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An Analysis of Port Entry Networks Using Philippine Customs Administrative Data[1]

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Abstract

This policy brief examines the network of Philippine ports and its partner country-products and aims to describe the relative importance of each port over time, as well as the clusters of ports and partner-products. The former was done by employing weighted centrality measures, and the latter through an algorithm of community detection within bipartite networks. The study found that ports in Metro Manila dominate in terms of number of transactions over time, with the rankings hardly changing over the study period. It also found that large ports tend to be in a cluster of their own, signifying that these may serve a separate niche market which makes it hard for other ports to substitute, even if they are located close to Metro Manila.

Introduction

Ports are integral in moving goods and people around an archipelagic country like the Philippines. It is therefore economically costly when policies impede the development and operation of ports. For instance, in 2014, the city government of Manila imposed a ban on trucks to use certain streets, which unintentionally led to the congestion of the port of Manila. This has cost the economy an estimated Php 43.85 billion in forgone customs revenue, losses in output and productivity, as well as added transportation costs (Patalinghug et al. 2016). Recognizing this issue, there are calls to develop different ports outside Metro Manila (specifically the ports of Batangas and Subic) in order to decongest the port of Manila and to spur the economies of areas outside the National Capital Region (JICA 2013; Patalinghug et al. 2016). The issue is becoming more urgent as import/export transactions are expected to further increase as the Philippines' gross domestic product (GDP) has been growing above 6% annually since 2012.

However, realizing the highest returns for infrastructure investments in general, and harnessing the comparative advantage of developing each port in particular, requires an intimate understanding of both supply- and demand-side linkages (Yang 2003). This involves knowledge on the network of products, trade partners, and markets that each port serves. There exists, however, an information gap that stems from both the level of availability of data and in the methods of describing the different networks of trade products and partners.

This policy brief aims to fill this gap. Using administrative data from the Philippine Bureau of

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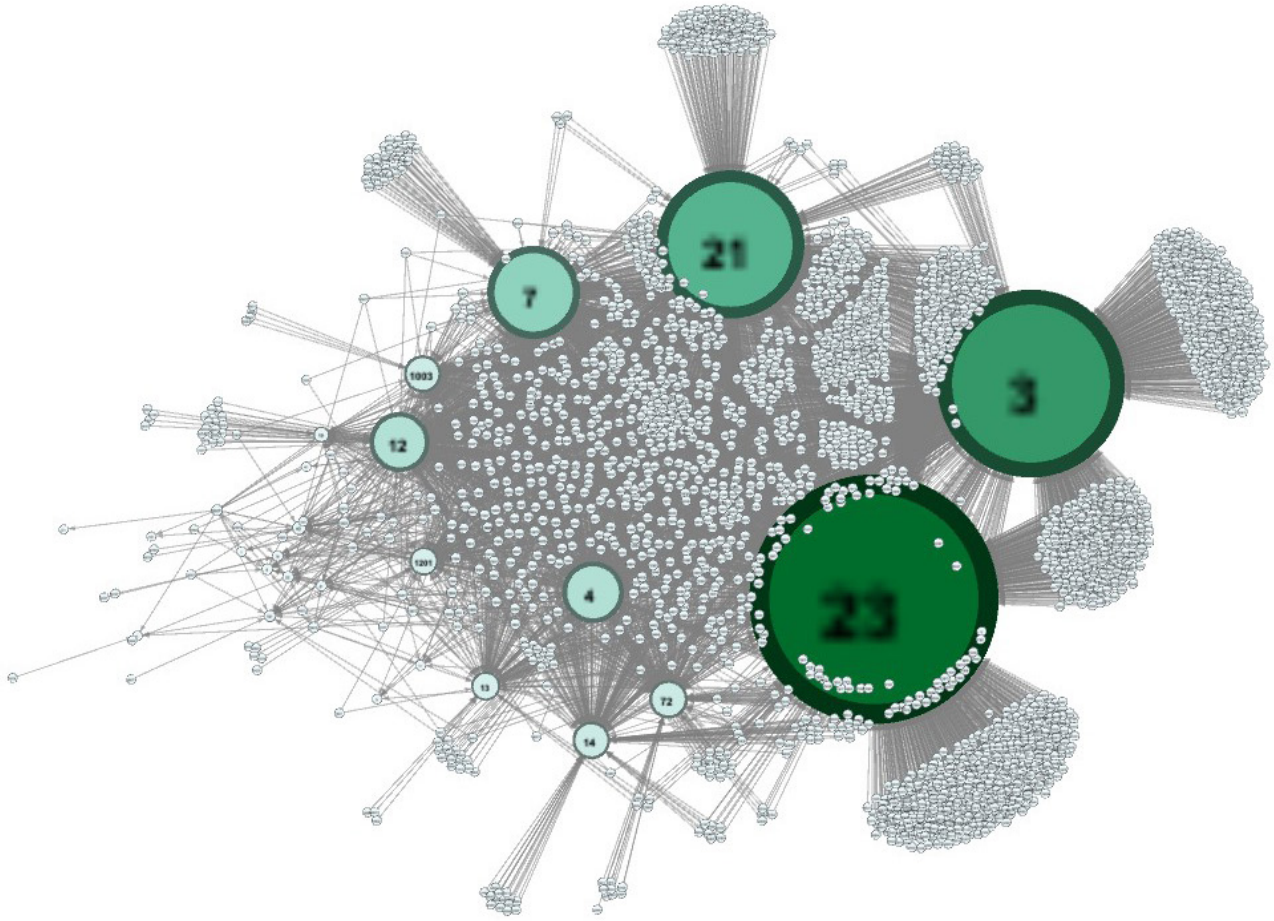
FIGURE 1 Network of partner-HS pairs with ports of entry, August 2014



Customs (BOC), we describe the evolution of the network of trade partners, products, and ports in order to highlight and analyze the importance of each port over time. This was done by examining each port's weighted degree centrality. We also applied the DIRTLPAwb+ algorithm for bipartite graphs in order to detect communities (or clusters) of ports and partner-product pairs and to examine the patterns of trade for each port.

The next three sections of this policy brief present the data, methodology, and results of the study, respectively. The final section concludes the discussion and provides further insights on policy directions on the development of Philippine ports and on harnessing administrative data for public policy.

