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The Effectiveness of Port-City Policies: A Comparative Approach

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ABSTRACT

The relation between ports and their cities have evolved: it is no longer evident that well-functioning ports have automatically a net positive impact on the port-city. There are various trajectories and many ports and port-cities attempt to stimulate port-city development by a range of public policies. Yet, little is known about effectiveness of policies to promote performance of ports and port-cities. This paper aims at filling this gap, by assessing the effectiveness of port-city policies, within various policy areas including port development, port-city economic development, transportation, environment, research and development, spatial development and communication. This is done via a principal component analysis (PCA), based on a database constructed for the purpose of this paper with outcome variables and scores of policies for a set of 27 large world port-cities, that makes it possible to identify policies that are associated with effective policy outcomes and show patterns of related policy outcomes and policies.

Keywords: port-cities, port development, transportation, principal component analysis, policy evaluation

JEL Classification: R42, L98, C38

FOREWORD

This working paper is one in a series of *OECD Working Papers on Regional Development* published by the OECD Public Governance and Territorial Development Directorate. It forms part of the *OECD Port Cities Programme*. This paper was written by Olaf Merk, (Administrator, OECD Port-Cities Programme, Paris, France) and Thai-Thanh Dang (Consultant to the OECD).

The paper can be downloaded on the OECD website: www.oecd.org/regional/portcities

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EXECUTIVE SUMMARY

There is a lack of studies on effective port-city policies; this report wants to fill this gap. Many ports and port-cities try to stimulate port-city development by a range of public policies. Yet, little is known about effectiveness of policies to promote performance of ports and port-cities. This paper assesses the effectiveness of port-city policies, via principal component analysis (PCA), based on a database constructed for the purpose of this paper with outcome variables and scores of policies for a set of 27 large world port-cities.

The most effective port-city policies are transportation and R&D-policies. Port policies are effective in stimulating high port traffic performance. Performance in this context is characterised by high standards in traffic volumes, port efficiency, and port connectivity as a central and diversified node. Policies focused on transport and research and development (R&D), are found to be effective in stimulating port growth and port-city development. Port-city prosperity mostly relies on high value-added and employment level generated by the port. Such features are likely to be prone to high transport density network and innovation, but also to negative externalities as CO_2 pollution.

Policies aimed at creating port-city synergies are found to be relatively ineffective in achieving both high port performance and city prosperity. City prosperity seems to be directly fuelled by port activity via port-related value-added activities and employment, but not so much by port-city policies. Spatial and communication policies also have mixed results in this respect.

Policy effectiveness in highly successful port-cities could possibly be increased by focusing even more attention to transportation policies, one of the most effective policy areas. These cities are generally characterised by high scores across all policy areas. Port-cities with average to least performing policy packages, by contrast, would benefit from moving their policy efforts towards the benchmark within the policy areas where they are the least performing, or focusing on the policy areas where public intervention is most effective, such as port development, transportation and R&D.

1. INTRODUCTION

Port-city relationships have evolved. In many places, the port and city have to a certain extent become disintegrated: ports have gradually or radically grown out of cities (towards the sea), logistics functions have moved land inwards, leaving the port-city with less direct economic impacts, but still with various negative impacts, including on air quality, water, waste, noise, odours and traffic. Containerisation, globalisation and consolidation of the terminal industry, port concentration and the growth of global cities have intensified this challenging relationship between ports and cities. In many cases, old port areas are transformed into urban waterfront, with more or less involvement of port functions in it.

The current state of port-city relations is diverse, but port-cities have one common challenge: to increase the net positive impacts from their ports. This diversity of port-city relations is determined by the relative weight of the port vis-à-vis the city, the spatial constellation of the port (in or outside the city centre) and the development perspective of the city. The common challenge of many port-cities is what we have labelled the local-global mismatch (Merk 2013): many of the economic benefits of ports spill over to other regions, whereas many of the negative impacts are highly localised. The various OECD Port-Cities case studies have illustrated this mismatch quantitatively; e.g. more than 90% of the indirect economic impacts of the ports of Le Havre and Hamburg are taking place in other regions than the port region itself (Merk et al. 2011; Merk and Hesse 2012).

Effective port-city policies might be needed to solve these challenges. A meta-assessment of port impact studies illustrates the large differences between ports with regards to the value added (of the port cluster) per tonne of port cargo, as well as large differences with respect to port-related jobs per tonne of port cargo (Merk forthcoming). Some ports are much more successful than others of generating value added and employment. Although there might be a large range of factors influencing this relation between port cargo and value added and jobs, one might assume that public policies can also contribute to (or discourage) the generation of port-related value added. So the question is: to what extent can public policies help to increase the performance of port-cities?

There is a large demand for knowledge and assessments of effectiveness of port-city policies, but the amount of policy-relevant knowledge is limited. This demand can be illustrated by the appearance of reports on port policies driven by the ports sector, in particular the European Seaports Organisation (e.g. ESPO 2012) and International Association for Ports and Harbors (IAPH) in policy areas such as green port policies, environmental management and renewable energy in ports. The great popularity of the conferences of the International Association of Cities and Ports (AIVP) is another indication. At the same time, there is disappointedly little academic literature on the effectiveness of port-city policies, as is indicated in section 2 below. This paper wants to fill this gap.

2. LITERATURE REVIEW

There is a large and rapidly growing body of academic literature on ports, as illustrated in the overview studies of the port-related articles in academic literature (Pallis et al. 2010; Pallis et al. 2011). However, the literature that specifically deals with the relationship between ports and cities is relatively rare. Issues that have been treated are port impacts on cities, spatial relationships between ports and cities, port-city economic trajectories, port-cities in history and a large amount of case studies of specific port-cities. What is striking in most of this literature is the absence of description and assessment of port-city policies.

There are only a few assessments of specific policy instruments. There is some literature on port pricing policies, but most of this literature is theoretical rather than practical. There are articles on port labour markets, but these focus more on institutional mechanisms rather than public policy tools. However, there are exceptions; e.g. the effectiveness of port gate strategies and truck retirement programmes in US ports have been well analysed and documented (Bishop et al. 2011, Lee et al. 2012, Dallmann et al.. 2011, Norsworthy and Craft 2013); the effectiveness of some maritime cluster policies has been assessed (e.g. Doloreux and Shearmur, 2009), as well as environmental port dues (Swahn, 2002), onshore power (Arduino et al. 2011) and waste reception facilities (De Langen and Nijdam, 2007). However, most reports on port and port-city policies are not coming from the academic domain, but have been written by international organisations, such as World Bank (The Port Reform Toolkit), ILO, IMO, European Union and OECD (OECD 2011, Merk 2013).

As far as we know there does not exist a systematic assessment of port-city policies, let alone from a comparative approach. The studies referred to above look at a limited set of policies and policy instruments, in many cases only for one particular port or port-city. As such, they do not respond to the demand from port and port-city policy makers for systematic overviews of instruments and their comparative effectiveness. The aim of this paper is to fill this gap and provide an overview of policy instruments and their relative effectiveness.

3. METHODOLOGY: PRINCIPAL COMPONENT ANALYSIS

The objective of the methodology is to provide a framework for exploring the following issues: i) identifying the links between port and city on the basis of quantifiable outcomes; ii) assessing policy effectiveness in achieving such outcomes; and iii) highlighting emerging patterns of various policy instruments taken as a whole. The principal component analysis (PCA) is an appropriate methodology to explore these issues. This data analysis technique is often used in opinion polls or surveys. It allows to measure key correlations for a set of indicators, shows the direction of the correlations, and summarises the various indicators into a limited number of interpretable factors. As such, this technique would enable to derive good summary indicators (e.g. factors) to address the multidimensional aspect of port and city outcomes, identify ports which are performing along these factors, highlight policy effectiveness by comparing port performance to port policy scoring, explore the links between policy scores across different policy areas. The paragraphs below provide a formal explanation of the methodology.

3.1 The principal component analysis (PCA)

Formally, the PCA condenses the information contained in a set of indicators into a smaller number of uncorrelated principal components, which are linear combinations of the original indicators. If X is a (n,p) matrix of n countries and p indicators, the first principal component (eigenvector) v1 is obtained by maximising the variance explained $v_1'X'X\ v_1$ under a normalisation constraint $v_1'v_1 = 1$. The second principal component is obtained by maximising $v_2'X'X\ v_2$ under the normalisation constraint $v_2'v_2 = 1$ and the condition that it is orthogonal to the first principal component $v_1'v_2 = 0$. Other principal components are derived in the same way. It can be demonstrated that v1 corresponds to the eigenvector associated with the largest eigenvalue of the covariance matrix X'X, v_2 to the eigenvector associated with the second largest eigenvalue and similarly for the other principal components. The eigenvalues represent the percentage of variance explained by each principal component and the p elements of the eigenvectors reflect the weights attributed to each indicator in the calculation of principal components.

The circle of correlations is a standard way to illustrate the relations between principal components and indicators. The correlation coefficient between indicator i and principal component j is derived as $\sqrt{\lambda_j}.v_{ij} / \sigma_i$, where λ_j is the eigenvalue associated with principal component j, v_{ij} the component of eigenvector j corresponding to variable i and σ_i the standard deviation of variable i. These coefficients – sometimes referred to as factor loadings – are reported in the correlation circle.

The variables which exhibit the strongest correlations with the principal components, and hence have most weight in this analysis, are represented close to the circle. Variables situated in the centre of the circle have little significance on the dimensions identified by the principal components – they are little correlated with most of the other variables. Country coordinates on principal components can be computed using the relevant eigenvectors v_j to weight indicator values, showing how countries score relative to each other on the dimensions associated with the axes.

However, a major limit of the PCA analysis is that it is deterministic. The links across variables are simply derived from observed data and the results are very sensitive to the sample and the ports considered. As for opinion polls, the sample should ideally be representative of worldwide ports. An improvement of this method would be to introduce stochastic effects for testing the significance or the robustness of the estimated links.

3.2 How to interpret results from a PCA analysis?

Interpreting the factors with the correlation circle: Factors, summarising multi-dimensional data, are derived from the PCA analysis. The factors are meant to capture the maximum differences across ports. They are built as a linear combination of a subset of indicators. The factor interpretation thus depends on the respective contributions of the indicators. The higher the contribution, the more representative is the indicator. The many the indicators, the more they are correlated (positive or negative correlation depends on the sign of the contribution). The more indicators contribute to different factors the more they are independent or uncorrelated.

