フィリピンの港湾における技術効率への民間参加の影響

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Master's Thesis

THE EFFECT OF PRIVATE PARTICIPATION IN THE TECHNICAL EFFICIENCY OF PHILIPPINE PORTS

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1. Introduction

The acceleration of economic globalization and integration has led to a dramatic increase in the flow of people and goods worldwide. With increasing demand follows advancements in various sectors of the supply chain especially in maritime transport. Trujillo and Nombela (1999) summarized the technological changes in two points: (1) containerization of cargo; and (2) development of larger and deeper specialized ships. These technical changes are argued to enable a competitive environment in the seaport industry. The development of integrated transport chains which reduced transport costs has saturated and broadened the port catchment areas in favour of ports with better facilities and connections regardless of distance. In theory, modern ports must be competitive in providing efficient services through capital investments and optimal pricing.

Globalization brought economies of scale and comparative advantage of major manufacturing and producing countries in the limelight. As larger and deeper specialized ships dominate the global fleet and global supply chain becoming more integrated, vulnerabilities have started to show up. The recent Suez Canal blockage and impacts of the global pandemic materialized the concerns of governments on the weak links of the supply-chain. Among the concerns is the ship turn-around time and port congestion. The world watched as the USA struggles to normalize the situation at the port of Los Angeles as the backlog intensifies. It is therefore important to look at port congestion when discussing port efficiency and competition.

Ports have been traditionally the responsibility of the state as it is considered a public good. There have been a lot of comparisons in literature between public and private ports and its nuances. Millan et. al. (2016) investigated the impact of public relations on the efficiency of the Spanish Ports from 1986-2012. Their research concluded that regulatory reforms that focused on the promotion of port autonomy, privatization and inter-port competition had a positive impact on the efficiency of the Spanish port system. On the other hand, Cullinane et. al. (2005), in their study on the top 30 container ports of the world in 2001 using panel data from 1992-1999, rejected the hypothesis that greater private sector involvement in the container port sector irrevocably leads to improved efficiency. There is no consensus on the direct effects of any form of privatization in port efficiency which tells us that the situation in each country is rather unique. One dimension is that port administration is not entirely the same for all countries and has their own nuances in terms of policy. Therefore, it is of best interest to compare efficiency at the national level.

1.1. The Philippine Ports System

The Philippines consists of 7,641 islands[1] and a 36,289-km long coastline. With this archipelagic setting, seaports play an important role in nation building wherein according to the Philippine Statistics Authority (PSA) commodity flow survey almost all (99.9%) of the total quantity of commodities (domestic trade) were transported by water (coastwise) in 2019 and 2020 while the remaining were through air (Figure 1). In 2017, there were about 1,800 public and private ports in the country, excluding fishing ports. These ports are managed and operated by various port management bodies namely: (1) the Philippine Port Authority (PPA) ports system consisting of public and private ports; (2) ports under the jurisdiction of independent ports authorities (IPA); (3) municipal ports devolved to the local government units (LGUs); and (4) Road RORO terminal System (RRTS) (Figure 2).

There are seven major container ports in the country which are operated by private companies with a combined design capacity of about 7.9 million twenty-foot equivalent units (TEUs). The Port of Manila is the busiest port in part due to its central location in the National Capital Region (NCR), with facilities and terminals for processing maritime trade to serve primarily the Metro Manila Area and surrounding provinces and cities. This port is the premier international shipping gateway to the country, fronting Manila Bay. Three privately managed container ports with large capacities are

[1] World Bank. 2003. Philippines: Environment Monitor 2003. Manila, Philippines.

situated in the Port of Manila, namely: Manila International Container Terminal (MICT), 2.5 million TEUs; Manila North Harbor (MNH), 2.0 million TEUs; and Manila South Harbor (MSH), 1.2 million TEUs. MITC handles primarily international container cargo, while MNH handles mainly domestic cargo. Outside of the NCR, there are four other major ports, including (in the order of capacity), the following: Davao International Container Terminal (DICT) (0.075 million TEUs) in Region 11, Subic Port (0.600 million TEUs) in Region 3, Cebu International Port (0.580 million TEUs) in Region 7, and Batangas Port (0.350 million TEUs) in Region 4A. These major ports also handle international container cargo.

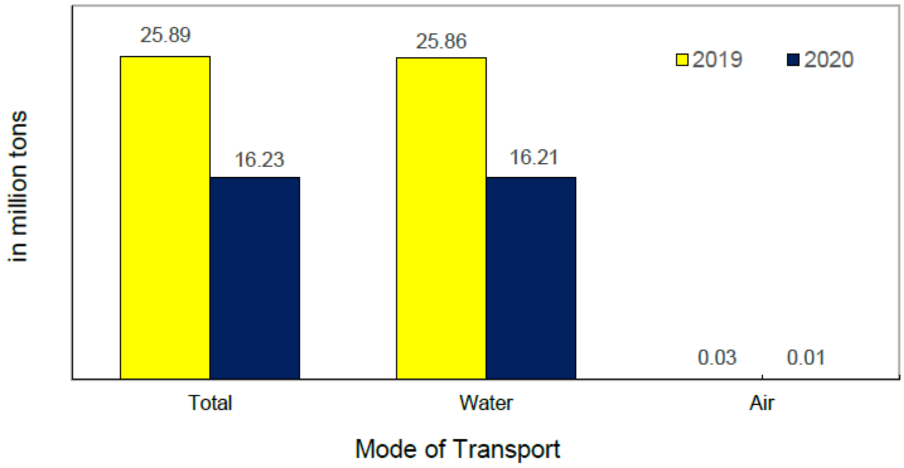


Figure 1. Quantity of domestic trade by mode of transport 2019 and 2020 (Source: PSA, 2021)