Data

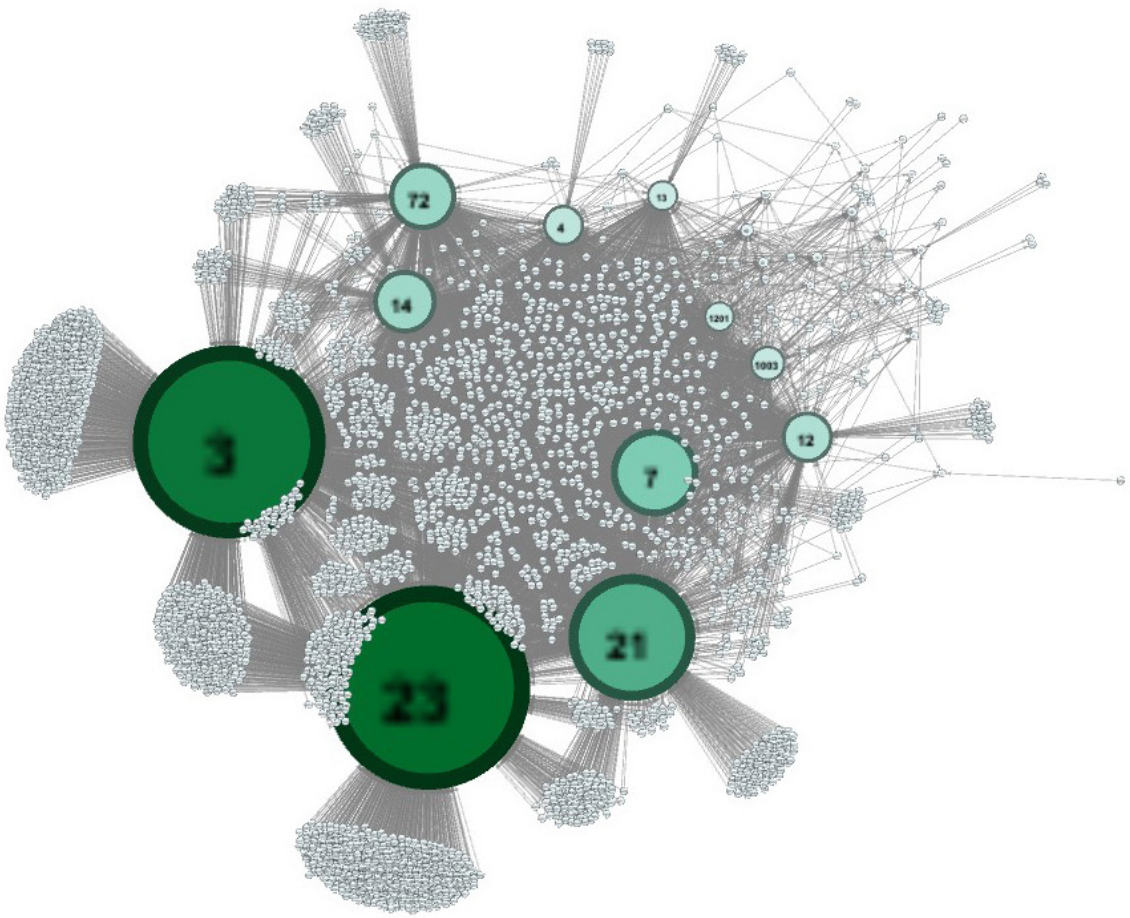
This policy brief uses the publicly available administrative dataset of the Bureau of Customs on goods imported monthly for the period from August 2014 to August 2017.[5] The period covered was determined by the completeness of reported data that is needed in our analysis. The study uses the following variables in its analysis: (1) the two-digit Harmonized Commodity Description and Coding System (HS) product codes, as well as their descriptions; (2) countries of origin; (3) customs value in US dollars; and (4) ports of entry. There are 7,145,970 recorded import transactions of 96 two-digit Harmonized System (HS) product codes from 222 partner country/territories entering 33 Philippine ports in BOC's dataset. Appendices 1, 2 and 3 list the countries, products, and ports, respectively.

[5] The dataset can be accessed online at http://customs.gov.ph/import-reports/. Due to data issues, we omitted the entries for December 2014, September 2015, December 2015, November 2016, December 2016, and February 2017.

FIGURE 1 (on previous page) and **FIGURE 2** (below) present the network of ports and (country) partner-product pairs (e.g., Japan, cereals (HS code 10)) on August 2014 and August 2017, respectively. The larger nodes are the ports and the smaller nodes are the partner-product pairs, while the links connecting the nodes indicate which of the partner-product pairs are shipped into a particular port. The size of a port node depends on the frequency of entry or transactions that the ports generated for a particular month. For both figures, the three largest ports in terms of number of transactions are the Manila International Container Port (MICP; port code 23), the Ninoy Aquino International Airport (NAIA; port code 3), and the Port of Manila (port code 21). Over a three-year span, the relative importance of ports changes. In **FIGURE 2**, we see that certain port nodes (for instance, the Port of Batangas (port code 4)) have shrunk in size compared to its size in **FIGURE 1**. This indicates that the relative importance of ports is not static and changes over time.

Another pattern that could be seen from the networks is that there are a number of partner-product pairs that rely exclusively on certain ports for entry. For instance, in both **FIGURES 1** and **2**, there are certain partner-product pairs that only enter through the NAIA. This suggests that there are partner-product-port *clusters* or *communities* based on patterns of trade in the country. This is important because the clusters may exist because of certain characteristics of both products and trade partners. For instance, the exclusive use of the NAIA for certain products indicate either perishability or the value of goods (e.g., products bought through e-commerce platforms by impatient consumers). It may also signify that the NAIA serves a niche market for certain products (e.g., consumer goods for urban Metro Manila). The upshot is that while the development of other ports will help decongest the country's main ports, the measure will only be effective if these ports serve the same market, host the entry of the same type of products, and offer their services at a relatively cost-effective manner for

FIGURE 2 Network of partner-HS pairs with ports of entry, August 2017



the partner countries. In short, some ports may not be perfect substitutes for another.

Methodology

In this section, we describe methods to answer which ports are becoming more or less important over time. We also describe how clusters or communities of partner-products-ports are detected.

Formally, our *network* is represented by ports and partner-products as *nodes* (or *vertices*) and import transactions as *links* (or *edges*) such as those in **FIGURES 1** and **2**. Thus, a partner-product pair linked to a port means that an import transaction occurs as a product of a given partner country entera a given port. Note that a partner-product node can be linked to several port nodes, indicating that a product from a particular country enter several ports.

