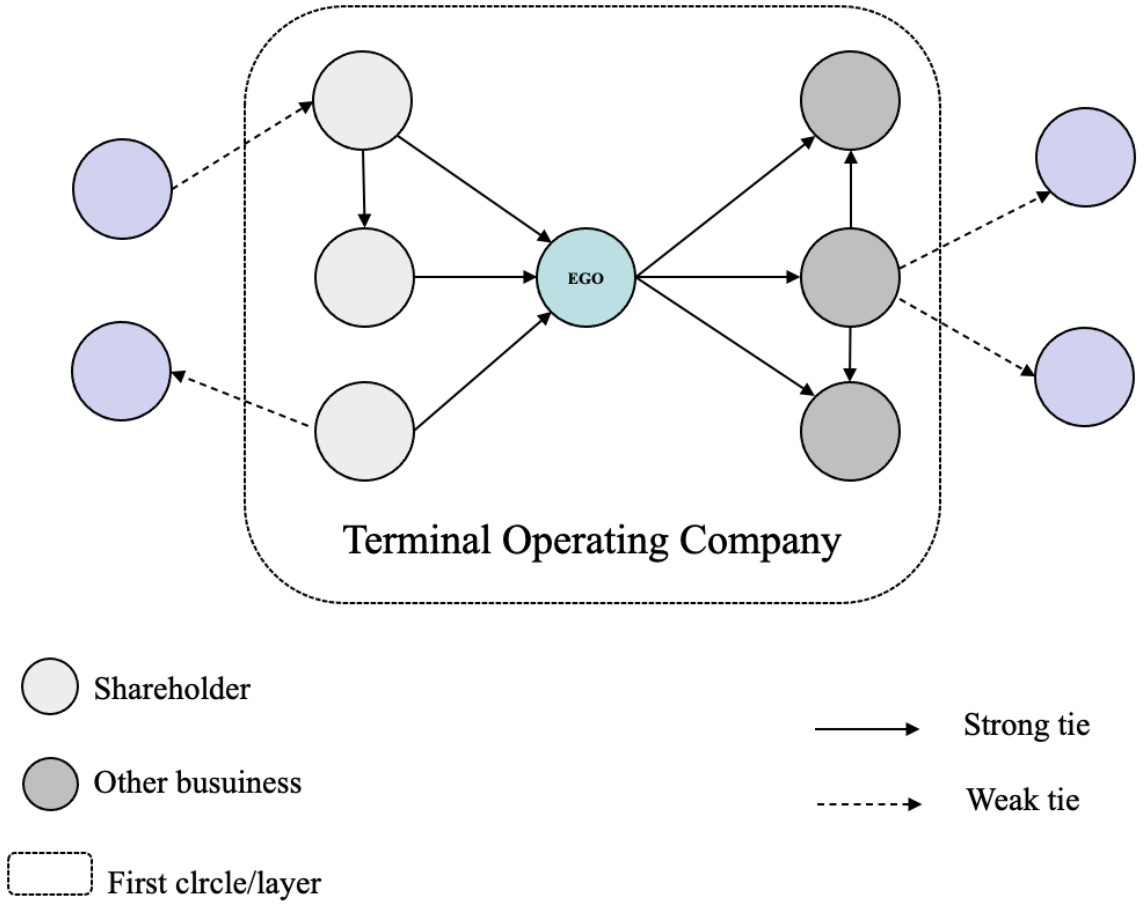
EJV is by definition a dyadic or network-like arrangements (Mainela 2001) as it is a sum of contributions of at least two separate firms.



TERMINAL AS EGO NETWORK

Terminal Operating Company (TOC), as a decision making entities, can be viewed as an Ego network, formed by shareholders together with the actors they are connected to (alters) and all the links among them.

Strong ties exist between close-knit members with frequent interactions.



Methodology: hypothesis development

H 1	Given the size of the network, the density of terminal operator's (ego) network has positive effect on the formation of new partnerships.
H 2a	Terminal operator tends establish new partnerships with partners having resource similarity when pursuing horizontal integration strategies.
H 2b	Terminal operator tends to establish new partnerships with partners having resource complementary when pursuing vertical integration strategies.

The Stochastic Actor Oriented Model (SAOM)

- In order to test the research hypothesis, the dependent variable of the analysis is the **formation of a new partnership (network tie).**

- Networks evolve over time with continuously **emerging and dissolving ties** between the actors (Ter Wal and Boschma 2009). Actor oriented models for network dynamics are a useful instrument for explaining this **dynamic process** and identifying the **driving factors** between two or more discrete time points.

- The Stochastic Actor Oriented Models (Snijders et al., 2010) offer the possibility to test a wide variety of influences on **network changes** and the opportunity to estimate parameters measuring such influences, producing statistical tests to confirm the underlying hypotheses.