Interpreting the graphs plotting port outcomes and policy scores: The graph plotting individual ports along these factors helps i) identifying groups of ports with similar features and ii) characterising these features along the interpreted factors. In addition, plotting policy scores of individual ports indicates to what extent the policy scores are related to the main features of each group. For example, a group of ports characterised by high policy scores and high performing port outcomes in terms of say, traffic volumes and growth, would indicate that the policy is likely to be effective in achieving such goals. If not (e.g. associated to lower port activity outcomes or lower policy scores) the policy is thus likely to be considered as ineffective.

4. DATASET: POLICY AND PERFORMANCE INDICATORS

The main challenges in building the dataset were to identify an appropriate set of indicators measuring port-city outcomes to be achieved by policy actions and, to provide a framework to evaluate current policy settings relative to a benchmark of best practices.

4.1 Policy indicators

Policy areas and policy instruments were identified on the basis of a series of place-specific case studies that were conducted within the framework of the OECD Port-Cities Programme (publicly available on www.oecd.org/regional/portcities), as well as additional port-city profiles that will be part of the OECD publication "The Competitiveness of Global Port-Cities" (OECD, forthcoming). Table 1 summarises the different instruments considered.

One of the main contributions of this work relies on the framework used to construct policy indicators. These latter are meant to reflect an evaluation of current policy settings relative to a benchmark of best practices. An important issue was thus to identify best policy practices and evaluate current policies, in terms of gap or progress to be made with respect to this benchmark. Current policies are thus assigned an ad-hoc scoring assessment agreed by both experts and the OECD secretariat. The scores are defined along the following criteria:

- Extent to which the policy instruments in question are considered to be a "best practice" by policy practitioners in the field.
- Effectiveness of these policies, as far as this has been evaluated
- Seriousness of the policy effort (how long has the instrument been in place),
- The number and variety of policy instruments in the area, relative to the instruments applied by other port-cities

The first element is based on approximately 50 responses to a questionnaire sent out by the OECD secretariat to port-city policy makers worldwide asking for best practices within a detailed sub-set of policies. The last three elements are assessed on the basis of a series of place-specific case studies that were conducted within the framework of the OECD Port-Cities Programme (currently ten of these case studies are publicly available, as well as additional port-city profiles that will be part of the OECD publication "The Competitiveness of Global Port-Cities" (OECD, forthcoming). Based on these four criteria, policy areas in specific port-cities were scored ranging from a score A (for policies considered to be among the best practices, with respect to effectiveness, seriousness, comprehensiveness and variedness), score B (for policies that be considered to score above the average standards in the field, without being the best practice), score C (for policies that be considered to score slightly below the average standards in the field) to score D (considered to be policies that in comparison to those of peer port-cities lag with respect to effectiveness, seriousness, comprehensiveness and variedness). The collection of the policy outcomes and policy scores was conducted for a selection of 27 large world port-cities from OECD countries, plus Singapore and China, in order to represent the major ports and port-cities of the world.

Table 1. Main port-city policy areas and instruments

Policy areas	Policy instruments
Port development	Long term strategic port planning Modernisation of port terminals Port information systems Industrial development policies on port site Development of new port functions Port labour relations Upgrading port workers' skills
Port-city development	Creation of maritime clusters Attraction of port-related headquarter functions Economic diversification policies Creating synergies between port and other clusters Coordination between ports Cooperation with neighbouring port-cities
Transport	Intermodal access of hinterlands Modal shifts of hinterland traffic Dedicated freight lanes/corridors
Research and innovation	Innovation policy to improve port performance Fostering local research related to the port sector Attraction of port-related research institutes Attraction of innovative port-related firms Logistics related innovation systems
Spatial development	Port land use planning Common master plan for port and city Waterfront development Urban regeneration of old port and industrial sites Integral coastal/river management
Environment	Emission reduction policies Climate change adaptation policies Renewable energy production in the port Energy efficiency policies Waste reduction policies
Communication	Port communication and information Maritime museums Waterside leisure and recreation Cultural projects related with port Port as part of global city-brand

4.2 Port-city performance indicators

On this basis, port-city indicators were selected so as to reflect or approximate policy goals to be achieved across different policy areas. The policy areas covered are ranging from port development, port-city development, transport, research and development, spatial development, environment and communication as described in Table 2. Various sources are used as indicated in the table below.

Table 2. Main port-city outcome indicators

Policy areas	Outcome Indicators	Data source
Port development	Port throughput 2009 (million tonnes) Port throughput containers 2009 (million TEUs) Growth port throughput (1971-2009) Growth port throughput TEUs (2001-2009) Value added port area (million USD) Efficiency index Maritime connectivity (degree of centrality) Maritime connectivity (clustering coefficient) Diversity maritime connections (diversity in vessel movements)	Own data based on Journal de la Marine Marchande Ibid. Ibid. Own data based on Merk (forthcoming) Own calculations based on data from Lloyd's Marine Intelligence Unit. Ibid. Ibid.
Port-city development	Metropolitan GDP per capita 2008 (USD, constant real prices, year 2000) Growth metropolitan GDP per capita 2000-2008 (USD, average annual growth) Metropolitan population 2008 Metropolitan population growth Port related employment (including direct and indirect port-related employment) Port-related labour productivity (ratio of port related employment and value added port area) Unemployment rate (2008)	OECD Metropolitan Database Ibid. Ibid. Ibid. Own data based on Merk (forthcoming) Own data based on Merk (forthcoming) OECD Metropolitan Database
Transport	Motorway network density (km/1000 km^2) Railroad network density (km/1000 km^2)	Data from Eurostat and various national statistics bureaus.
Research and innovation	Total patent applications in region (TL3, 2005-2007) Patent applications in shipping sector (2005-2007) Number of articles in port research journals (1995-2011)	OECD Patent Database Ibid. Own data collection, summarised in Merk 2013
Spatial development	Land surface of port (km^2) Urbanised area (km^2)	Own data collection based on port data OECD Metropolitan Database
Environment	CO_2 emissions per capita (tonnes per inhabitant, 2005) Population exposure to $PM_{2,5}$ (annual average 2005)	OECD Metropolitan Database OECD Metropolitan Database
Communication	Number of Twitter followers (31/1/2013)	Own data collection

5. MAIN RESULTS: WHAT ARE EFFECTIVE PORT-CITY POLICIES?

This section assesses the effectiveness of port-city policies by confronting policy outcomes with policy instruments in five different policy areas: port development, port-city development, transportation, environment, and a last category that includes R&D, spatial development and communication.

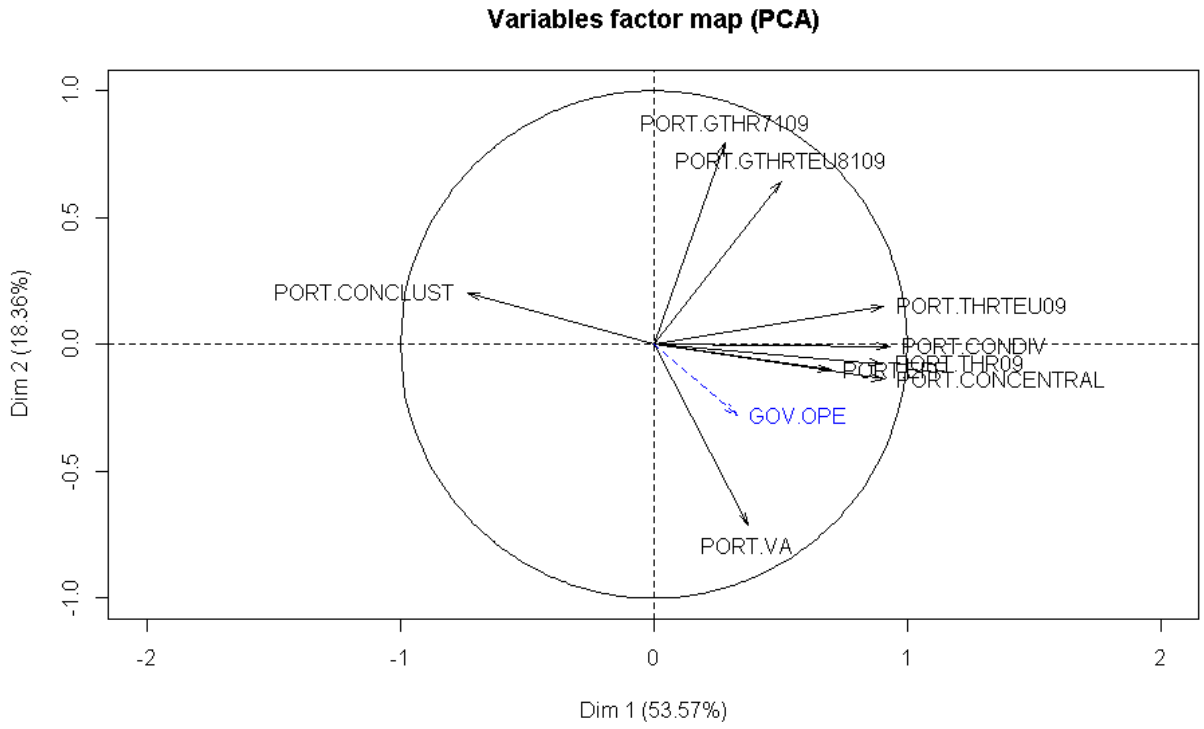
5.1. Port policies

The characteristics of port activity is captured by a set of indicators, which includes traffic volumes and growth, for both total throughputs and containers, value-added generated at the port level and productive efficiency (e.g. efficiency of a port as a producer). It also includes connectivity indicators measuring port centrality (e.g. port is a central node), diversity (e.g. based on observed vessel movements) and clustering (e.g. port connection with neighbouring ports) within the sea port network. The PCA analysis shows that port performance can be broadly summarised along two factors, one focusing on traffic volumes and another on traffic growth, as shown by the correlation circle (see Figure 1 below). Both dimensions capture 72% of overall differences of port activity across the sample.

Ports with high traffic volumes are found to be highly centrally and diversely connected. The traffic volume factor reflects 54% of the main differences across ports. On the right hand side of the factor, ports are characterized by high traffic volumes in total throughput (PORT.THR09) and containers (PORT.TEU09). These are both correlated to high port efficiency (PORT.EFF) and port connectivity, as a central (PORT.CONCENT) and diversified (PORT.CONDIV) node. At the left hand side, smaller traffic volumes are generally correlated to connectivity based on port connection with their neighbourhood (PORT.CONCLUST).