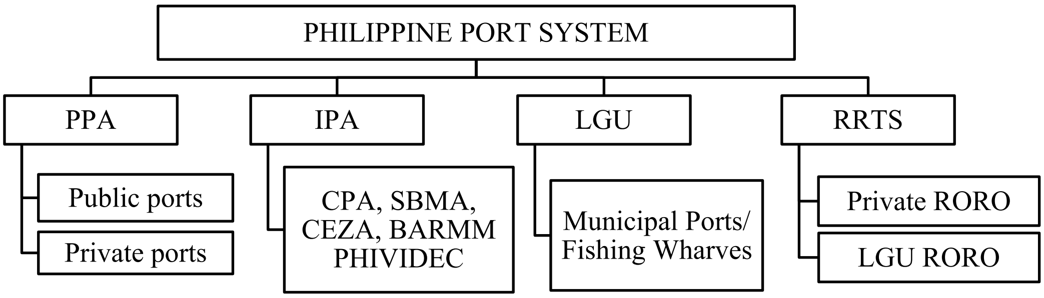


Figure 2. The Philippine port system

1.1.1. Independent Port Authorities (IPA)

There are six IPAs outside the jurisdiction of the PPA, namely: (1) Subic Bay Metropolitan Authority (SBMA), which operates and manages the Subic Bay Freeport (SBF) in Zambales; (2) Cebu Port Authority (CPA), for all ports in the province of Cebu; (3) Cagayan Economic Zone Authority (CEZA), for the Port Irene; (4) Phividec Industrial Authority (PIA), for the Mindanao Container Port Terminal (MCPT) located within the Phividec Industrial Estate in Cagayan de Oro; (5) the newly reorganized Bangsamoro Ports Management Authority (BPMA), which manages all the ports in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) which includes the Polloc Freeport and Economic Zone, Jolo, and Bongao ports; and (6) Bases Conversion and Development Authority (BCDA), which supervises the port in San Fernando, La Union, and manages the former US facility in Clark Field, Pampanga.

Excluding SBF, MCPT and Cebu International Port (CIP) under CPA, which were relatively recent developments funded in part via JICA loan, all other IPAs were devolved from the PPA. IPAs can set their own rates but usually follows suit from adjustments done by the PPA. These IPAs, with their various individual charters, were created to decentralize control of the PPA in hopes of creating a more competitive maritime industry and allow LGUs to have larger autonomy of its own ports. It is important to note that both SBF and MCPT are being operated by Subic Bay International Container Terminal Corp. (SBITC) and Mindanao International Container Terminal Services, Inc (MICTSI) respectively, which are affiliate companies of Philippines-based global port operator International Container Terminal Services, Inc. (ICTSI). CIP was also operated by an ICTSI affiliated company Cebu International Container Terminal, Inc (CICT) until it was sold and transferred to another private company in 2014.

Figure 3. Subic bay freeport (left) and Mindanao Container Port Terminal (right) (Source: ICTSI, 2020)

1.1.2. Local Government Units (LGU) and fish ports

The Department of Transportation (DOTr) as part of its mandate also develops and funds the construction of small landing stages and feeder ports, which eventually are handed over to the LGUs. As of 2018, 1,190 municipal ports are owned and managed by LGUs that provide linkage among neighbouring small islands and nearby urban centers. Municipal ports generally cater to small passenger and fishing boats. Fishing ports also operate at the regional (8 ports) and municipal (79 ports) levels, managed either by the government or the private sector, primarily to serve the fishing business. Ports under the jurisdiction of LGUs are those built by the national government but then devolved to municipal governments and those built by the LGUs themselves. Fishing ports are basically used for fishing but nevertheless handle some commercial cargo transfer under the agreement of the PPA and the Philippine Fisheries and Development Authority (PFDA).

Some LGU ports such as in Malalag, Davao del Sur were reverted to PPA's administration after considerations on funding for the operations, maintenance, and development of the port facilities. On the other hand, the PFDA as a national government agency and a GOCC have enough resources to operate and develop its nine regional and 136 municipal fish ports which moved 2,931 metric tons of fishery products in 2020.