The Stochastic Actor Oriented Model (SAOM)

An individual's choice can have three potential outcomes

Creation of non-existing ties	Maintenance of existing ties	Presence of ties regardless whether they are created or maintained
Creation model	**Endowment model**	**Evaluation model**
The change is conditioned to non-existing ties	The change is conditioned to pre-existing ties	A log-probability ratio between the frequencies of present ties on the frequencies of absent ties

The estimated parameters for each effect have to be interpreted as

Formally, **i→j** represents the presence of a tie between actor i and actor j, and i⋯j representing "no-tie". Hence, the following probability expressions can be derived:

The Stochastic Actor Oriented Model (SAOM)

- Evaluation model (Structural properties of the network):

$$\log\left[\frac{\Pr\{(i \to j \mid i \cdots j) \cup (i \to j \mid i \to j)\}}{\Pr\{(i \cdots j \mid i \cdots j) \cup (i \cdots j \mid i \to j)\}}\right]$$

- Creation model (Attributes of the actor):

$$\log\left[\frac{\Pr\{(i \to j \mid i \cdots j)\}}{\Pr\{(i \cdots j \mid i \cdots j)\}}\right]$$

- Endowment model (Attributes of the actors):

$$\log\left[\frac{(i \to j \mid i \to j)\}}{(i \cdots j \mid i \to j)\}}\right]$$

STATISTICAL VARIABLES OF SAOM

Structural properties of the network

Network Density	*Indegree*
The global propensity to establish relationships	The ego attitude to receive relationships
Outdegree	*Transitivity*
The ego propensity to establish relationships	The general propensity to build chains of relationships

Attributes of the actor

Firm's Activity *Covariate* for homophily	*Interaction* between kinds of Transitivity and Activity
The attitude of similar actors to establish relationships	The propensity to build chains among similar or different actors

METHODOLOGY: UNIT OF ANALYSIS AND DATA

Unit of Analysis

The terminal operating company in the Italian container terminal industry.

There are 25 terminal operators in 2011. In 2015, Taranto Container Terminal (TCT) - the transhipment hub for the liner shipping Evergreen – closed due to, the lack of dredging and infrastructural investments. Thus, the number decreased to 24 terminal operators.

Dataset

Secondary data sources: company's balance sheet in two years (2012 and 2016) and in particular collecting all the information relating to shareholders, participations and investments made in other business activities.

The relational dataset has been completed by using complementary data provided by port and maritime transport journals (Containerization International, Ship2Shore, Informare, Drewry, and Port Technology).

METHODOLOGY: THE CONSTRUCTION OF RELATIONAL DATA

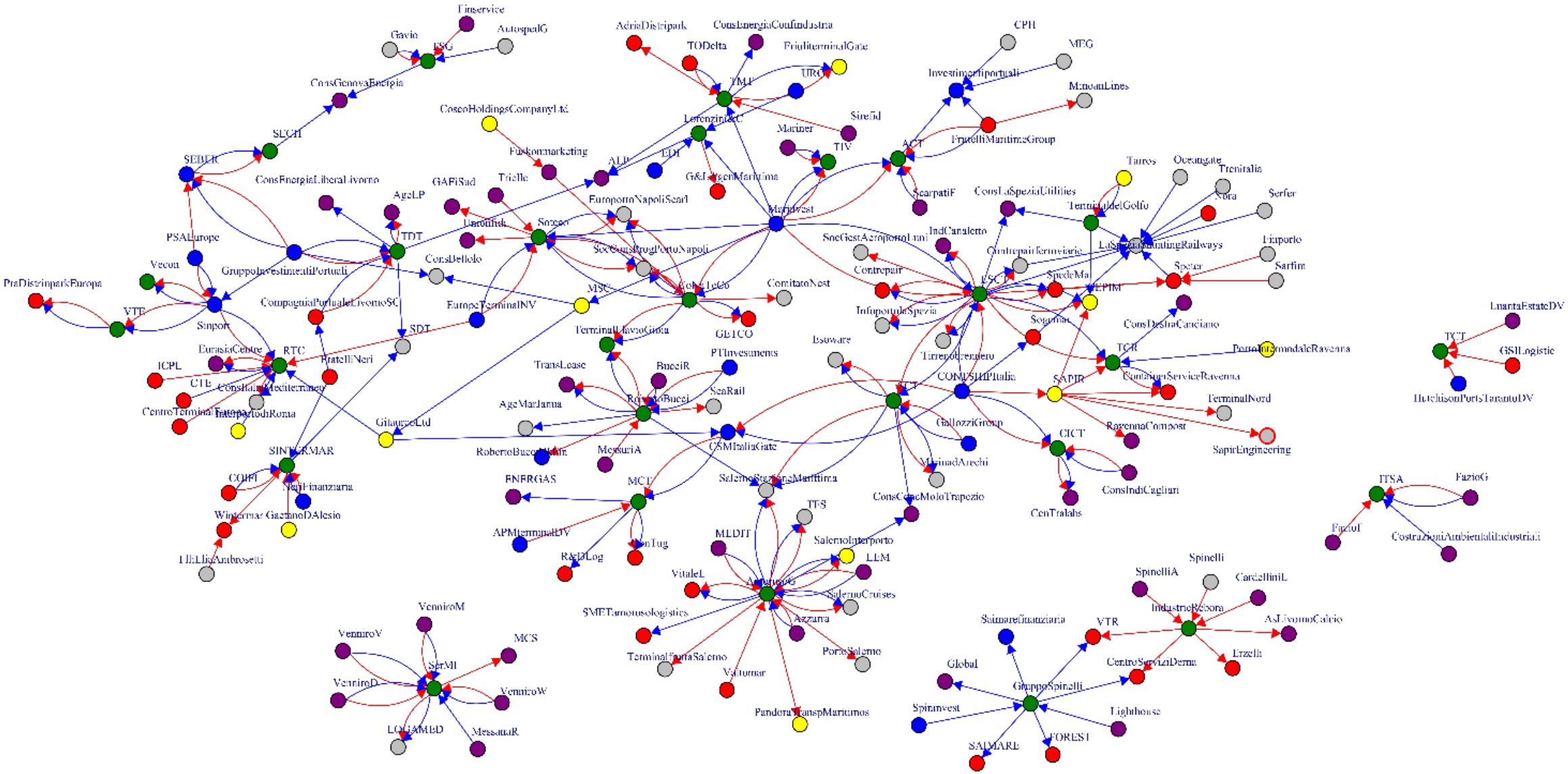
The data frame consists of two waves of relational data arranged in two adjacency matrices, A2011 e A2015, conformed to have equal size (166 X166); a factor variable, constant throughout the waves, grouping actors running same activities, with the following frequency distribution.