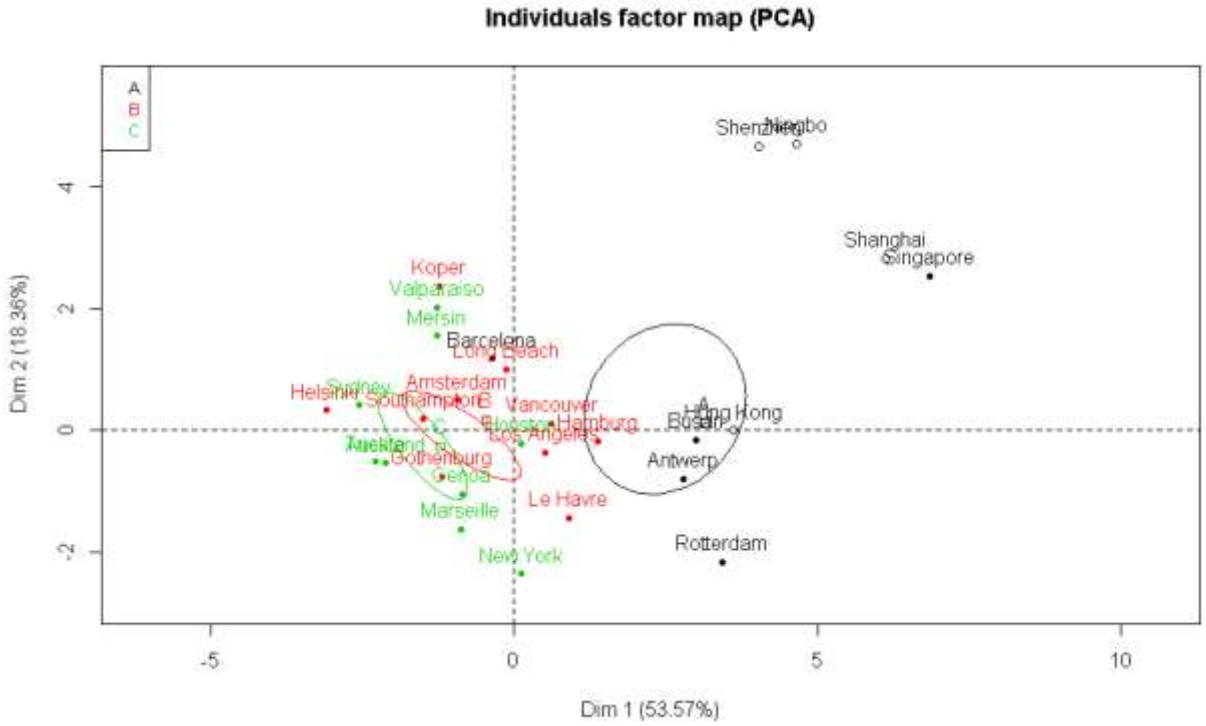
High traffic growth is not a source of port value added, and is uncorrelated to the level of port traffic volumes. The growth traffic factor mainly reflects about 18% of the differences across ports in the sample. On the upper side, both total and containers traffic growth are found correlated. On the downside, ports with high value added are characterised by implicitly relatively low traffic growth. Port competition is mostly found in ports with relatively high levels in traffic volumes and value added. A governance competition proxy, measured by the number of port container operators (GOV.OPE), is used as a control of the analysis. Indeed, the correlation circle indicates that high number of operators is rather found in situations with both high levels in traffic volumes and value added. The control variable is plotted as a supplementary[1] variable.

Figure 1. Correlation circle of port performance



Port policies are found to be effective in achieving high cargo handling volumes of ports. Port policies are focused on promoting volume growth in ports. They include a wide range of actions ranging from planning long-term strategic development, developing activities on port sites, new port functions, port information, modernising port-terminals, good labour relations and upgrading skills (see Table 1). As shown in Figure 2 best practice policies are mostly found in ports with by highest traffic volumes both marked by high value added (e.g. Rotterdam and Antwerp) or strong growth (e.g. the Chinese ports like Shenzhen, Ningbo, Shanghai, and Singapore). Policies with lower scores are usually associated to the lower traffic volumes (centre to left hand side). Both policy groups are not significantly different as seen from the confidence ellipses[2] in the figure, suggesting that the impact of policies on port performance is mixed. However, a large majority of ports fall within this mid-range policy category.

Figure 2. Port performance and policy: individual port features



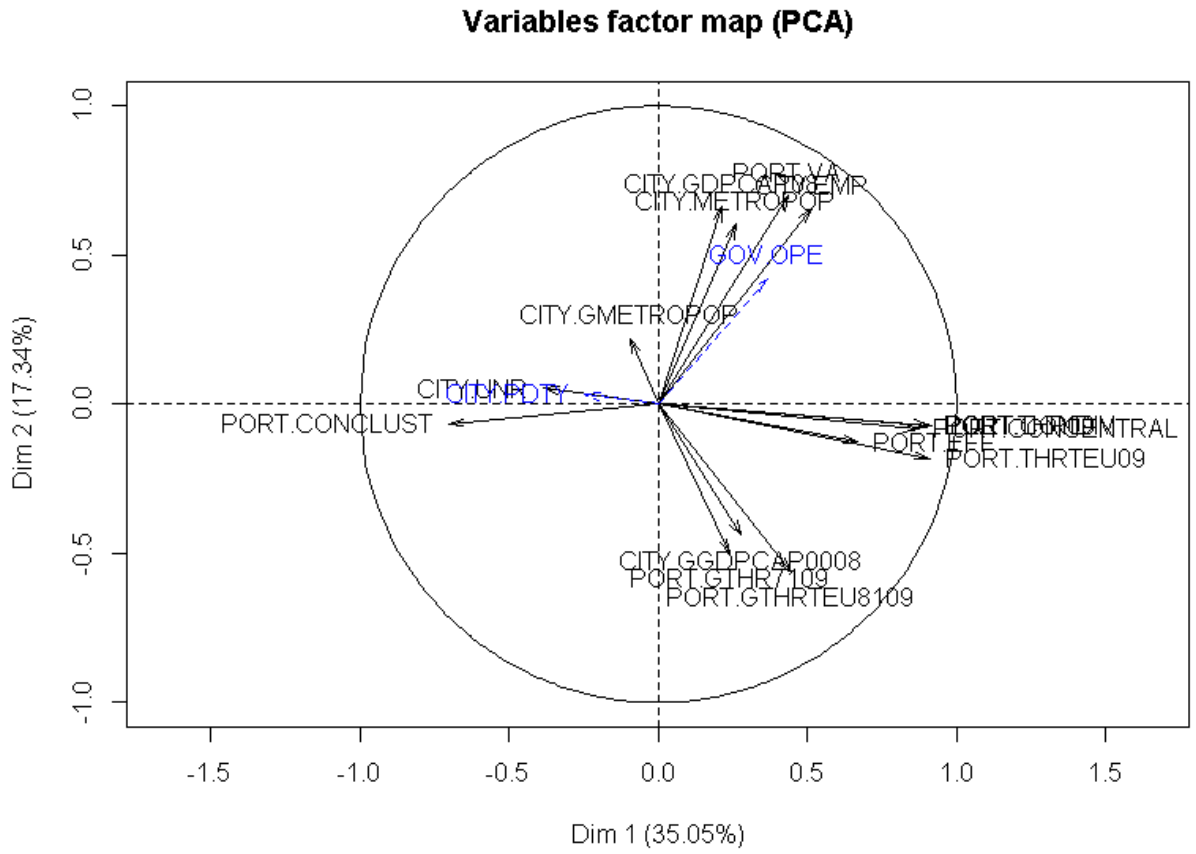
In sum, port performance can be summarised by high traffic volumes and high connectivity (central and diversified) on one side, and strong traffic growth or high value added on the other side. However, whereas strong growth in traffic is uncorrelated to volume of traffic, it is often associated to lower value added for the port. Performing ports, especially in terms of high port volumes, are generally marked by best practice policies. In this respect, such policies are found to be effective while for the large majority of ports at distance from this policy benchmark, additional policy efforts may be beneficial.

5.2 Port-city policies

The development of port-cities is analysed in relation to its port activity. As such, two sets of indicators are considered, one related to the port development as describe earlier, the other related to the development of the city. The city indicators include metropolitan population size and revenue per capita, both in level and growth, unemployment rate, and more specifically related to port, direct and indirect port employment, and labour productivity of the port. Differences in port-cities and port activities are captured by two factors, one broadly reflecting port traffic and the other, the prosperity of the city. Both dimensions reflect 52% of overall differences across ports.

Port traffic volume remains the main feature differentiating port-cities. This factor captures 35% of overall port-city differences. As for the port performance, this dimension reflects the link between port traffic volumes and connectivity (centrality and diversity), as mentioned above. Prosperity of port-city is correlated to high value-added of the port and high port employment, but less to port volume growth. The prosperity of the city-factor captures an additional 18% of port-city differences. On the upper side, high GDP per capita (CITY.GDPCAP) is mostly found in big port-cities with a large population size (CITY.METROPOP), and where ports generate high value-added (PORT.VA) and employment (PORT.EMP). On the down side, cities with lower GDP per capita are mostly associated to sustained traffic growth at the port level (PORT.GTHR0109, PORT.GTHRTEU8109) and strong GDP per capita growth (CITY.GGDPCAP). Interestingly, such a result highlights an existing trade-off between port traffic growth and port value-added and their different implications on port-cities. Port volume growth is not directly benefitting port-cities. Port traffic volume and city prosperity are contributed to separate factors and are thus uncorrelated. However, port-cities may combine both characteristics when located on the upper right quadrant of the correlation circle.

Figure 3. Correlation circle of port-city and port development



The range of policies considered, mostly cover measures focused on reinforcing synergies between the port activity and the city. Such measures include attracting port related headquarter functions, creating maritime clusters and synergies between port and other clusters, coordinating ports and cooperation with neighbouring port-cities (see Table 1). Port-city policies would be considered as effective if high policy scoring mostly focused on prosper port-cities.

Port-city policies are unlikely to be effective in bringing port activity benefits into the city. As shown in figure 4, best practice policies are somehow associated to ports with high traffic volumes but not the most prosperous port-cities. Similar findings apply to lower policy scoring. Wealthy port-cities, such as New York, Los Angeles or Huston, are characterised by C to D-score indicating relatively weak policy efforts in mutualising the benefits between port and city. However, big cities such as New York and Los Angeles, city wealth may rely on other sectors (e.g. industries or services) but maritime activities.