Weighted network centrality

A node's *centrality* is a measure of how important a node is in relation to the whole network (Freeman 1978). One of the most common measures of centrality is *degree centrality*. Degree centrality is the number of other nodes that a particular node is connected to. A higher degree centrality means that a node has a greater number of connections than another node (with a lower degree centrality). Formally, the degree centrality measure can be described as:

$$k_i = C_D(i) = \sum_{j=1}^{N} x_{ij} \quad (1)$$

where i is the node in focus, j are all other nodes, N is the total number of nodes, and x_{ij} is a binary entry that takes on the value 1 if nodes i and j are connected or 0 if otherwise.[6] For instance, if the Port of Manila's degree centrality is 5, it means that five partner-product pairs (e.g., Japan, glass and glassware) have entered the port.

There is a slight complication when the *links* of a network are *weighted*, that is, some of the relationship strengths are more intense than others. An extension of the degree centrality measure to weighted graphs (Barrat et al. 2004; Newman 2004) can be described as:

$$s_i = C_D^w(i) = \sum_{j=1}^{N} w_{ij} \quad (2)$$

where $w_{ij} > 0$ represents the strength or weight of the connection of nodes i and j and $w_{ij} = 0$ if i and j are unconnected.

In this paper, we use two measures as weights for network centrality: *custom value* and number of *transactions* (or port entries). Thus, the link between a port and a partner-product will have a heavier weight whenever the value of the imports is higher and if it enters into a particular port more frequently.

Community detection

In any real-world network, agents rarely interact at random. Rather, agents tend to interact with the same set of agents because of long-standing relationships or because it is costly to form other ties with a different set of agents. This phenomenon gives rise to *communities* or *clusters* within the network and finding algorithms to detect these communities is an active research area in network science (Fortunato 2010).

Our port-partner-product networks are characterized as a *bipartite network*, where there are two distinct classes of nodes and where the interactions or connections are only possible with nodes outside their class. In our context, the two node classes are the ports and the partner-product pairs. Here, the only possible links are between partner-products to ports, and there are neither port-to-port links nor links from partner-products to other partner-products. This distinction is important as there are dedicated algorithms to detect communities from such bipartite networks. An excellent review of these algorithms is summarized in Beckett (2016) and in Geiger (2017).

The community detection algorithm that we used in our analysis is Beckett's DIRTLPAwb+

[6] We adopt the convention that $x_{ij} = 0$ for any node i. As will be discussed later, since our network is *bipartite*, the only possible connections that can be made are from partner-products to ports.

(2016) algorithm, which belongs to a class of label propagation algorithms (LPA) first proposed by Raghavan, Albert, and Kumara (2007). In this class, each node is given a unique label; afterwards, each iterating step forces each node to assume the label that is shared by the neighbors in which it is connected to within the graph. Liu and Murata (2010) extended this class of LPA algorithms for bipartite weighted networks and called it LPAb+. Beckett's DIRTLPAwb+ algorithm (2016) is a further refinement of the LPAb+ algorithm. What it does is to maximize *modularity*, which is arrived at by partitioning the nodes of the network into separate subsets or *modules*. Modularity is maximized whenever each of these modules are relatively isolated from the other modules in the network.[7] In the programming language R, we used the package called 'bipartite' and the function 'DIRT_LPA_wb_plus' to implement the DIRTLPAwb+ algorithm.[8]

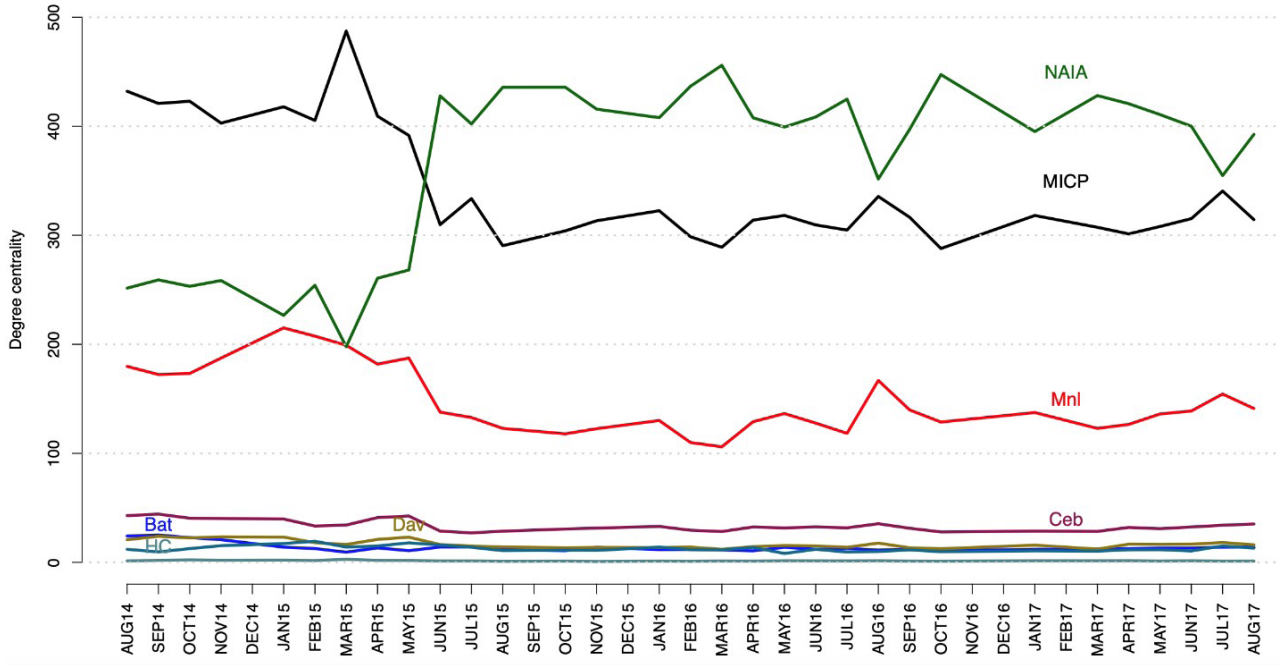
Based on this community detection algorithm, we identified the communities or clusters of port-partner-products for each month in our dataset.

Results and discussion

FIGURE 3 below shows the evolution of the weighted degree centrality measure of each port (with port entry frequency as weights) over the study period. Consistent with **FIGURES 1** and **2**, **FIGURE 3** shows that the NAIA, the MICP, and the Ports of Manila and Cebu are the most important ports in terms of number of import transactions. As seen in the graph, the NAIA has gained ground over time, while the MICP and the Port of Manila slightly declined in terms of importance.

However, the importance of each port slightly changes when we use custom values as weights. As shown in **FIGURE 4** (on the next page), the Port of Batangas overtakes the Ports of Manila and Cebu in terms of importance. The NAIA has also increased its importance over time, while the Port of Manila has lost ground over the same period. The importance of other ports are relatively stable during the three years covered by the study.