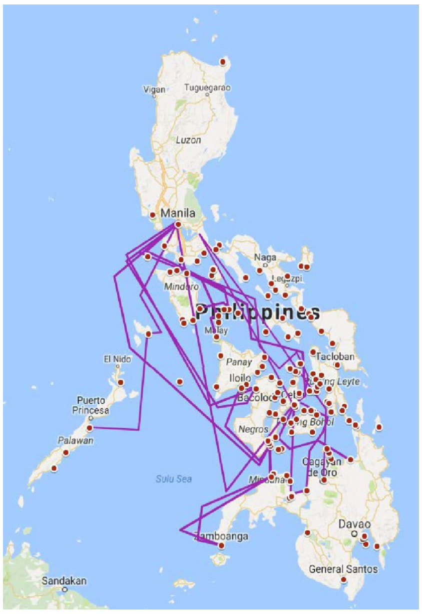
Figure 4. Malalag Port (left, Source: PPA, 2019) General Santos fish port complex (right, PFDA, 2019)

1.1.3. Road-RORO terminal system (RRTS)

The Road-RORO terminal system (RRTS) was established in 2003 through Executive Order (EO) 170 serving as an integral part of the national highway network functioning as movable bridges.

It is a network of terminals all over the country linked by RORO vessels which goal is to provide greater access to the island provinces and better integration among different regions. The system is primarily a response to connect with greater efficiency and lower cost in transporting passengers and goods from Mindanao to Luzon. EO 170 is among the few radical policies in the maritime industry that pushes for greater participation of the private sector. It calls for private sector and LGU collaboration in the establishment of RORO links as part of the national highway network (Basilio, 2003). It does this by mandating the privatization and/or devolution of existing public RORO ports under the PPA and CPA. Existing private port operators were facilitated to integrate their operations to the RRTS. While there is no consensual agreement on the effects of the RRTS in the maritime industry in that a study by Kobune (2008) indicated that the inter-island shipping in terms of total transport cost is competitive only within a 200-km distance whereas Odchimar and Hanaoka (2015) highlighted the positive effect of the RRTS in the development of intermodal transport network in the Philippines, as seen in Figure 5, its effect on expanding inter-island connectivity is evident.

A. Roll-On Roll-Off Terminal System
(Strong Republic Nautical Highway)



B. Primary Routes
(Long Haul)

C. Secondary Routes
(RORO + Fastcrafts)

Figure 5. Domestic shipping routes (source: MARINA, 2019)

Figure 6. RORO ports Liloan (left) and Lipata (right) (source: JICA, 2004)

1.1.4. The Philippine Ports Authority (PPA)

The PPA port system is the most critical and extensive network of ports in the country. As of 2019, PPA's jurisdiction covers a total of 291 ports wherein 177 are private (30 commercial and around 147 non-commercial) and 114 are PPA-owned ports (89 are terminal ports and 25 are baseports) which are being managed through 25 Port Management Offices (PMO). On July 11, 1974, the Philippine Ports Authority (PPA) was created through the issuance of Presidential Decree (PD) No. 505 as amended by PD 857 issued on November 16, 1978, recognizing the need to integrate and coordinate port planning, development, control, and operations at the national level while at the same time promoting the growth of regional port bodies referred to as Port Management Units (PMU), which are now called PMO, with localized perspective.

The PPA-owned ports were developed and are being maintained by the PPA. The largest common-user ports in the Philippines are concentrated in the NCR, Manila. In particular, it is concentrated in the Port of Manila, located at the west end of the City of Manila directly facing Manila Bay. It is divided into the MICT and the South and North Harbors. The MICT and South Harbor are under long-term concessions with the private sector whereas North Harbor cargo handling services are provided by a private cargo handling company. Other major PPA-owned ports outside of Manila are also being served by private cargo handling companies such as the case of General Santos and Cagayan Port. Private ports are mostly operated for industrial use; there are, however, some which were given permits by the PPA to operate for commercial purposes such as the Harbour Centre Port Terminal (HCPT) in Manila that operates both as a domestic and a foreign port. HCPTI competes with PPA-owned ports South Harbor, and North Harbor.

The PPA has no investment in the private ports but receives a share of port dues (i.e., 50% share from usage/berthing fees and wharfage dues). There are around 30 private commercial ports, e.g., Allen Port in Samar, San Lorenzo Port in Guimaras, Bredco in Bacolod, Tefasco port in Davao and the recent DICT also in Davao. In the past, private commercial ports rarely provide competition to PPA ports apart from HCPT that operates in the same area in Manila where the PPA ports operate. The PPA is financially autonomous from the government and earns revenues from (a) concession fees from the lease of South Harbor and MICT; (b) port charges such as wharfage, berthing, pilotage, etc.; and (c) a share of cargo handling revenues from private cargo handling operators and from port charges of privately operated ports. Its ports handle domestic and foreign cargo (containerized and bulk) and passengers while some PPA-owned ports include RORO operations.