Figure 4. Port-city policies and city prosperity (1)

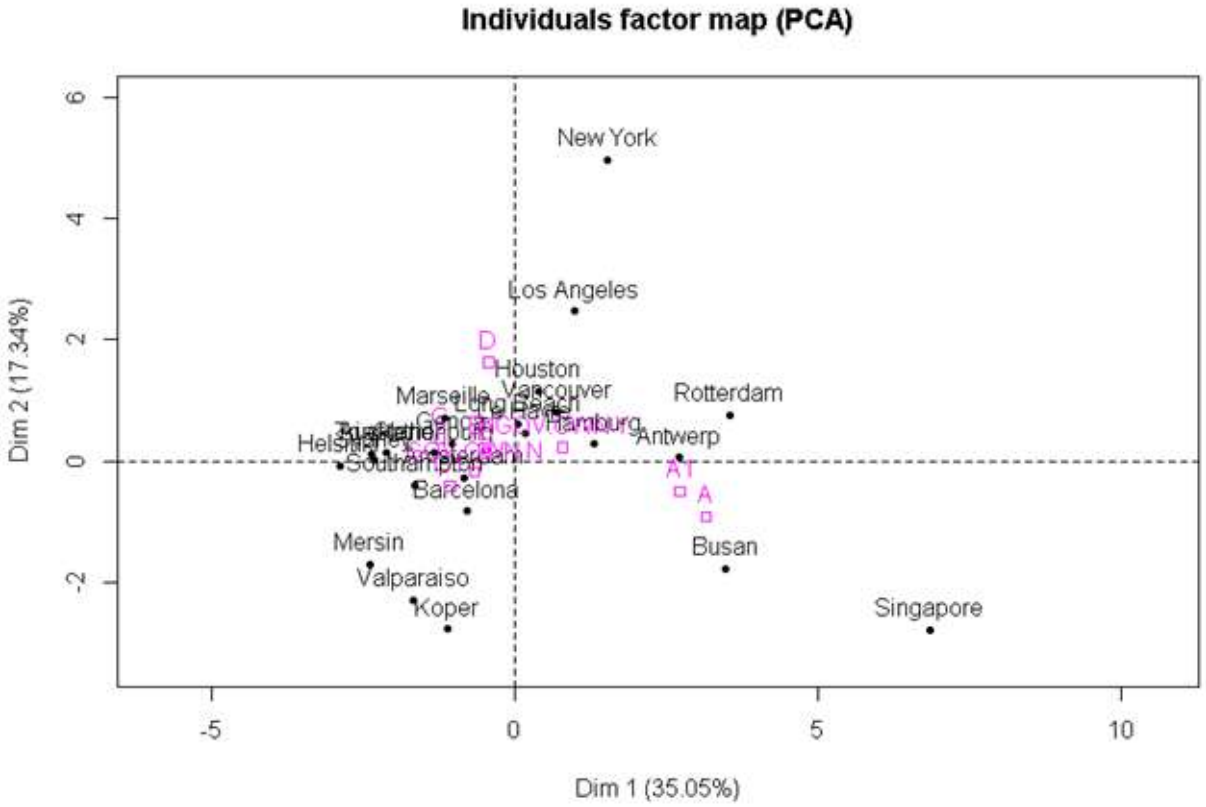
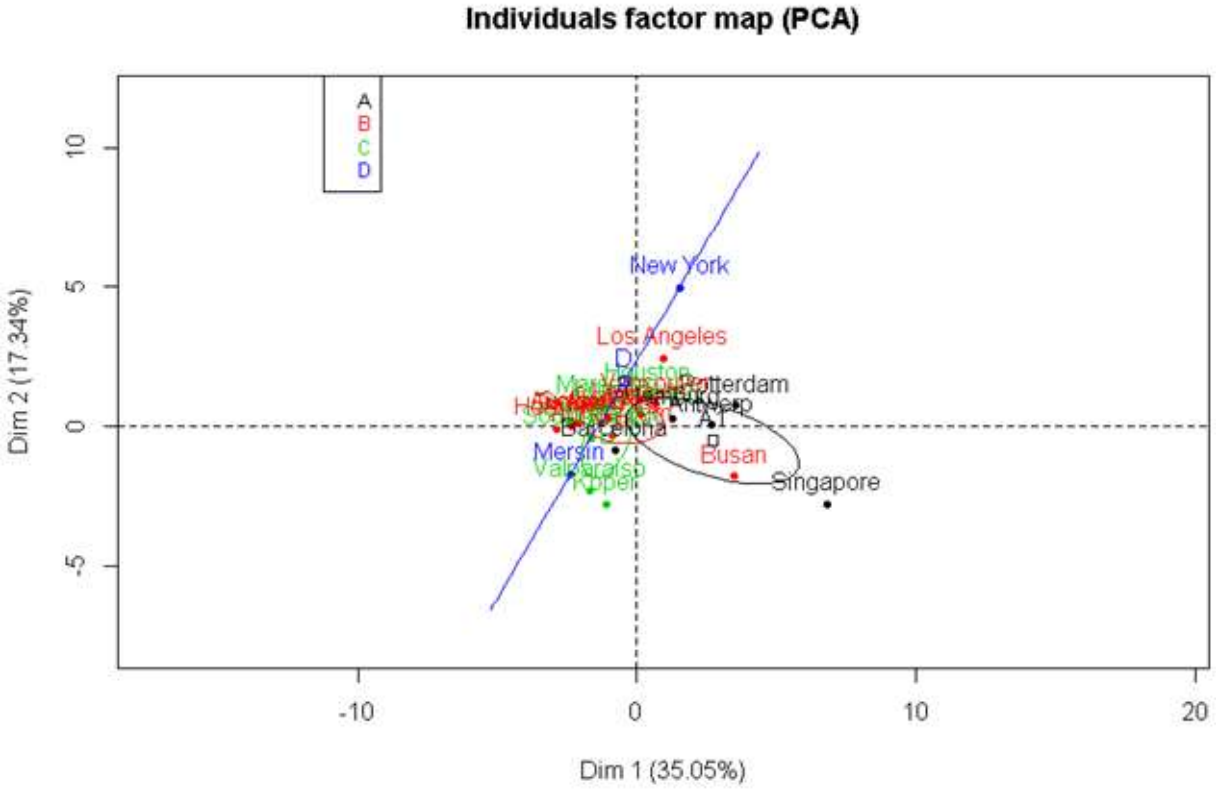


Figure 5. Port-city policies and city prosperity (2)



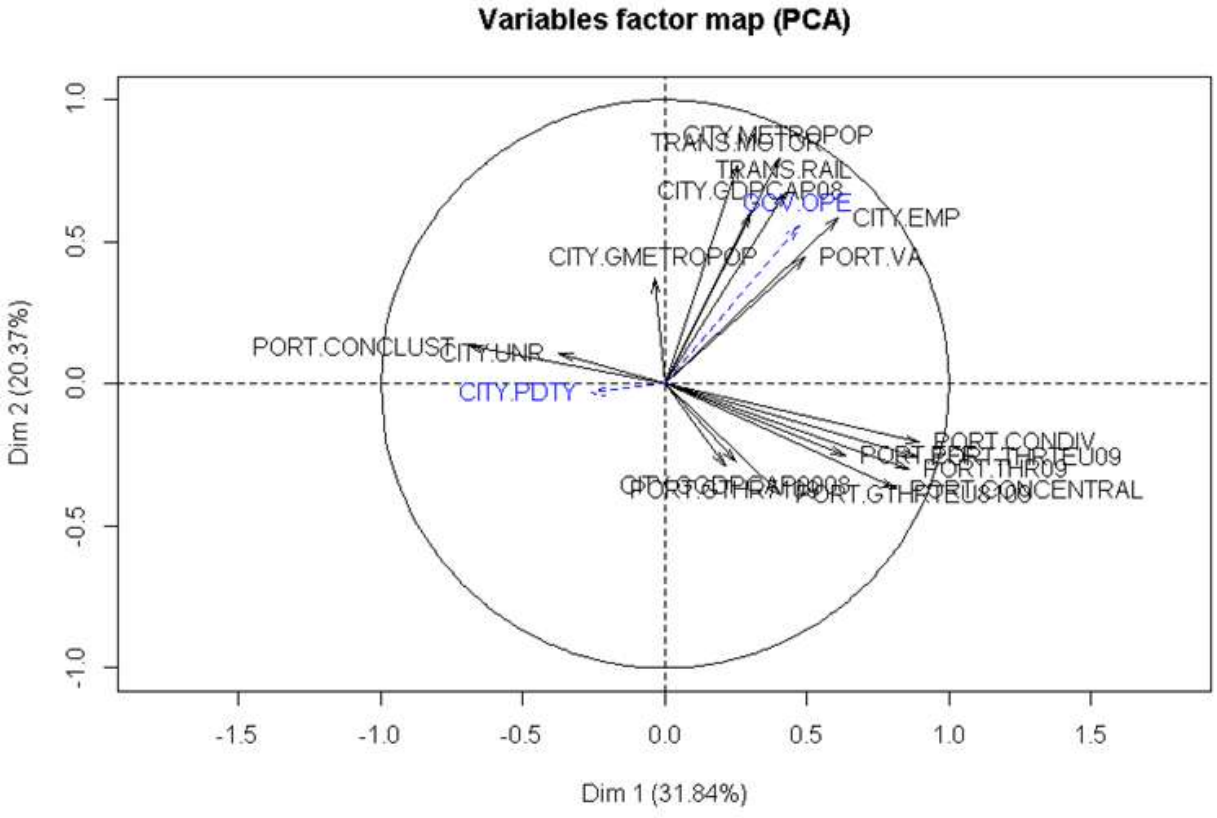
To sum up, gains for the city drawn from port activity are mostly and directly related to high-value added activities and employment. Surprisingly, strong growth in port traffic is not associated with economic performance of port-cities, as it possibly generates low value-added traffic. In addition, port-city policies are found to be relatively ineffective in promoting economic prosperity in the port-city. This suggests that policy instruments need to be refined or re-defined. An alternative explanation is that the port-related economy has relatively little weight in economies of port-cities, with the health of other economic sectors has possibly having a larger impact on the port-city economy.

5.3 Transport policies

Transportation is here analysed in relation to the economic development of port-cities. Transport networks may adequately support sustained traffic growth, or conversely, and lacking transport infrastructure may generate transport congestions and inefficiencies. Transport indicators would ideally reflect the existing infrastructure for port and city logistic activities such as traffic density, transport network, intermodal platform shifts, and access to hinterland. However, these indicators are not available in a comparative fashion for the port-cities considered. Proxied indicators used here are the railroad and the motorway network density in the port-city.