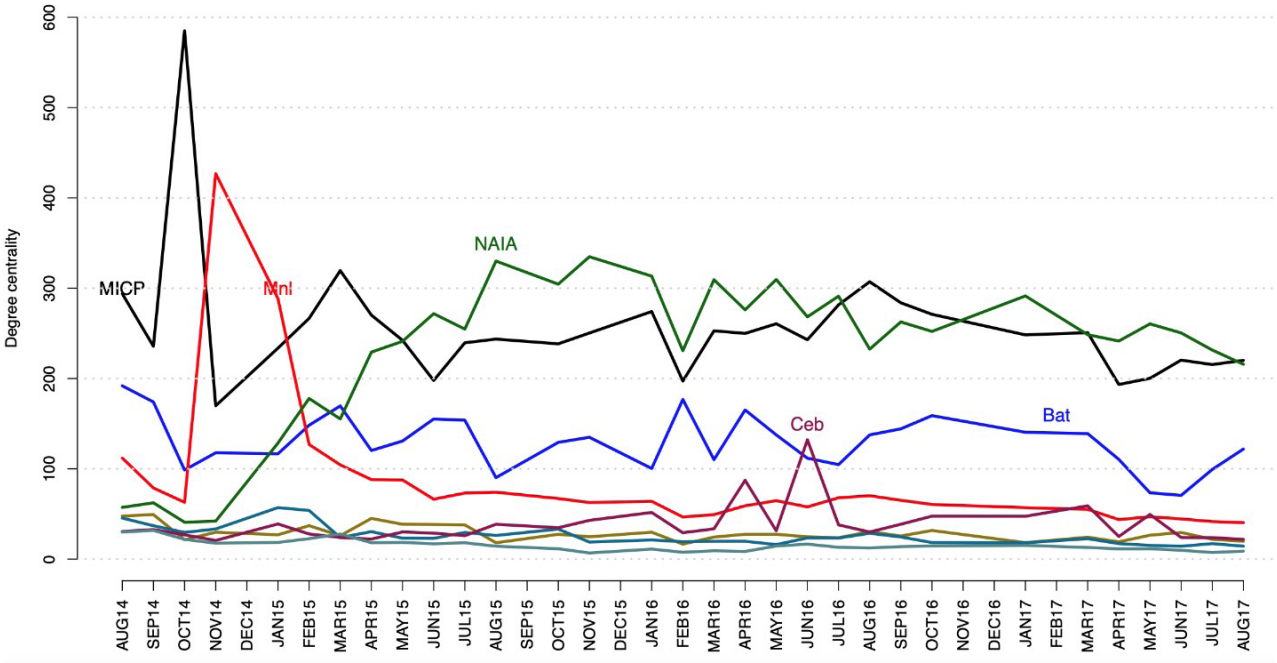
FIGURE 3 Port entry frequency-weighted degree centrality of Philippine ports, August 2014 to August 2017



[7] Compared to other LPA algorithms for community detection on bipartite graphs, DIRTLPAwb+ consistently classifies the structure of communities with the highest modularity score. See Stephen J. Beckett, "Modularity in Weighted Bipartite Networks," *Phage on Toast* (blog), January 20, 2016, https://phageontoast.wordpress.com/2016/01/20/modularity-in-weighted-bipartite-networks/.

[8] The documentation for the 'DIRT_LPA_wb_plus' function is available at https://github.com/sjbeckett/weighted-modularity-LPAwbPLUS.

FIGURE 4 Customs value-weighted degree centrality of Philippine ports, August 2014 to August 2017



Why has the NAIA gained importance over the period of the study, while the other ports regressed? Can these ports substitute each other in terms of markets and/or transactions costs? In order to answer these questions, we examined the different clusters of ports, partners, and products over time.

As shown in **FIGURE 4**, certain ports, such as the Port of Manila and the MICP, have been historically more important as ports of entry. There is a palpable concern that these ports are hitting their capacities due to the lack of infrastructure improvements for decongestion, which could be done either by expanding current port capacity or by improving other complementary ports.

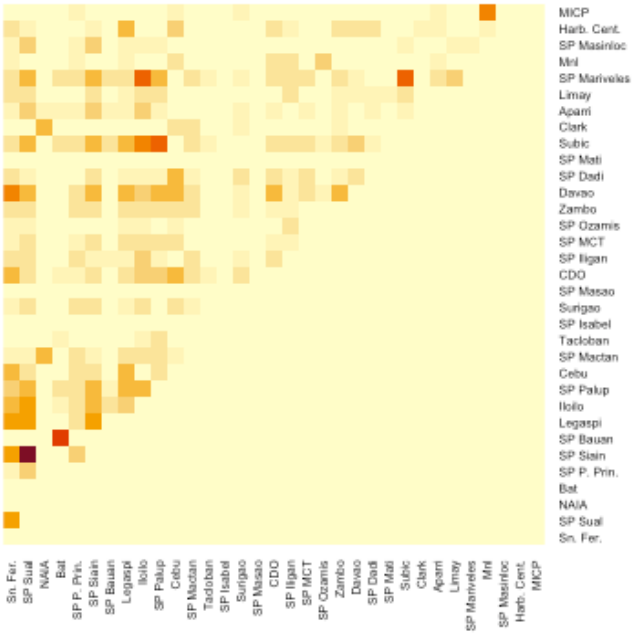
Appendix 4 lists the different clusters of ports and their top partner-products for each month of the study period. Each cluster represents the set of ports that import the same products from the same set of countries. For instance, Cluster 1 in January 2015 involves three ports (Batangas (port code 4), Port of Zamboanga (port code 11), and the Sub-port of Bauan (port code 43)) that frequently import salt and sulphur (HS code 25) from Australia; inorganic chemicals (HS code 28) and other chemicals (HS code 38) from China; and vehicles, vehicle parts, and accessories (HS code 87) from Indonesia and Germany, among others.

In any given month, the number of clusters are small, ranging from a minimum of 5 to a maximum of 15. Furthermore, the number of ports in each cluster is small, rarely exceeding 10 ports. In some cases, a cluster consists of only one port, usually the most important ports such as the Port of Manila, the NAIA, or the MICP.

This leads to two observations. First, the diversity of Philippine imports is quite limited and is dominated by a few products from big partner countries. We should expect that the number of clusters should increase with more varied partner-product pairs, as some ports may specialize in serving particular markets. This lack of diversity is borne out of the Philippines' low economic integration and globalization rankings relative to other ASEAN countries (Intal and Chen 2017).