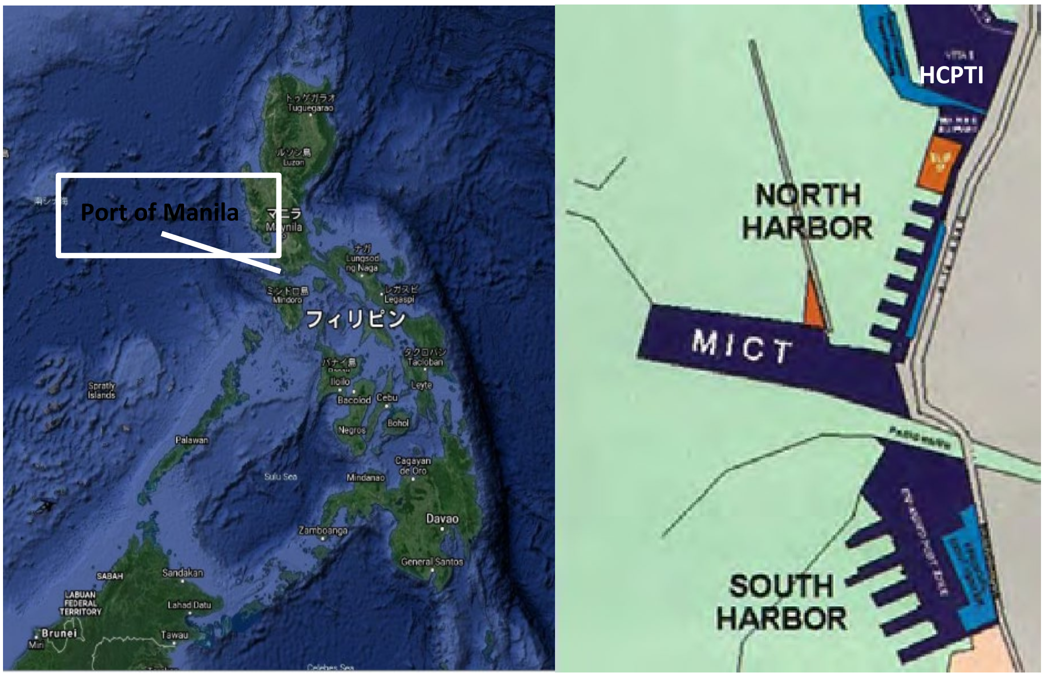


Figure 7. Port of Manila (Source: PPA)

The formal mandate of the PPA is to establish, develop, regulate, manage, and operate a rationalized national port system in support of trade and national development. The "operate" component of the mandate refers to the role of the authority as a port operator with an obligation to contribute 50% of its net income as dividend to the national government as a Government Owned and Controlled Corporation (GOCC). This dual role of the PPA as both a regulator and operator has been challenged by many researchers and policy makers alike. Basilio (2006) argued that the PPA charter confides regulatory capture and summarised it into four points.

1. PPA has both developmental and regulatory powers. In carrying out its development mandate, PPA works closely with all the operating elements in port development and operations (shipping, cargo handling, terminal operations) – which are the same parties it is supposed to regulate in the industry.

2. Conflict of interest. By virtue of PD 857, PPA has a share from revenues in cargo handling of at least 10%. This ensues conflict of interest as PPA might increase rates not based on merit or financial justification but for its fiscal benefits. Basilio noted that in the past cargo handling share has reached as much as 33% and furthered that PPA almost always approves petitions for a rate increase even in the absence of petitioners and public hearing/s.

3. Bias towards multiple cargo handling. The income that PPA accrues from cargo handling operations perpetuates a system based on "multiple" cargo handling, that is, more cargo handled means more revenues generated.

4. The port is a huge government monopoly. As the primary port regulatory body, PPA fixes rates and collects dues such as wharfage, berthing/usage fees and revenue share from cargo handling (arrastre and stevedoring). On the other hand, as a corporation, PPA is among the few GOCC that does not require national government funding for its budgetary requirements despite having to remit 50% of its net income. Arguably, this incentivises the PPA to increase rates to generate more revenue and enact regulations that are predatory to competitors.

The biggest take-away from these points is the prevalent choice of the PPA of becoming primarily a revenue-generating agency or a service-provider and its effects in the maritime industry of the Philippines. Regulatory capture exhibits partiality towards the industry's interest at the expense of the consumers. Furthermore, according to Limao and Venables (2001) 40 percent of predicted transport costs for coastal countries like the Philippines may be explained by the quality of onshore infrastructure accounts. Therefore, any inefficiencies in this sector inevitably passes costs on to the general population.

"The inefficient sea transport and distribution system in the country has served through the years as an effective barrier to domestic trade. It has stymied countryside development, efforts to improve productivity at the farm level, and promote tourism and the global competitiveness of our exports. Worse, these inefficiencies have resulted in the high cost of transporting goods as well as in the degradation of the quality and quantity of the products being shipped. To a large extent, the high domestic transport cost and the attendant problems in transporting our goods between the islands can be traced to the inefficiencies in our ports." (Basilio, 2007)

The PPA regulates through awarding of contracts for cargo handling services to the private sector in owned ports and regulates the entry of the private sector through the issuance of permits to construct and operate ports. Furthermore, the PPA has no investment in the private ports but receives a share of port dues (i.e., 50% share from usage/berthing fees and wharfage dues). Despite this, severe fiscal constraints in the Philippine government widened the gap in the demand for more efficient port-infrastructures. In their policy paper Basilio et. al. (2007) argued that undue regulatory intervention in the potentially competitive sector gives rise to inefficiencies and lower level of welfare. They concluded that the PPA may have a weak incentive to promote competition to protect its own interest and could induce inefficiencies and anticompetitive behavior of firms involved in the port industry.