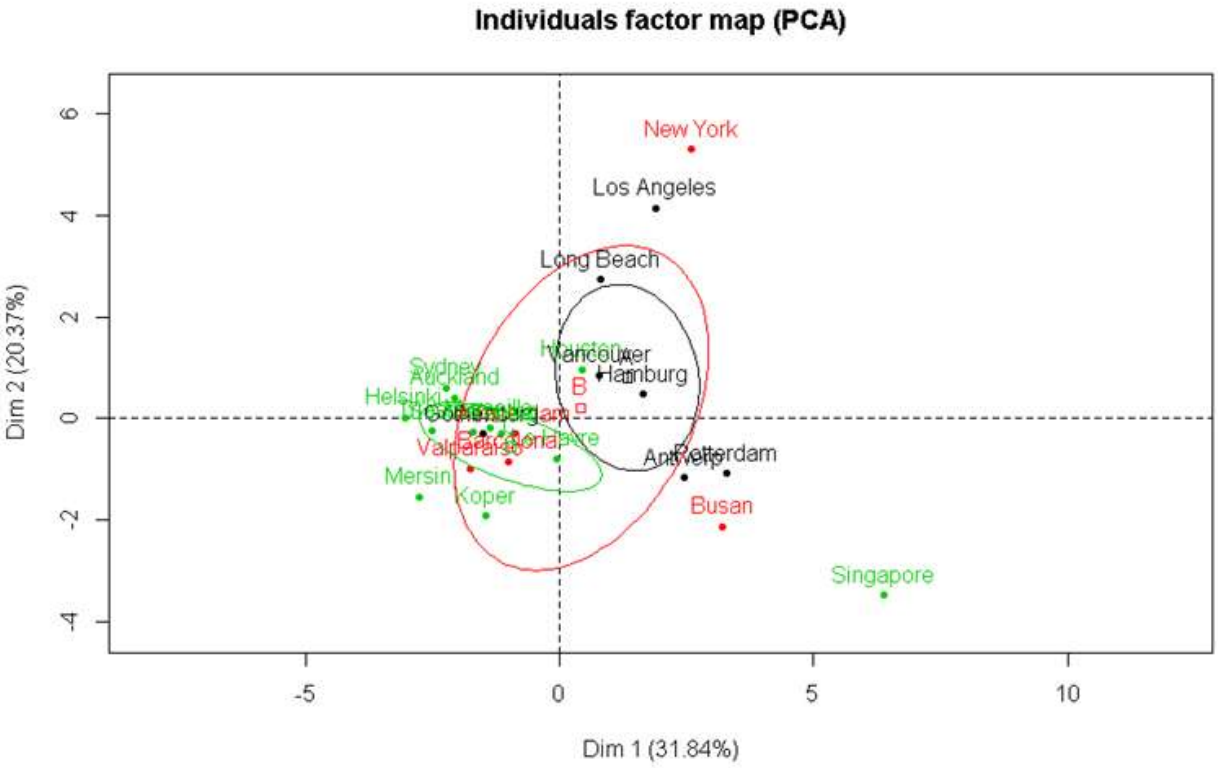
The main differences with regards to transport infrastructure in port-cities, resulting from the PCA analysis, are captured by two factors: one reflecting port traffic volumes, and the other reflecting city prosperity. Both dimensions reflect 52% of differences across all ports. High transport density is mostly associated to prosperous port-cities. On the upper side of the factor, high transport network density, both railroad (TRANS.RAIL) and motorway (TRANS.MOTOR), is found associated to big and rich metropolitan port-cities (e.g. as measured by population and GDP per capita) where port employment and value-added are high. However, strong traffic growth (e.g. both total throughput and containers) is represented on the opposite side, where implicitly transport density is low, highlighting potential risks of traffic congestion. Transport network density is not supporting port traffic volumes. As earlier found, the port traffic factor reflects the strong correlation between traffic volumes, efficiency, and port connectivity. The relatively weak correlation of transport density seems to indicate that it does not in itself support high port traffic volumes.

Figure 6. Correlation circle of transport density and port-city development



Best practices in transport policies, however, are found to be effective in supporting high port traffic. Transport policies oriented to port activity are mainly focused on instruments aimed at improving hinterland access, traffic modal shifts and dedicating freight corridors. An effective transport policy is expected to be associated to greater port performance. As shown from Figure 7, best practice policies are mostly found in port-cities where the port is well-performing and characterised either by relatively low (Rotterdam and Antwerp) or high (Los Angeles, Long Beach, Vancouver and Hamburg) transport network density. By contrast, transport policies that are very distant from the policy benchmark, are usually associated to ports with lower traffic volumes and city-transport profiles around the mean (with the exception of Singapore).

Figure 7. Transport policies and port-city development



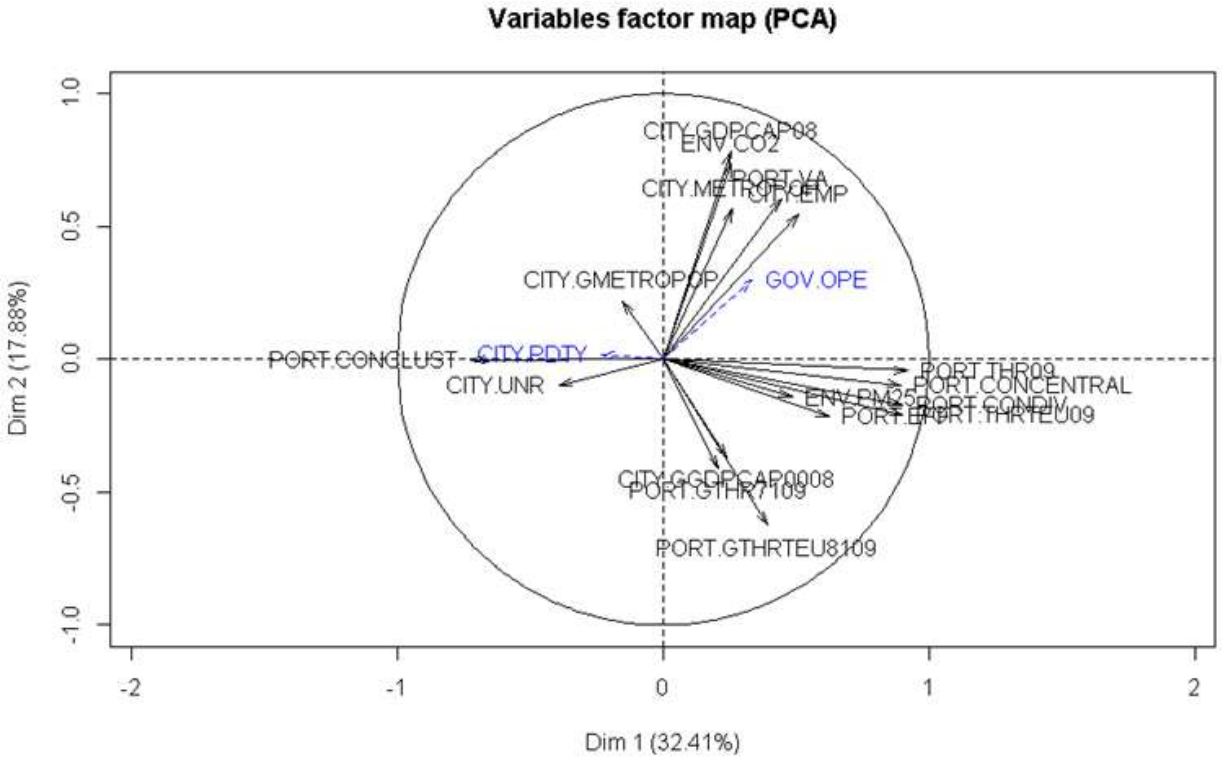
In conclusion, the transport network density is strongly associated to the size of the metropolitan port-city. It does not seem to be a condition to support high port traffic volumes though it may well slow down sustained traffic growth where the infrastructure is found limited (Busan and Singapore). However, transport policies seem to be more effective in sustaining port activity performance either where transport density is more (Los Angeles, Long beach) or less (Antwerp and Rotterdam) developed. In cases where ports face transport congestions, improving transport current policy standards toward best practices may well relief the infrastructure constraint to port development.

5.4 Environmental policies

The environmental policies are analysed in relation to the negative externalities generated by port development. Environmental indicators would ideally reflect the impact of port traffic on water and air pollution, waste and population health. The environmental indicators are here proxied by the CO_2 emissions per capita and the population exposure to $PM_{2.5}$.

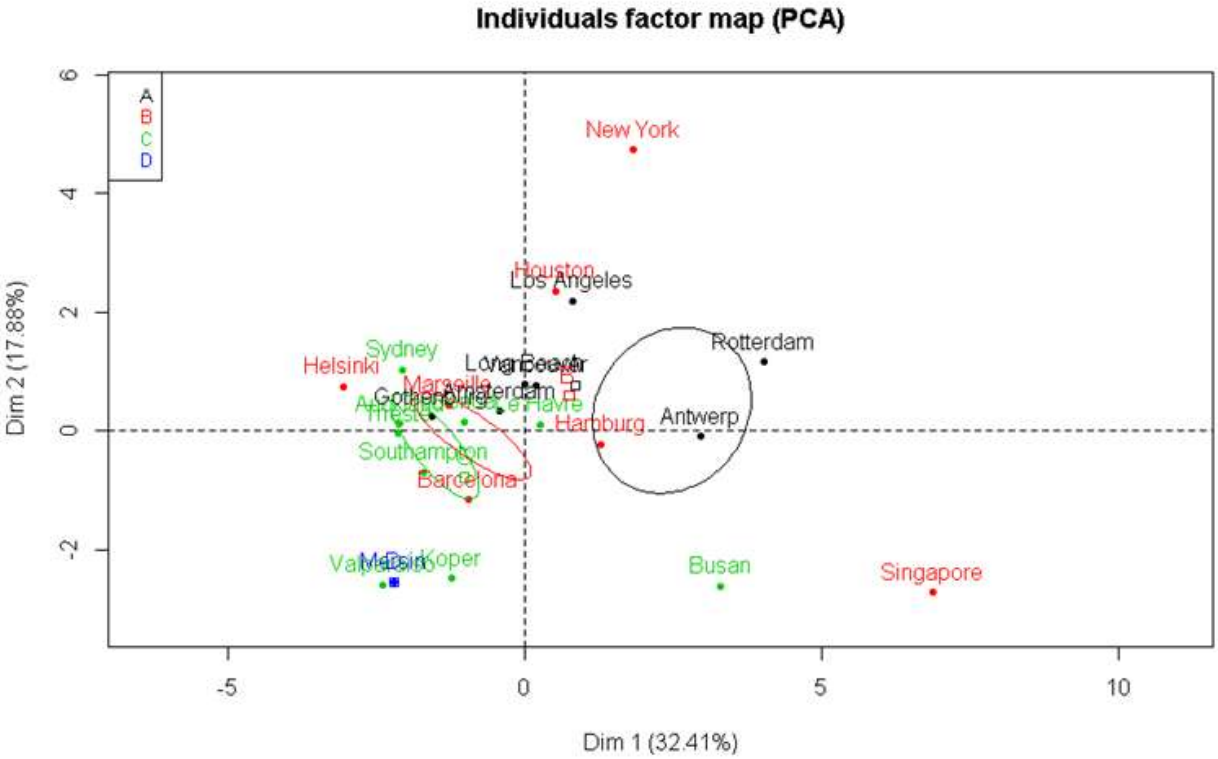
Pollution is associated to both port traffic and port-city development. The results from Figure 8 show that the main features differentiating port-cities in terms of pollution and port-city development remain, as earlier seen, port traffic size and city prosperity. Both dimensions reflect around 51% of overall port differences. In the upper side of the correlation circle, emission of CO_2 (ENV.CO2) is found to be strongly associated to the prosperity of the port-city. On the right hand side, high population exposure to $PM_{2.5}$ (ENV.PM2.5) is by contrast associated to port volumes.