Second, the bigger ports seem to satisfy a separate market by themselves, with not much degree of substitution with other ports. This is confirmed by **FIGURE 5**, which shows the heatmap of the likelihood that a particular port will be in a cluster with another port. The darker the color of the cell of a heatmap means that a cluster will more likely include both ports. For instance, the Port of Manila and the MICP tend to belong to the same cluster, while the Port of Batangas and the Sub-Port of Bauan are more likely to be together in a cluster. What the heatmap also

FIGURE 5 Heatmap of clustered ports



tells us is that the likelihood that the Port of Batangas and either the Port of Manila or the MICP to be in the same cluster is low, hinting of some degree of specialization among these ports. It is most likely that the products or markets that these ports serve differ from one another. An upshot of this finding is that any plan to upgrade the Batangas Port in order to decongest the Port of Manila or the MICP should warrant further studies, as the improved capacity of the Batangas Port may not necessarily lessen the transactions in the congested ports in Manila.

Conclusion

If the Philippines sustains its economic growth, the number of export and import transactions will likewise increase in lockstep. This puts pressure on Philippine ports, as some of them are nearing their full capacity. In order to decongest the main ports located in Metro Manila, several calls to develop ports in the provinces have been put forward.

By employing weighted centrality measures and an algorithm of community detection within bipartite networks, we found that ports in Metro Manila dominate in terms of number of transactions over time, with the rankings hardly changing over the study period. Based on the existing literature, clustering or network analysis has not been done on Philippine ports and on any other industry. This study found that the country's largest ports tend to be in a cluster of their own, suggesting that they may be serving a niche market. As such, it is a challenge for other ports to serve as substitutes for the main ports despite being located near Metro Manila.

This policy brief merits further investigation on factors contributing to such clustering of ports. It is hoped that this study will help in designing or reallocating public investments, especially for the development of the country's ports. Further studies should consider the constellation of products and markets served by our ports, as well as the synergistic nature of other complementary infrastructure investments that create the setting for their clustering. As such, better-studied investments will help the country gain better economic returns. ■

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APPENDIX 1 Import partner countries

AFGHANISTAN
ALBANIA
ALGERIA
AMERICAN SAMOA
ANDORRA
ANGOLA
ANGUILLA
ANTARCTICA
ANTIGUA AND BARBUDA
ARGENTINA
ARMENIA
ARUBA
AUSTRALIA
AUSTRIA
AZERBAIJAN
BAHRAIN
BANGLADESH
BARBADOS
BELARUS
BELGIUM
BELIZE
BERMUDA
BOLIVIA
BOSNIA-HERCEGOVINA
BOTSWANA
BOUVET ISLAND
BR. IND. OC. TR.
BRAZIL
BRITISH VIRGIN ISLANDS
BRUNEI DARUSSALAM
BULGARIA
BURKINA FASO
CAMBODIA
CAMEROON
CANADA
CAPE VERDE
CAYMAN ISLANDS
CENTRAL AFRICAN REPUBLIC
CHAD
CHILE
CHINA
CHRISTMAS ISLANDS
COLOMBIA
COMOROS
CONGO
COSTA RICA
COTE D'IVOIRE
CROATIA
CUBA
CYPRUS
CZECH REPUBLIC
DEMOCRATIC YEMEN
DENMARK
DJIBOUTI
DOMINICA
DOMINICAN REPUBLIC
EAST TIMOR
ECUADOR
EGYPT
EL SALVADOR
EQUATORIAL GUINEA
ERITREA
ESTONIA
ETHIOPIA
FAEROE ISLANDS
FALKLAND ISLANDS (MALVINAS)
FED. STATES OF MICRONESIA
FIJI
FINLAND
FORMER CZECHOSLOVAKIA
FRANCE
FRENCH GUIANA
FRENCH POLYNESIA
FRENCH SOUTHERN TERRITORIES
GABON
GAMBIA
GEORGIA
GERMANY, FEDERAL REPUBLIC OF
GHANA
GIBRALTAR
GREECE
GREENLAND
GRENADA
GUAM
GUATEMALA
GUINEA
GUINEA-BISSAU
GUYANA
HAITI
HEARD MCDON. IS.
HONDURAS
HONG KONG
HUNGARY
ICELAND
INDIA
INDONESIA
IRAN, ISLAMIC REPUBLIC OF
IRAQ
IRELAND
ISRAEL
ITALY
JAMAICA
JAPAN
JORDAN
KAZAKHSTAN
KENYA
KIRIBATI
KOREA, DEM. PEOPLE'S REP.
KOREA, REPUBLIC OF
KUWAIT
KYRGYZSTAN
LAO PEOPLE'S DEMOCRATIC REPUBLIC
LATVIA
LEBANON
LESOTHO
LIBERIA
LIECHTENSTEIN
LITHUANIA
LUXEMBOURG
LYBIAN ARAB JAMAHIRIYA
MACAU
MADAGASCAR
MALAWI
MALAYSIA
MALDIVES
MALI
MALTA
MANY
MARSHALL ISLANDS
MAURITIUS
MEXICO
MOLDOVA
MONACO
MONGOLIA
MOROCCO
MOZAMBIQUE
MYANMAR
NAMIBIA
NAURU
NEPAL
NETHERLANDS
NETHERLANDS ANTILLES
NEW CALEDONIA
NEW ZEALAND
NICARAGUA

APPENDIX 1 Import partner countries (CONTINUED)

NIGER
NIGERIA
NIUE
NORFOLK ISLAND
NORTHERN MARIANAS
NORWAY
OMAN
PAKISTAN
PALAU
PANAMA
PAPUA NEW GUINEA
PARAGUAY
PERU
PITCAIRN
POLAND
PORTUGAL
PUERTO RICO
QATAR
REPUBLIC OF SERBIA
REUNION
ROMANIA
RUSSIAN FEDERATION
RWANDA
SAMOA
SAN MARINO
SAO TOME AND PRINCIPE
SAUDI ARABIA
SENEGAL
SEYCHELLES
SIERRA LEONE
SINGAPORE
SLOVAKIA
SLOVENIA
SOLOMON ISLANDS
SOUTH AFRICA
SPAIN
SRI LANKA
ST VINCENT AND GRENADINES
ST. HELENA
ST. KITTS-NEVIS
SUDAN
SURINAME
SVALBARD ISLANDS
SWAZILAND
SWEDEN
SWITZERLAND
SYRIAN ARAB REPUBLIC
TAIWAN, PROVINCE OF CHINA
TAJIKISTAN
TANZANIA, UNITED REPUBLIC OF
THAILAND
TOGO
TOKELAU
TONGA
TRINIDAD AND TOBAGO
TUNISIA
TURKEY
TURKMENISTAN
TURKS AND CAICOS ISLANDS
UGANDA
UKRAINE
UNITED ARAB EMIRATES
UNITED KINGDOM
UNITED STATES
UNITED STATES VIRGIN ISLANDS
URUGUAY
US MINOR OUTLYING ISLANDS
UZBEKISTAN
VANUATU
VATICAN
VENEZUELA
VIET NAM
YEMEN
YUGOSLAV REP. OF MACEDONIA
YUGOSLAVIA (FORMER FED. OF)
ZAMBIA
ZIMBABWE