1.2. Privatization trend in the global port industry

Traditionally, many public goods and services with its lumpy initial capital requirement such as roads, water, electricity generation and distribution and ports have been traditionally set up by the government. In the Philippines, for example, the government has even invested in oil refinery and airlines to jumpstart these industries when they were still at their infancy and did not make much financial sense given the premature demand at the time. At the turn of the last century, however, many public goods such as roads, electricity and water has proven financially viable which attracted the eye of the private sector. Arguably the trendsetter of 'privatization' has been Thatcher's UK government in the early 1980s. The objective of which was to improve efficiency and competition in the various sectors. To this day, experts fall on both sides when assessing the impact of privatization vis-à-vis expectations. Nevertheless, privatization and its nuances has found success in various industries from different governments that followed suit. One industry that joined the bandwagon is the seaports.

Privatization depending on which industry is quite nuanced. In the port industry, World Bank (2007) defined the mixture of public and private sectors involvement into the following four categories:

> **Services port**: Services ports are mainly public in character. The port authority is responsible for the port as a whole. It owns, maintains, and operates the infrastructure and superstructures, and cargo handling services are executed by labor hired by the port authority itself. Many ports in developing countries are still structured according to this model.
>
> **Tool port**: Port infrastructure and superstructure are owned and managed by the port authority. Private cargo handling companies use these facilities through concessions or licenses.
>
> **Landlord port**: In this model, port infrastructure is owned by the port authority but is leased to private operating companies and/or industries. The private port operators provide and maintain their own superstructure, including buildings, cranes, vans, and forklifts. The port authority acts largely as a regulator and as a landlord, while port operations are carried out by

the private sector. This model is increasingly becoming popular in large and medium-sized ports worldwide.

Fully privatized port: In this model, the state basically has no meaningful participation. Ownership of port land is transferred to the private sector. Regulatory functions are also passed on to the private successor. Therefore, privatized ports are essentially self-regulating.

In this study, World Bank's four port categories is adopted to delineate public-private participation. In particular, this study covers 46 commercial ports in the Philippines under PPA jurisdiction. Of the 46, 26 are tool ports, 3 are landlord ports, and the remaining 17 are private commercial ports. Tool ports were further divided into two groups tool ports A and B where tool ports A are ports in which the private sector has invested heavily in cargo handling equipment such as ship-to-shore (STS) cranes or mobile cranes and rubber-tired gantry (RTG) cranes. There are six ports that fall in these criteria, namely, North Harbor, Cagayan de Oro (CDO) port, Sasa port, Zamboanga port, Tagbilaran port, and Dumaguete port where the remaining 20 falls under tool ports B. Figure 8 shows the location of the ports considered in this study while Table 1 enumerates the ports under the scope of the study.