Figure 8. Correlation circle of air pollution and port-city development



Effectiveness of environmental policies is found to be mitigated. Environment policies cover a wide range of actions ranging from general policy instruments aimed at reducing pollution emissions and wastes, improving energy efficiency, and adapting to climate change, to more targeted policies such are using renewable energy production in the port. Effective environmental policies are expected to be found in port-cities characterised by high port activity and relatively low CO_2 emissions. As can be concluded from Figure 9, port-cities have not achieved significant reduction in CO_2 or $PM_{2.5}$ (e.g. expected downward or left-hand shift). As a result, effects of port environmental policies could be considered mixed. Pollution in port-cities, such as measured by CO_2 and $PM_{25,}$ is unlikely to be driven only by port activities, but also by other activities of port-cities. Port environmental policies might have an impact, but are in many port-cities not having a significant effect on reducing port-city pollution, depending on port volumes and port-city development.

Figure 9. Environmental policies and port-city development

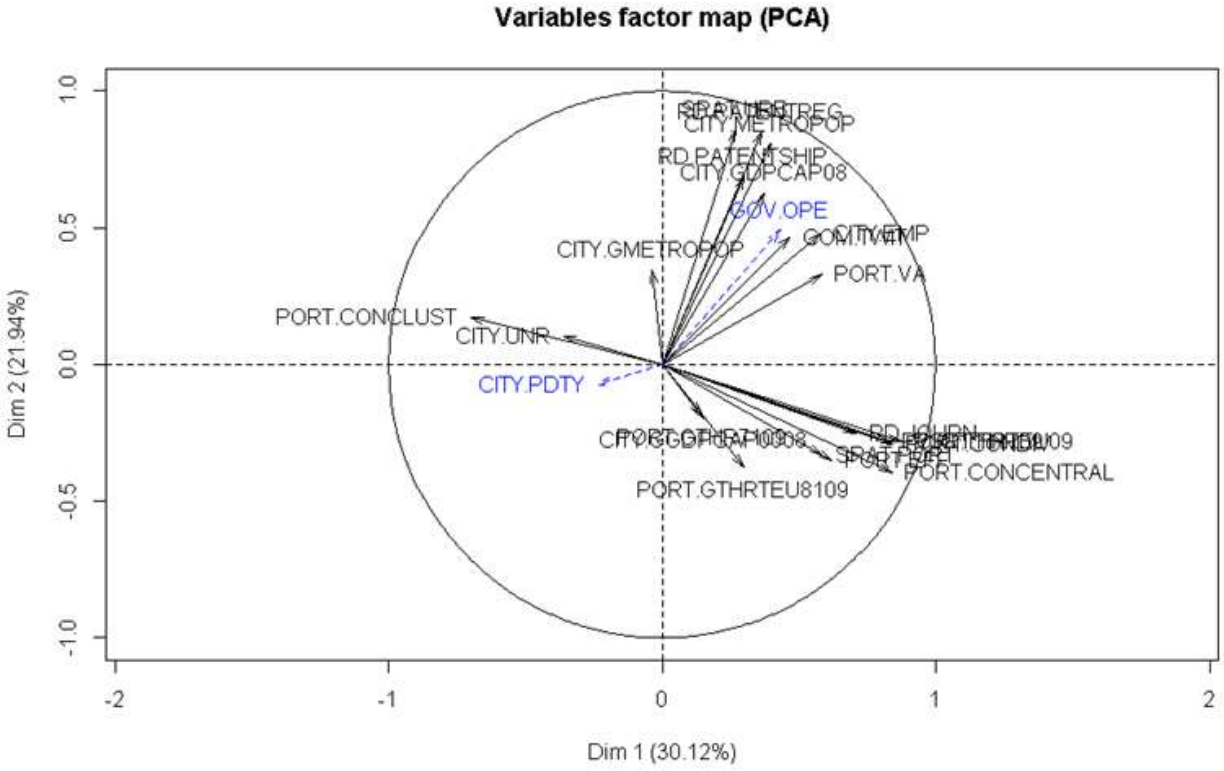


5.5 R&D, spatial and communication policies

Policies focused on R&D, spatial development and communication form a set of policies that can be used to balance port and port-city development. The indicators used to capture these various aspects are as following: i) R&D should reflect potential spillover effects of innovation to benefit port modernisation, labour productivity and highly qualified port employment. As such, R&D is proxied by total patent applications at the regional level, patent applications in the shipping sector and the number of published articles in port research journals; ii) Spatial development should provide a picture of territorial management dealing with the contentious expansion of port surface and the urbanised area. The proxies used are the land surface of port and urbanised area; iii) finally pro-active communication is essential to build common interests along with potential source of conflicts arising from a mismatch development between port and port-city. The number of twitter followers is used as a proxy to measure efforts of port communication.

Innovation is mostly associated to rich port-cities. High number of patents, both at the regional (RD.PATENT) level and applied to the shipping sector (RD.PATENTSHIP), is mostly found in port-cities where the level of prosperity is relatively high. By contrast formal research as measured by the number of articles in port journals (RD.JOURN) is mostly related to port volumes. Large port areas are strongly associated to high port volumes. Unsurprisingly, higher urbanised areas (LAND.URB) are found in prosper and big port-cities while largest port areas (LAND.PORT) are found with high traffic volumes. Port area expansion appears as a crucial channel for port development. Port communication is partly associated to high port traffic and rich port-cities. Port communication (COM.TWIT) contributes equally but only partially to both port volume and city prosperity. This result may suggest that pro-active port communication seems to contribute to some degrees to a balanced development between port and port-city.

Figure 10. R&D, spatial development, communication and port-city development



Research and innovation policies are found to be effective to support port traffic and maritime and port research. The policy tools are mainly focused on improving port performance, attracting innovative port-related firms, supporting innovation logistic systems, while research oriented policies tend to attract research institutes and foster local research on port sector. Best practice policies in research & innovation are found effective as these are mostly associated to ports with performing port traffic and port research (Hamburg, Rotterdam, Antwerp, and Singapore) (Figure 12).

The effectiveness of spatial development policies seems mixed. Spatial development policy objectives are focused on planning port land use, developing master plan for the port and the city, the waterfront and the coastal /river management, and redesigning old port and industrial sites for urban purposes. Ports recognised as having best practices face very heterogeneous situations (Figure 13) in terms of port traffic and related port area (Singapore, Rotterdam, Antwerp, Hamburg, Sydney, Barcelona and, Amsterdam).

Communication policy seems unlikely to be effective in supporting port activity via efficient port communication. Communication policy covers port communication and information, the development of cultural projects around the port, maritime museums, the promotion of port as a city-brand and the communication around waterside leisure and recreation. Best practice policies are difficult to assess (Figure 14) as such policies should be associated to ports characterised with a balanced development between the port and the city (situated in the right upper quadrant) where no ports are found.

To sum up, port performance is mostly found to rely on large port land availability and to some extent on fundamental research, while port-city development may lean on innovation (e.g. patents) and large urbanised areas. Port communication is associated with rich port-cities and performing ports. With the exception of innovation policy tools, most of the policies are found to be ineffective in supporting a balanced development between the port and the city.

Figure 11. Effectiveness of R&D, spatial and communication policies (1)

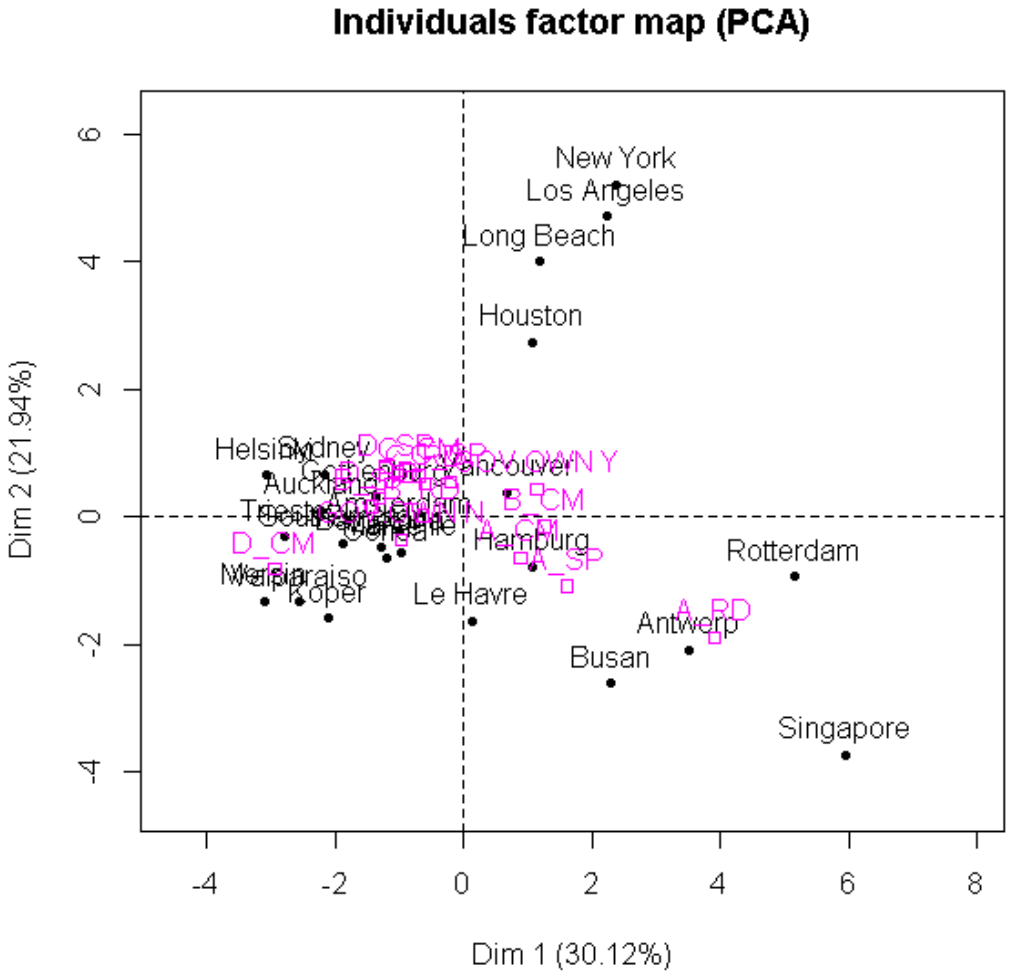


Figure 12. Effectiveness of R&D, spatial and communication policies (2)