APPENDIX 2 Two-digit HS codes and descriptions

01	ANIMALS; LIVE
02	MEAT AND EDIBLE MEAT OFFAL
03	FISH AND CRUSTACEANS, MOLLUSCS AND OTHER AQUATIC INVERTEBRATES
04	DAIRY PRODUCE; BIRDS' EGGS; NATURAL HONEY; EDIBLE PRODUCTS OF ANIMAL ORIGIN, NOT ELSEWHERE SPECIFIED OR INCLUDED
05	ANIMAL ORIGINATED PRODUCTS; NOT ELSEWHERE SPECIFIED OR INCLUDED
06	TREES AND OTHER PLANTS, LIVE; BULBS, ROOTS AND THE LIKE; CUT FLOWERS AND ORNAMENTAL FOLIAGE
07	VEGETABLES AND CERTAIN ROOTS AND TUBERS; EDIBLE
08	FRUIT AND NUTS, EDIBLE; PEEL OF CITRUS FRUIT OR MELONS
09	COFFEE, TEA, MATE AND SPICES
10	CEREALS
11	PRODUCTS OF THE MILLING INDUSTRY; MALT, STARCHES, INULIN, WHEAT GLUTEN
12	OIL SEEDS AND OLEAGINOUS FRUITS; MISCELLANEOUS GRAINS, SEEDS AND FRUIT, INDUSTRIAL OR MEDICINAL PLANTS; STRAW AND FODDER
13	LAC; GUMS, RESINS AND OTHER VEGETABLE SAPS AND EXTRACTS
14	VEGETABLE PLAITING MATERIALS; VEGETABLE PRODUCTS NOT ELSEWHERE SPECIFIED OR INCLUDED
15	ANIMAL OR VEGETABLE FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PREPARED ANIMAL FATS; ANIMAL OR VEGETABLE WAXES
16	MEAT, FISH OR CRUSTACEANS, MOLLUSCS OR OTHER AQUATIC INVERTEBRATES; PREPARATIONS THEREOF
17	SUGARS AND SUGAR CONFECTIONERY
18	COCOA AND COCOA PREPARATIONS
19	PREPARATIONS OF CEREALS, FLOUR, STARCH OR MILK; PASTRYCOOKS' PRODUCTS
20	PREPARATIONS OF VEGETABLES, FRUIT, NUTS OR OTHER PARTS OF PLANTS
21	MISCELLANEOUS EDIBLE PREPARATIONS
22	BEVERAGES, SPIRITS AND VINEGAR
23	FOOD INDUSTRIES, RESIDUES AND WASTES THEREOF; PREPARED ANIMAL FODDER
24	TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES
25	SALT; SULPHUR; EARTHS, STONE; PLASTERING MATERIALS, LIME AND CEMENT
26	ORES, SLAG AND ASH
27	MINERAL FUELS, MINERAL OILS AND PRODUCTS OF THEIR DISTILLATION; BITUMINOUS SUBSTANCES; MINERAL WAXES

APPENDIX 2 Two-digit HS codes and descriptions (CONTINUED)

28	INORGANIC CHEMICALS; ORGANIC AND INORGANIC COMPOUNDS OF PRECIOUS METALS; OF RARE EARTH METALS, OF RADIO-ACTIVE ELEMENTS AND OF ISOTOPES
29	ORGANIC CHEMICALS
30	PHARMACEUTICAL PRODUCTS
31	FERTILIZERS
32	TANNING OR DYEING EXTRACTS; TANNINS AND THEIR DERIVATIVES; DYES, PIGMENTS AND OTHER COLOURING MATTER; PAINTS, VARNISHES; PUTTY, OTHER MASTICS; INKS
33	ESSENTIAL OILS AND RESINOIDS; PERFUMERY, COSMETIC OR TOILET PREPARATIONS
34	SOAP, ORGANIC SURFACE-ACTIVE AGENTS; WASHING, LUBRICATING, POLISHING OR SCOURING PREPARATIONS; ARTIFICIAL OR PREPARED WAXES, CANDLES AND SIMILAR ARTICLES, MODELLING PASTES, DENTAL WAXES AND DENTAL PREPARATIONS WITH A BASIS OF PLASTER
35	ALBUMINOIDAL SUBSTANCES; MODIFIED STARCHES; GLUES; ENZYMES
36	EXPLOSIVES; PYROTECHNIC PRODUCTS; MATCHES; PYROPHORIC ALLOYS; CERTAIN COMBUSTIBLE PREPARATIONS
37	PHOTOGRAPHIC OR CINEMATOGRAPHIC GOODS
38	CHEMICAL PRODUCTS N.E.C.
39	PLASTICS AND ARTICLES THEREOF
40	RUBBER AND ARTICLES THEREOF
41	RAW HIDES AND SKINS (OTHER THAN FURSKINS) AND LEATHER
42	ARTICLES OF LEATHER; SADDLERY AND HARNESS; TRAVEL GOODS, HANDBAGS AND SIMILAR CONTAINERS; ARTICLES OF ANIMAL GUT (OTHER THAN SILK-WORM GUT)
43	FURSKINS AND ARTIFICIAL FUR; MANUFACTURES THEREOF
44	WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL
45	CORK AND ARTICLES OF CORK
46	MANUFACTURES OF STRAW, ESPARTO OR OTHER PLAITING MATERIALS; BASKETWARE AND WICKERWORK
47	PULP OF WOOD OR OTHER FIBROUS CELLULOSIC MATERIAL; RECOVERED (WASTE AND SCRAP) PAPER OR PAPERBOARD
48	PAPER AND PAPERBOARD; ARTICLES OF PAPER PULP, OF PAPER OR PAPERBOARD
49	PRINTED BOOKS, NEWSPAPERS, PICTURES AND OTHER PRODUCTS OF THE PRINTING INDUSTRY; MANUSCRIPTS, TYPESCRIPTS AND PLANS
50	SILK
51	WOOL, FINE OR COARSE ANIMAL HAIR; HORSEHAIR YARN AND WOVEN FABRIC