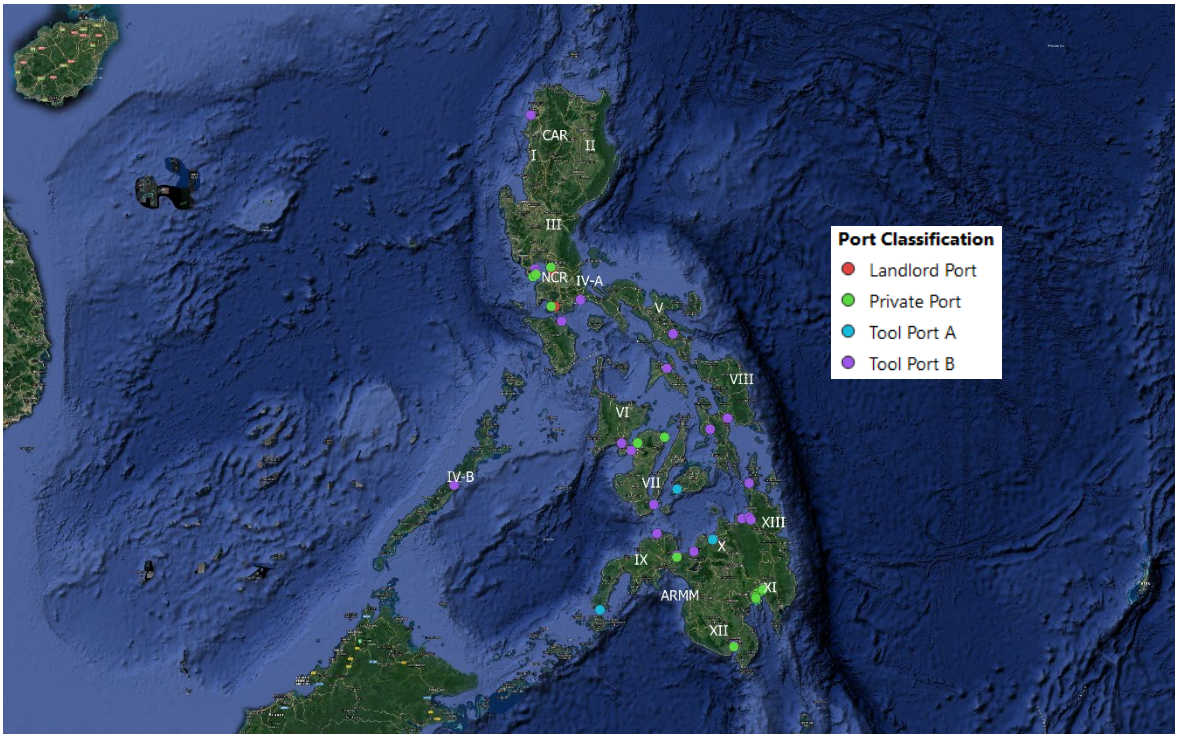


Figure 8. Major PPA ports

1.2.1. Services and tool ports

Services and tool ports are primarily owned and operated by the PPA. Major PPA ports are classified as baseports which house PPA PMOs while the other ports attached to their management are called terminal ports. Locations of these PPA-owned ports are shown in Figure 9. All baseports and some terminal ports have concessions for their cargo handling and are served by the private sector and therefore fall under the tool ports category. However, as mentioned above only six ports have the private sector heavily investing in cargo handling equipment. These ports are as follows (in order of annual throughput): North Harbor in Manila, CDO port in Misamis Oriental, Sasa port in Davao city, Zamboanga port in Zamboanga del Sur, Tagbilaran port in Bohol, and Dumaguete port in Negros Oriental.

Table 1. List of ports under the study

Port	PMO	Classification	2019 Throughput (in metric ton)
NCR North	NCR North	Tool Port A	27,861,039.24
MICT	MICT	Landlord Port	23,981,084.13
CDO	CDO	Tool Port A	6,683,369.42
NCR South	NCR South	Landlord Port	6,062,327.07
HCPTI	NCR North	Private Port	5,300,791.14
BREDCO	Negros Occidental	Private Port	5,180,680.27
Iloilo	Iloilo	Tool Port B	4,089,048.47
Davao	Davao	Tool Port A	3,880,318.54
Gensan	Gensan	Tool Port B	3,594,326.85
Seafront	Bataan	Private Port	3,432,763.99
DICT	Davao	Private Port	3,144,846.67
Zamboanga	Zamboanga	Tool Port A	2,567,770.00
Batangas	Batangas	Landlord Port	2,495,559.18
TEFASCO	Davao	Private Port	1,953,790.37
Tagbilaran	Bohol	Tool Port A	1,927,675.95
Palawan	Palawan	Tool Port B	1,573,429.78
KTC	Davao	Private Port	1,537,733.29
SLHBTC	NCR North	Private Port	1,425,081.01
Nasipit	Agusan	Tool Port B	1,251,555.04
Samar	Samar	Tool Port B	1,011,705.63
Ozamiz	Ozamiz	Tool Port B	932,013.43
PNOC ESB	Batangas	Private Port	814,673.34
Dumaguete	Negros Oriental	Tool Port A	792,993.28
Legazpi	Bicol	Tool Port B	753,359.56
Energies	NCR North	Private Port	737,879.68
Kudos	Davao	Private Port	707,498.57
MGC	Bataan	Private Port	641,437.17
Surigao	Surigao	Tool Port B	468,617.91
Ormoc	Western Leyte	Tool Port B	441,251.20
BPSC	Negros Occidental	Private Port	406,684.00
ZDN	ZDN	Tool Port B	360,103.79
Banago	Negros Occidental	Tool Port B	320,034.07
Masbate	Masbate	Tool Port B	305,268.15
Iligan	Iligan	Tool Port B	289,735.39
DUCOMI	Negros Oriental	Private Port	215,347.98
HIPSI	Davao	Private Port	165,465.29
Quezon	Quezon	Tool Port B	126,285.27
Bataan	Bataan	Tool Port B	123,571.29
Pulupandan	Negros Occidental	Tool Port B	46,296.12
Calapan	Mindoro	Tool Port B	44,733.51
Masao	Agusan	Tool Port B	41,878.85
SFI	Gensan	Private Port	26,043.42
Butuan	Agusan	Tool Port B	17,327.60
Currimao	North Luzon	Tool Port B	3,777.52
Daima (2015)	Iligan	Private Port	1,274,201.00*
R2 (2010)	NCR North	Private Port	5,051,272.00**

* Commercial operation terminated by 2015
** Operation terminated by 2010 and reorganized as HCPTI starting 2011
Source: PPA

North Harbor is situated in the north part of the Port of Manila. It is a multipurpose terminal, handling mainly domestic cargoes. With its 57-ha port area, a total berth length of approximately 5,440-m and average draft of 10-mllw handles the largest domestic cargo in the Philippines. The cargo throughput in 2019 was 27,861,039 metric tons (mt) which were all domestic trade. Of the total cargo throughput, 26,489,223-mt (95%) were containerized and the remaining 1,371,816-mt (5%) were breakbulk. A total of 4,380 ships called in 2019 at an average total dwell time of 46.87-hrs per ship. North Harbor with its 15 piers have cargo handling served by various private companies with a combined number of eight shore cranes, 25 rubber-tired gantry cranes and a fleet of forklifts and trucks. The North Harbor is under talks of being privatized with ICTSI leading the bid.