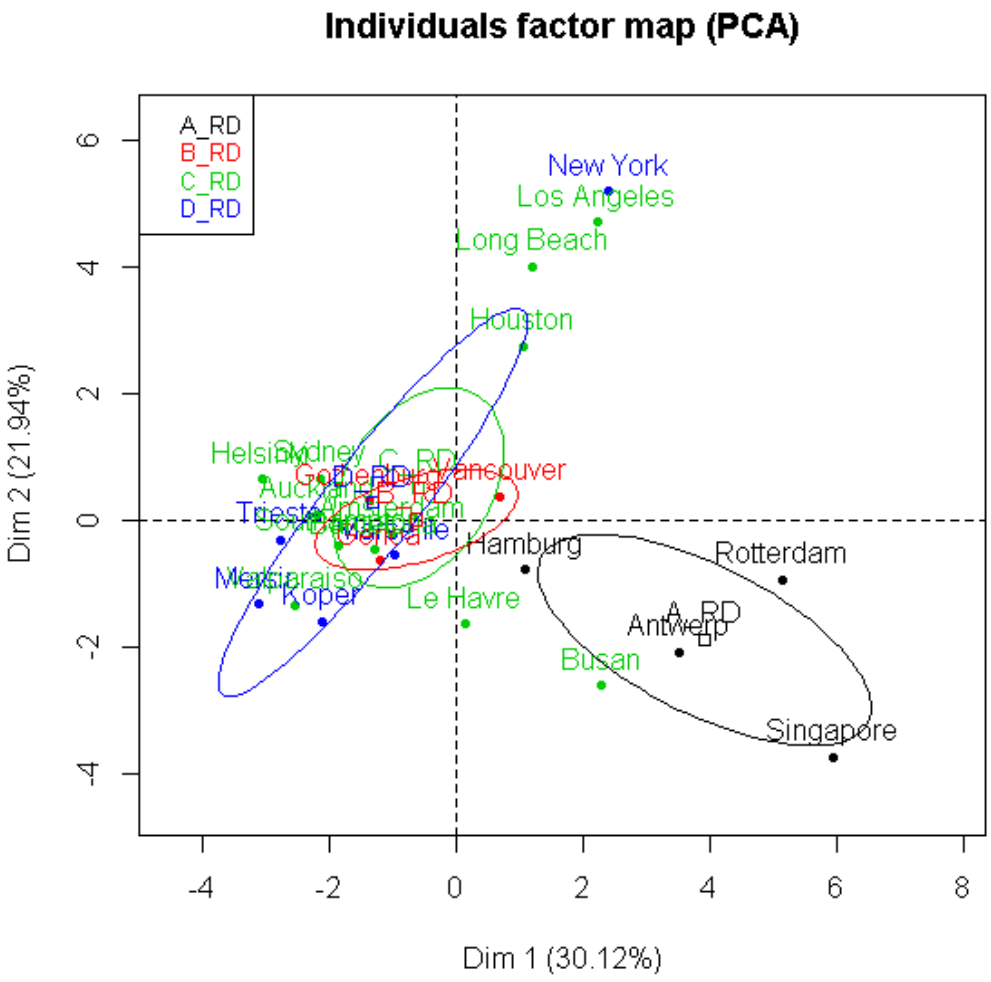


Figure 13. Effectiveness of R&D, spatial and communication policies (3)

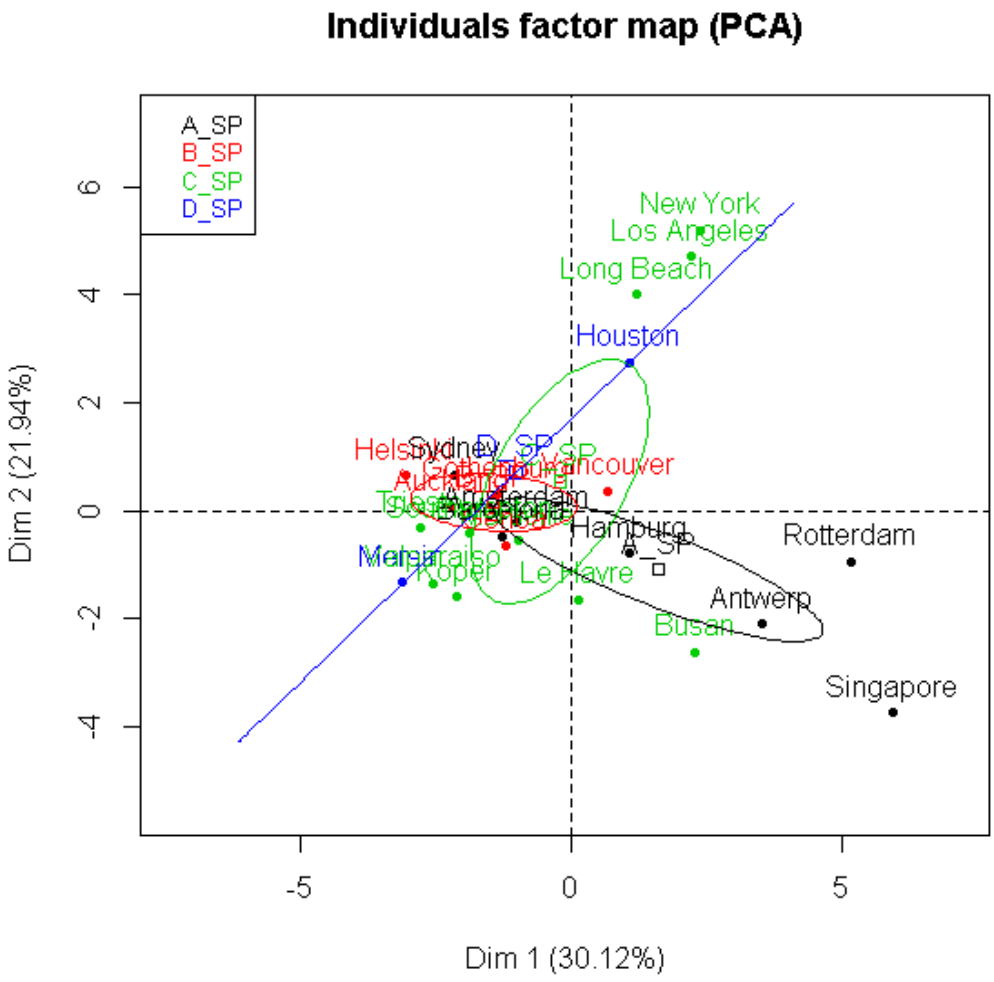
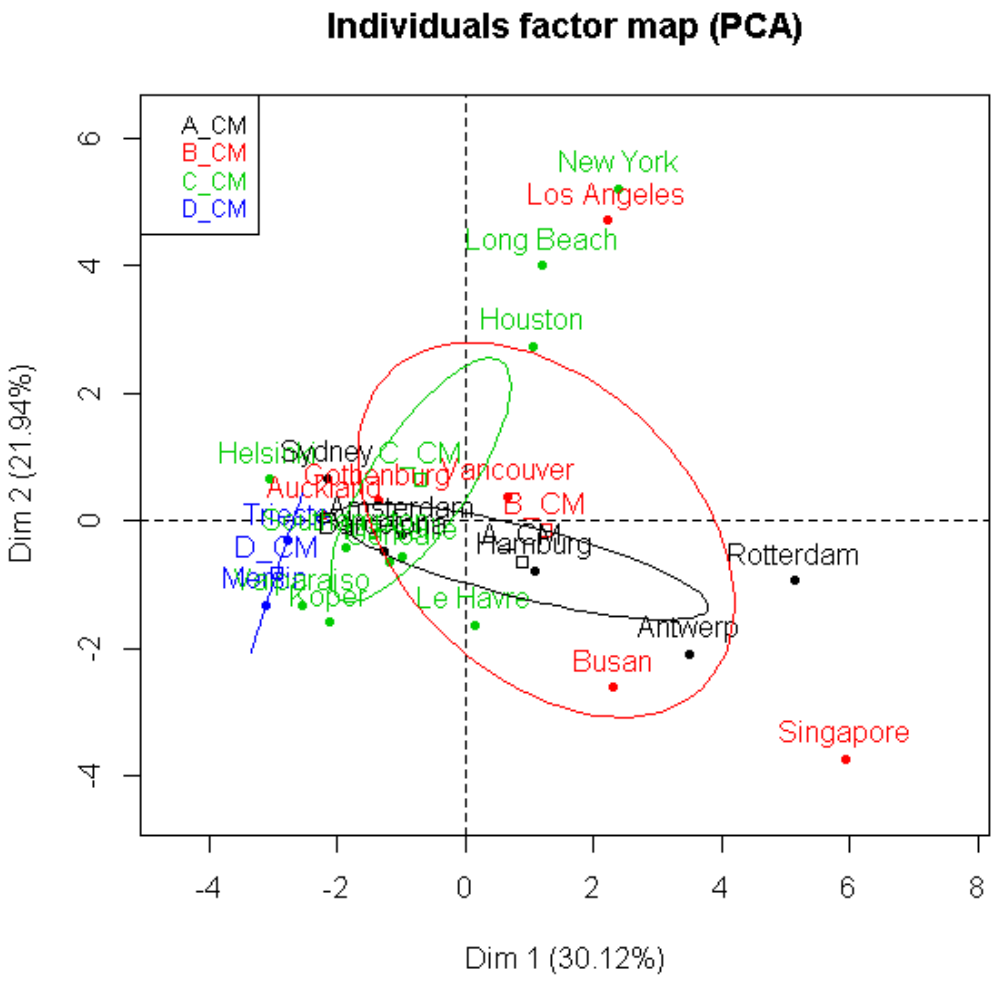


Figure 14. Effectiveness of R&D, spatial and communication policies (4)