APPENDIX 2 Two-digit HS codes and descriptions (CONTINUED)

52	COTTON
53	VEGETABLE TEXTILE FIBRES; PAPER YARN AND WOVEN FABRICS OF PAPER YARN
54	MAN-MADE FILAMENTS; STRIP AND THE LIKE OF MAN-MADE TEXTILE MATERIALS
55	MAN-MADE STAPLE FIBRES
56	WADDING, FELT AND NONWOVENS, SPECIAL YARNS; TWINE, CORDAGE, ROPES AND CABLES AND ARTICLES THEREOF
57	CARPETS AND OTHER TEXTILE FLOOR COVERINGS
58	FABRICS; SPECIAL WOVEN FABRICS, TUFTED TEXTILE FABRICS, LACE, TAPESTRIES, TRIMMINGS, EMBROIDERY
59	TEXTILE FABRICS; IMPREGNATED, COATED, COVERED OR LAMINATED; TEXTILE ARTICLES OF A KIND SUITABLE FOR INDUSTRIAL USE
60	FABRICS; KNITTED OR CROCHETED
61	APPAREL AND CLOTHING ACCESSORIES; KNITTED OR CROCHETED
62	APPAREL AND CLOTHING ACCESSORIES; NOT KNITTED OR CROCHETED
63	TEXTILES, MADE UP ARTICLES; SETS; WORN CLOTHING AND WORN TEXTILE ARTICLES; RAGS
64	FOOTWEAR; GAITERS AND THE LIKE; PARTS OF SUCH ARTICLES
65	HEADGEAR AND PARTS THEREOF
66	UMBRELLAS, SUN UMBRELLAS, WALKING-STICKS, SEAT STICKS, WHIPS, RIDING CROPS; AND PARTS THEREOF
67	FEATHERS AND DOWN, PREPARED; AND ARTICLES MADE OF FEATHER OR OF DOWN; ARTIFICIAL FLOWERS; ARTICLES OF HUMAN HAIR
68	STONE, PLASTER, CEMENT, ASBESTOS, MICA OR SIMILAR MATERIALS; ARTICLES THEREOF
69	CERAMIC PRODUCTS
70	GLASS AND GLASSWARE
71	NATURAL, CULTURED PEARLS; PRECIOUS, SEMI-PRECIOUS STONES; PRECIOUS METALS, METALS CLAD WITH PRECIOUS METAL, AND ARTICLES THEREOF; IMITATION JEWELLERY; COIN
72	IRON AND STEEL
73	IRON OR STEEL ARTICLES
74	COPPER AND ARTICLES THEREOF
75	NICKEL AND ARTICLES THEREOF
76	ALUMINIUM AND ARTICLES THEREOF
78	LEAD AND ARTICLES THEREOF
79	ZINC AND ARTICLES THEREOF
80	TIN; ARTICLES THEREOF

APPENDIX 2 Two-digit HS codes and descriptions (CONTINUED)

81	METALS; N.E.C., CERMETS AND ARTICLES THEREOF
82	TOOLS, IMPLEMENTS, CUTLERY, SPOONS AND FORKS, OF BASE METAL; PARTS THEREOF, OF BASE METAL
83	METAL; MISCELLANEOUS PRODUCTS OF BASE METAL
84	NUCLEAR REACTORS, BOILERS, MACHINERY AND MECHANICAL APPLIANCES; PARTS THEREOF
85	ELECTRICAL MACHINERY AND EQUIPMENT AND PARTS THEREOF; SOUND RECORDERS AND REPRODUCERS; TELEVISION IMAGE AND SOUND RECORDERS AND REPRODUCERS, PARTS AND ACCESSORIES OF SUCH ARTICLES
86	RAILWAY, TRAMWAY LOCOMOTIVES, ROLLING-STOCK AND PARTS THEREOF; RAILWAY OR TRAMWAY TRACK FIXTURES AND FITTINGS AND PARTS THEREOF; MECHANICAL (INCLUDING ELECTRO-MECHANICAL) TRAFFIC SIGNALLING EQUIPMENT OF ALL KINDS
87	VEHICLES; OTHER THAN RAILWAY OR TRAMWAY ROLLING STOCK, AND PARTS AND ACCESSORIES THEREOF
88	AIRCRAFT, SPACECRAFT AND PARTS THEREOF
89	SHIPS, BOATS AND FLOATING STRUCTURES
90	OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING, CHECKING, MEDICAL OR SURGICAL INSTRUMENTS AND APPARATUS; PARTS AND ACCESSORIES
91	CLOCKS AND WATCHES AND PARTS THEREOF
92	MUSICAL INSTRUMENTS; PARTS AND ACCESSORIES OF SUCH ARTICLES
93	ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF
94	FURNITURE; BEDDING, MATTRESSES, MATTRESS SUPPORTS, CUSHIONS AND SIMILAR STUFFED FURNISHINGS; LAMPS AND LIGHTING FITTINGS, N.E.C.; ILLUMINATED SIGNS, ILLUMINATED NAME-PLATES AND THE LIKE; PREFABRICATED BUILDINGS
95	TOYS, GAMES AND SPORTS REQUISITES; PARTS AND ACCESSORIES THEREOF
96	MISCELLANEOUS MANUFACTURED ARTICLES
97	WORKS OF ART; COLLECTORS' PIECES AND ANTIQUES

APPENDIX 3 Philippine port codes and names

1	Port of San Fernando
103	Sub-Port of Sual
3	Ninoy Aquino International Airport
4	Port of Batangas
41	Sub-Port of Puerto Princesa
42	Sub-Port of Siain
43	Sub-Port of Bauan
5	Port of Legaspi
6	Port of Iloilo
61	Sub-Port of Palupandan
7	Port of Cebu
72	Sub-Port of Mactan
8	Port of Tacloban
83	Sub-Port of Isabel
9	Port of Surigao
92	Sub-Port of Masao
10	Port of Cagayan de Oro
1001	Sub-Port of Iligan
1003	Sub-Port of MCT-Philvidec
1002	Sub-Port of Ozamis
11	Port of Zamboanga
12	Port of Davao
1201	Sub-Port of Dadiangas
1202	Sub-Port of Mati
13	Port of Subic
14	Port of Clark
15	Port of Aparri
16	Port of Limay
161	Sub-Port of Mariveles
21	Port of Manila
211	Sub-Port of Masinloc
22	Harbour Center
23	Manila International Container Port

APPENDIX 4 Clusters of ports and partner-products for the month of January (2015–2017)

Editor's Note: The full dataset can be accessed via **bit.ly/upcidsportsdata**.