CDO Port is located in the northern area of Mindanao Island. It is the largest port in northern Mindanao and acts as a gateway supporting the economic activities in Cagayan de Oro City and Provinces of Misamis Oriental, Bukidnon, Camiguin, and Agusan del Norte. The 25-ha port with 1,256-m berth at an average of 12.3-mllw handled 6,683,369-mt in 2019, where 5,119,522-mt (77%) were domestic and 1,563,847-mt (23%) were foreign cargo. Containerized cargo were 2,524,332-mt (38%) while the remaining 4,159,037 (62%) were a mix of breakbulk, liquid bulk and dry bulk (in decreasing order). A total of 2,727 ships called at CDO port in 2019 at an average total dwell time of 35.71-hrs per ship. CDO port cargo handling services is operated by Oroport Cargo Handling Services, Inc. and is equipped with four shore cranes, nine rubber-tired gantry cranes and a fleet of forklifts and trucks of various sizes and capacities.

The port of Davao locally known as Sasa port is located on the south-east coast of Mindanao Island, opposite Samal Island across Pakiputan Strait. The port supports the economic activities in Southern Mindanao and its catchment area reaches as far north as Bukidnon coalescing with CDO port. Its 18-ha area handled 3,880,318-mt in 2019 wherein 1,799,219-mt (46.4%) are domestic and 2,081,099-mt (53.6%) are foreign cargo. A total of 2,740,065-mt (70.6%) were containerized and the remaining 1,140,253 (29.4%) are a mix of breakbulk and dry bulk (in descending order). A total 777 ships called at Sasa port in 2019 with an average total dwell time of 60.10-hrs per ship. The cargo handled by Sasa port peaked at 5,353,329-mt in 2011 and as it experienced worsening port congestion the PMO decided to permit more the operation of private commercial ports to handle the spillage. Davao region perhaps has the highest private participation and competition in the Philippines after the spillage brought up two additional private ports. Sasa port cargo handling services are handled by two private companies namely Filipinas Port Services, Inc. (FILPORT) and Davao Integrated Port and Stevedoring Services Corp. (DIPSSCOR) which is owned in part by ICTSI. Despite being a gateway port in the southern part of the Philippines, Sasa port is not equipped with any shore cranes limiting the vessel that can call there to those equipped with their own cranes. The port however has three RTGs owned by DIPSSCOR. Talks about modernization of the port came as early as 2015 but are currently being processed for development under an unsolicited Public-Private Partnership (PPP) program Build-Operate-Transfer (BOT) scheme. In 2019 PPA has already granted Chelsea Logistics and Infrastructure Holdings Corp. the original proponent status (OPS) for the Davao Sasa Port modernization project with an estimated investment of PhP19.89-billion. This allows Chelsea to match any bid from competitors in a Swiss challenge for the award of the project.

The port of Zamboanga is located at the southernmost tip of the Zamboanga Peninsula, in south-west Mindanao. The port's significance is not only as a shipping port of local products like copra and rubber, but also as a gateway to the neighbouring countries potentially playing a huge role in the Brunei Darussalam–Indonesia–Malaysia–Philippines East ASEAN Growth Area (BIMP-EAGA). It covers 57-ha with a 1,720-m long berth at an average of 8-mllw draft. In 2019, the port handled 2,567,770-mt wherein majority are domestic at 2,290,935-mt (89.2%) and the remaining 276,835-mt (10.8%) are foreign trade. It has a balanced mix of containerized cargo at 1,486,654-mt (58%) with the remaining 1,081,116-mt (42%) largely breakbulk. A total of 10,149 ships (including fishing vessels) called at the port making the average total dwell time of ships at 18.79-hrs. The cargo handling services are provided by Zamboanga City Integrated Port Services, Inc. where one mobile crane and one top lifter is used.