6. PORT-CITY POLICY PACKAGES

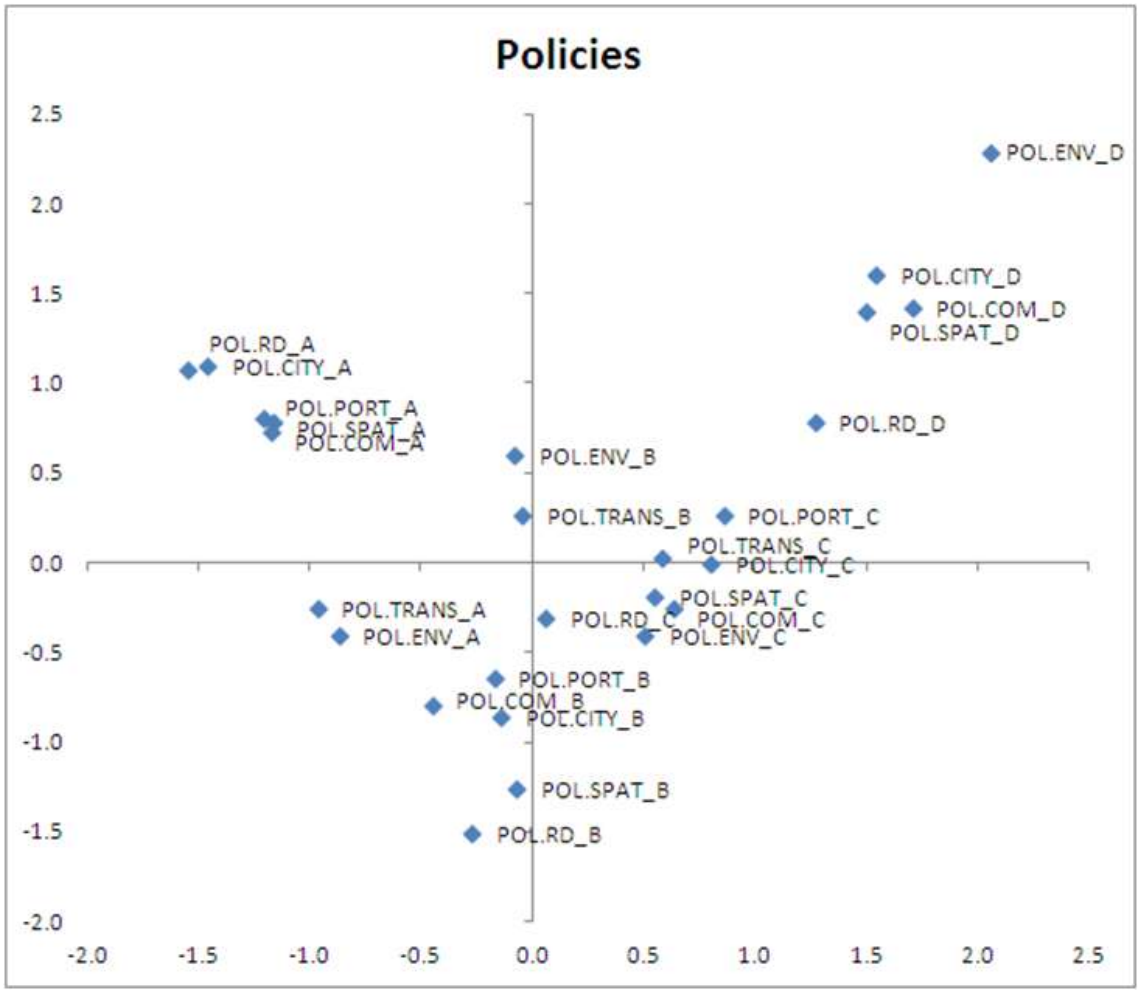
When considering the whole package of policies, policy makers might ask if current policy settings are appropriately focused. Is there any emerging policy profile with similar port-city features? Are policy areas given similar priorities or efforts? What are the possible effects/links with port performance and city prosperity? The following analysis is based on the multiple correspondence analysis (ACM), which is the counterpart of PCA for categorical data.

Policy efforts are found rather homogeneous across selected policy areas. As shown in the figure 15 showing the links (distance) between policy scorings in all areas, there are common features emerging in terms of policy priorities:

- Policy efforts appear very homogenous in a majority of policy areas, even if policies are not always considered to be effective. Performing policies (A-score) are usually focused on a large range of policy areas. This includes both relatively effective policies (port development and R&D and innovation policies) and relatively ineffective ones (city development, spatial and communication policies). In line with this, the port-cities with least performing policies (D-score) apply to overall policy areas, reflecting a general absence of policy priority dedicated to port or city development. In the mid-range, similar homogeneity across areas is observed.

- Transport and environment policies are found closely related. However, best policy practices (A score) and effective policy tools (B score) are not associated to similar policy scoring in other areas. This suggests that policy priorities in transport and environment are sometimes disconnected from policy priorities in the other policy areas.

Figure 15. Policy efforts across policy areas



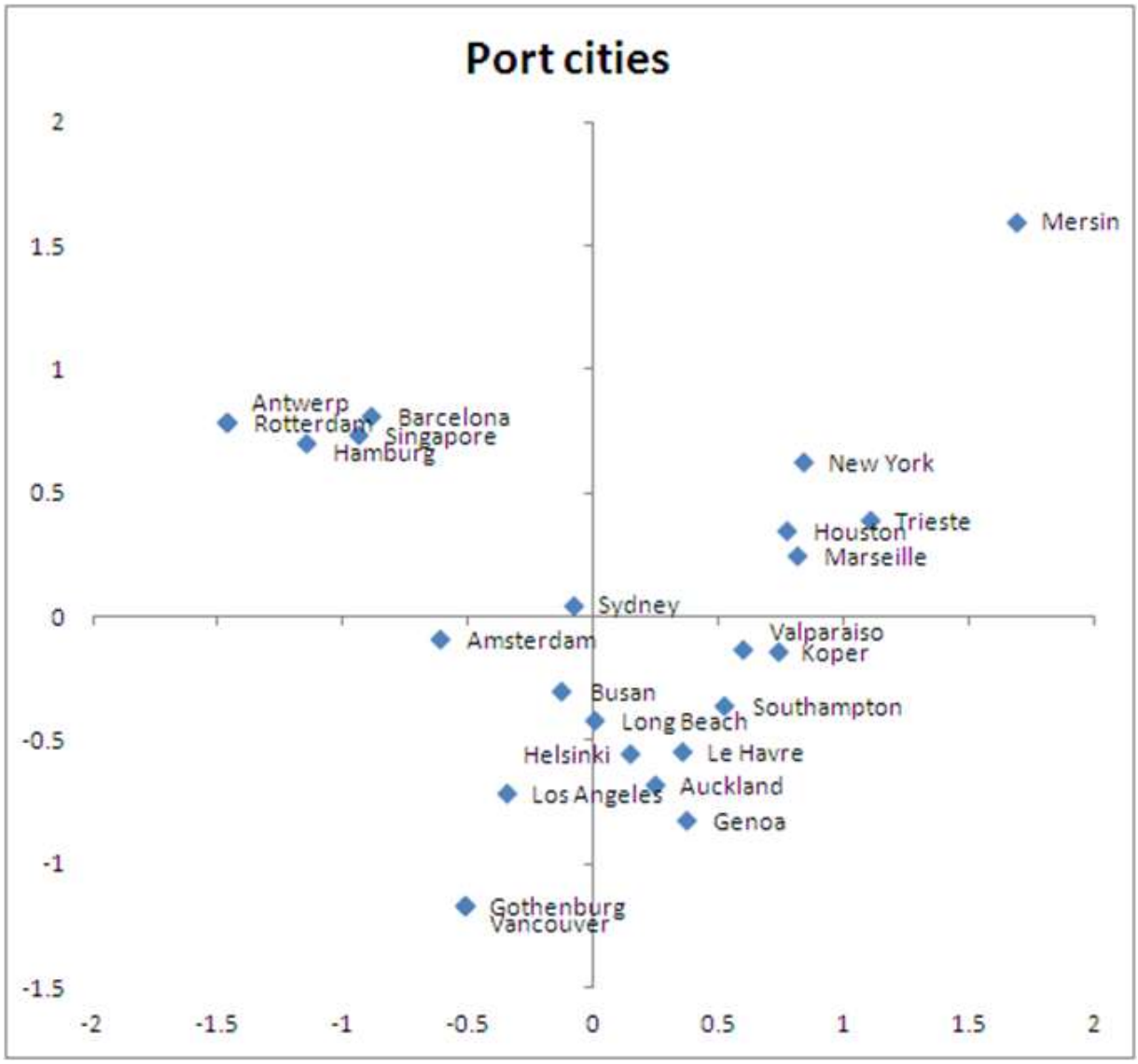
Plotting individual port-cities helps to identify groups of ports with similar policy profile. There are three different emerging groups as can be seen from in Figure 16:

- Port-cities with most performing policies. This group includes Rotterdam, Antwerp, Singapore, Hamburg, and Barcelona. Best practices are not necessarily applied to current environment and transport policies. These ports are mostly performing in terms of port traffic and growth and city prosperity to some extent.

- Port-cities with least performing policies. This group is constituted by New York, Houston, Marseille, and Trieste. Mersin is particular marked by its relatively poor scoring in environmental policy. These ports face very heterogeneous situations in port traffic and city prosperity outcomes.

- Port-cities with about average performing policies. The group of mild performing policies include the remaining but a large majority of port-cities. They face large heterogeneity in terms of port traffic and city prosperity outcomes.

Figure 16. Policy scoring of port-cities



Ports with high performing policies are generally characterised by high scores across all policy areas. Increased policy effectiveness in these port-cities could possibly be achieved by focusing even more attention to what came out as one of the most effective policy area, namely transportation policies. Port-cities with average to least performing policy packages, by contrast, would benefit from moving their policy efforts towards the benchmark within the policy areas where they are the least performing or focusing on the most effective policy areas, such as port development, transportation and R&D.

It is of crucial improvement to understand why various port-city policies are relatively ineffective. This might require more in-depth understanding of port-city policies in specific port-cities, e.g. building upon the various OECD Port-Cities studies (available on www.oecd.org/regional/portcities) and the port-city policies described in these. For port-cities, it is of utmost importance that high port performance also translates into port-city prosperity. As highlighted in this report, one possible way could be to focus policy actions on stimulating port-related value added and port-related employment as these were found to be highly associated with port-city prosperity.

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NOTES

[1] - Supplementary variables or individuals are not active in the PCA analysis. They do not affect factor contributions or the representation of the ports in the volume-traffic dimensions. They just reflect the position of the variable with respect to these dimensions.

[2] Ellipses of confidence can be plotted around categories of a qualitative supplementary variable (i.e., the centre of gravity of individuals with the same category). These ellipses are used to visualise if two categories are significantly different or not.