January

	2015		2016		2017	
	Port	Partner-Product	Port	Partner-Product	Port	Partner-Product
Cluster 1	4 11 43	Australia, 25 China, 28 China, 38 Germany, 82 India, 27 Indonesia, 87 Republic of Korea, 27 Republic of Korea, 87 Russian Federation, 27 Thailand, 87 United Arab Emirates, 27	5 15 22 42 103	Australia, 27 China, 26 China, 72 Taiwan, 25 Indonesia, 27 Viet Nam, 25	5 6 11 12 16 42 103 161	China, 25 Indonesia, 25 Indonesia, 27 Japan, 27 Japan, 29 Japan, 39 Kuwait, 27 Russian Federation, 72 Saudi Arabia, 27 Viet Nam, 10 Viet Nam, 25 Viet Nam, 31
Cluster 2	5 6 12 13 41 61 72 1001 1003	Australia, 10 Canada, 31 China, 31 Taiwan, 27 Taiwan, 73 Taiwan, 84 Japan, 39 Japan, 70 Japan, 73 Japan, 87 Republic of Korea, 31 Malaysia, 27 Singapore, 27 Viet Nam, 9 Viet Nam, 25 Viet Nam, 31 Thailand, 10 Thailand, 27 Ukraine, 10 United States, 23	4 6 13 43 161	Argentina, 23 Brazil, 10 China, 27 Taiwan, 27 India, 27 Indonesia, 87 Japan, 29 Japan, 87 DPR of Korea, 27 Republic of Korea, 27 Republic of Korea, 87 Malaysia, 27 Malaysia, 31 Nigeria, 27 Russian Federation, 27 Singapore, 27 Thailand, 87 United Arab Emirates, 27 Ukraine, 10 United Kingdom, 85 United States, 23 United States, 87	10 13 41 61 72 211 1001	Australia, 10 Australia, 27 China, 27 China, 31 Taiwan, 27 France, 88 Indonesia, 29 Indonesia, 31 Republic of Korea, 25 Thailand, 10 United States, 23
Cluster 3	23	China, 84 India, 30 Singapore, 82 Singapore, 84 Viet Nam, 33 Thailand, 84 United States, 21 United States, 87	23	China, 84 Taiwan, 84 Indonesia, 85 Malaysia, 85 Thailand, 84 United States, 21	15 21 23	China, 73 China, 84 China, 87 India, 30 Indonesia, 15 Republic of Korea, 84 Malaysia, 15 Viet Nam, 84 Viet Nam, 96 Thailand, 84

APPENDIX 4 Clusters of ports and partner-products for the month of January (2015–2017) (CONTINUED)

	2015		2016		2017	
	Port	Partner-Product	Port	Partner-Product	Port	Partner-Product
Cluster 4	1 7 10 14 22 42 103	Brazil, 10 China, 72 China, 73 China, 90 Taiwan, 85 France, 39 Indonesia, 27 Indonesia, 31 Japan, 80 Japan, 84 Japan, 85 Republic of Korea, 72 Republic of Korea, 81 Macao, 52 Russian Federation, 72 Viet Nam, 10 Viet Nam, 47 Viet Nam, 72 Viet Nam, 73 Thailand, 25	1 7 10 12 61 1201	Australia, 38 China, 31 Italy, 85 Japan, 3 Japan, 39 Japan, 72 Japan, 80 Japan, 84 Japan, 90 Republic of Korea, 3 Papua New Guinea, 12 Paraguay, 10 Singapore, 87 Viet Nam, 10 Viet Nam, 31 Thailand, 10	1 7 1003 1201	Brazil, 26 France, 35 Kiribati, 3 Japan, 3 Japan, 23 Japan, 73 Japan, 80 Japan, 84 Japan, 89 Republic of Korea, 3 Papua New Guinea, 3 Papua New Guinea, 12 Singapore, 27 United States, 4
Cluster 5	1201	Japan, 40 Japan, 56 Japan, 94 Republic of Korea, 3 Papua New Guinea, 3	9 41	Indonesia, 25 Japan, 28 Republic of Korea, 25 Malaysia, 25	9	Japan, 28 Malaysia, 25
Cluster 6	3	China, 85 France, 88 Hong Kong, 85 Italy, 88 Singapore, 85 Viet Nam, 84 Viet Nam, 85	3	China, 85 Taiwan, 85 France, 88 Japan, 85 Republic of Korea, 84 Republic of Korea, 85 Singapore, 85 Viet Nam, 85 United States, 85	3 14	Belgium, 85 China, 85 Taiwan, 85 Czech Republic, 85 Hong Kong, 85 Japan, 85 Republic of Korea, 85 Singapore, 84 Singapore, 85 Viet Nam, 85 United States, 84 United States, 85
Cluster 7	16 161	Argentina, 10 Argentina, 23 Australia, 27 China, 27 Japan, 27 Japan, 29 Saudi Arabia, 27 Viet Nam, 27 United States, 27	16	Kuwait, 27 Saudi Arabia, 27	4 43	Argentina, 23 Indonesia, 87 Japan, 87 Republic of Korea, 27 Republic of Korea, 87 Malaysia, 27 Qatar, 27 Thailand, 87 United Arab Emirates, 27 United States, 10 United States, 87

APPENDIX 4 Clusters of ports and partner-products for the month of January (2015–2017) (CONTINUED)

	2015		2016		2017	
	Port	Partner-Product	Port	Partner-Product	Port	Partner-Product
Cluster 8	16 161	Argentina, 10 Argentina, 23 Australia, 27 China, 27 Japan, 27 Japan, 29 Saudi Arabia, 27 Viet Nam, 27 United States, 27	16	Kuwait, 27 Saudi Arabia, 27	4 43	Argentina, 23 Indonesia, 87 Japan, 87 Republic of Korea, 27 Republic of Korea, 87 Malaysia, 27 Qatar, 27 Thailand, 87 United Arab Emirates, 27 United States, 10 United States, 87
Cluster 9			1001	Canada, 10 Indonesia, 12 Indonesia, 23		
Cluster 10			72	Japan, 40 Japan, 73		
Cluster 11			11 21	China, 69 China, 73 China, 87 Indonesia, 30 Japan, 89 Malaysia, 15 Papua New Guinea, 44		

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