1-Terminal	2-Freight-Shipping	3-Logistic	4- Transport	5-Financial	6- Other
27	*12*	*30*	*35*	*19*	*43*

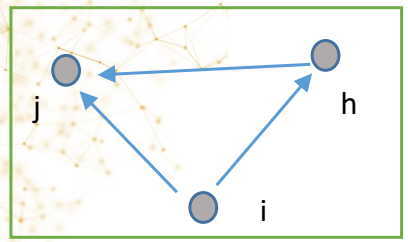
Frequency distribution of activities

The Whole Network Representing the Two Waves

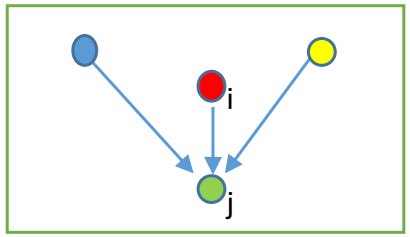
(*2011: red ties and 2015: blue ties*)



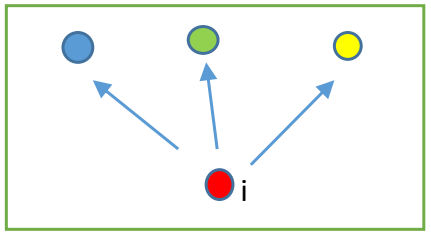
HYPOTHESIS TEST: THE SAOM



a) Transitive triplets



b) Indegree Popularity from different activity



c) Outdegree towards different activities

Estimated Effects in Model 1 (a) and Model 2 (b, c)

Network effect	**Model 1**		**Model 2**	
	θ	**(S.E.)**	***θ***	**(S.E.)**
Rate parameter	1.20	(0.15)	1.31	(0.17)
Outdegree (density)	-3.56	(0.26)	-4.51	(0.42)
Transitive triplets	2.71	(0.87)	--	--
In-degree pop. from dif. Activity			0.28	(0.12)
Out-degree act. to dif. Activity			0.30	(0.10)
Overall maximum convergence ratio	*0.04*		*0.05*	

Estimated models with parameters θ for A2011 and A2015; Standard errors and overall convergence ratio

Results: Research Hipothesys

Hypothesis H1 is verified

- There is a tendency of few TOCs, with high density, to create new equity ties (outdegree) in the second wave.
- There is a tendency to close the network and, thus, to establish triangulation relations.

Hypothesis H2a is not verified

- The shareholders of the Italian TOCs belong from different businesses.
- The Italian container terminal industry shows a low “interest” of International terminal operators to invest in the market.

Hypothesis H2b is verified

- TOCs tend to build supply chain relationships (vertical integration) with network actors belonging to different an complementary business respect to the terminal business.

CONCLUSIONS

Stochastic Actor Oriented (SAO) Model to the Italian Container industry represents a micro-analytical approach that contributes to shedding light on terminals' terminals' ownerships and organizational structures as well as power positions that other studies have partially addressed.

While data show a supply fragmented in a plurality of ports, in reality the Italian container port systems is characterized by leading positions of a few players that control the market.

The issue is of crucial importance and deserve attention from the Public and Port Authorities with reference to terminal concession policy and to the regulation of free market competition.

FUTURE STEP OF THE RESEARCH

- The analysis of subsequent waves such as 2019 and 2021 will make a significant contribution both to the analysis of network evolution and the shocked caused by the Covid-19 emergency.
- Increasing the level of the analysis at the European level can offer more useful insights as it will be possible to find further links among the actors and, therefore, to better identify leading and power positions in the network.
- Finally, the quantification of the performance (economic, financial and logistics) and market shares need to be combined with social and environmental sustainability in order to address “value distribution” at local and regional levels.

Grazie

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