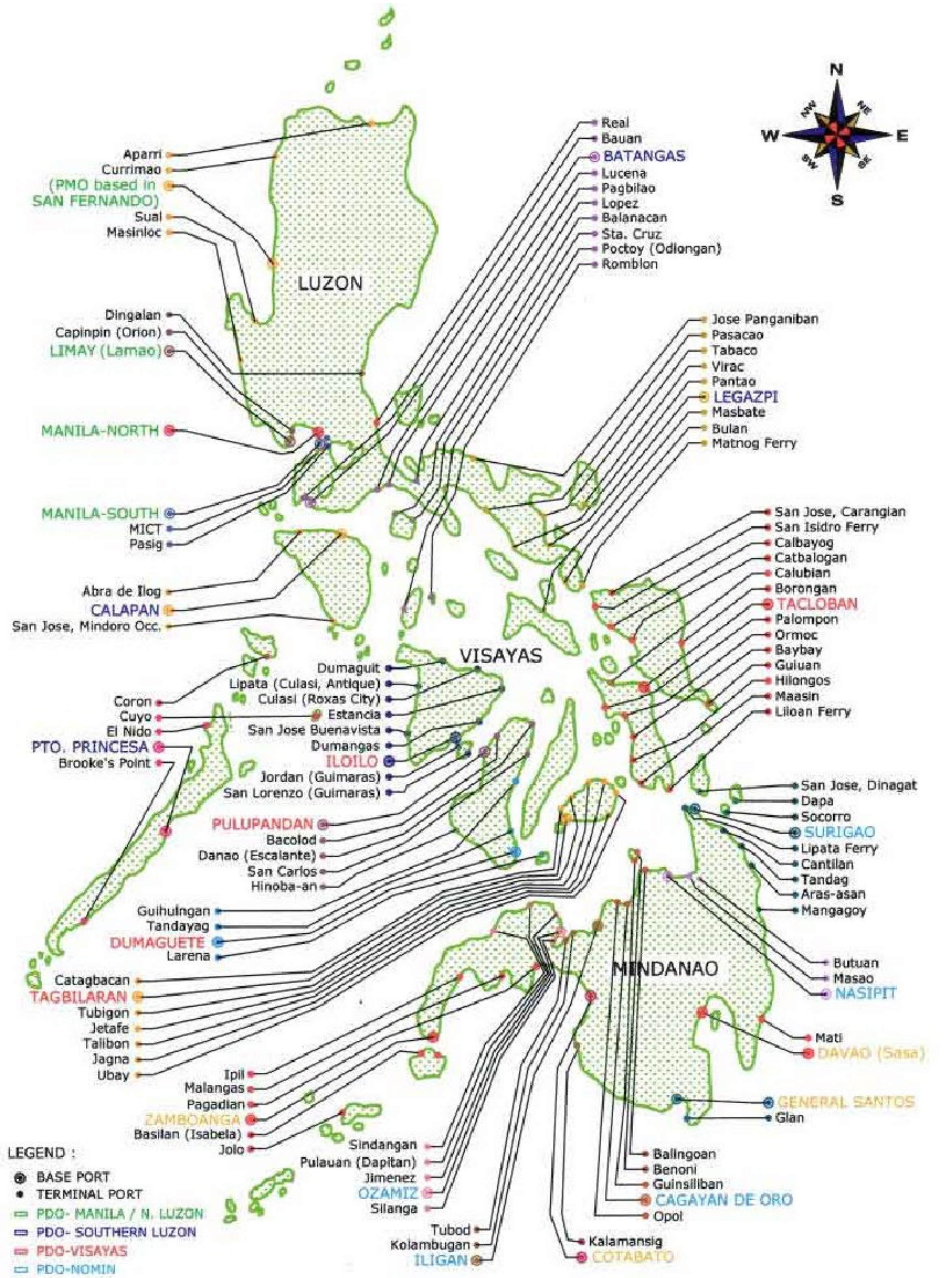


Figure 9. Location of PPA owned ports per PMO (source: JICA 2004)

Iloilo port is the biggest port under tool ports B category. It is located on the south-east coast of Panay Island, opposite Guimaras Island. The port is a regional base port, supporting the economic activities of both Panay Island and Guimaras Island. It consists of three terminals: Loboc, Fort San Pedro and Muelle Loney. In 2019, the terminals handled 4,089,048.47-mt where 2,950,652-mt (72.2%) were domestic trade while 1,138,396.47 (27.8%) were foreign. Majority of the foreign cargo, 1,099,756-mt (96.6%) are containerized imports whereas about 1,800,000 (61%) of domestic trade were containerized and the remaining 1,150,652-mt (39%) are breakbulk, dry bulk and liquid bulk (in descending order). There were 19,137 ships that called at the three terminals at an average of 15.08-hrs total dwell time per ship. Loboc terminal otherwise known as Iloilo Commercial Port Complex (ICPC) has its cargo handling serviced by Visayan Vets Port Services, Inc. and has no STS and RTG installed. Fort San Pedro terminal is operated by Iloilo Integrated Arrastre Services Corporation while Muelle Loney terminal is serviced by Prudential Customers Brokerage Services, Inc. and both also have no STS and RTG installed. ICTSI has also proposed for the development and modernization of ICPC via an unsolicited joint venture (JV) proposal and has already been granted an OPS by PPA at an estimated investment of over PhP8.7-billion including dredging and deepening of the drafts and channel to allow the direct entry of new generation, international vessels; and purchase of modern quayside crane handling equipment estimated to cost around PhP1.35 billion.

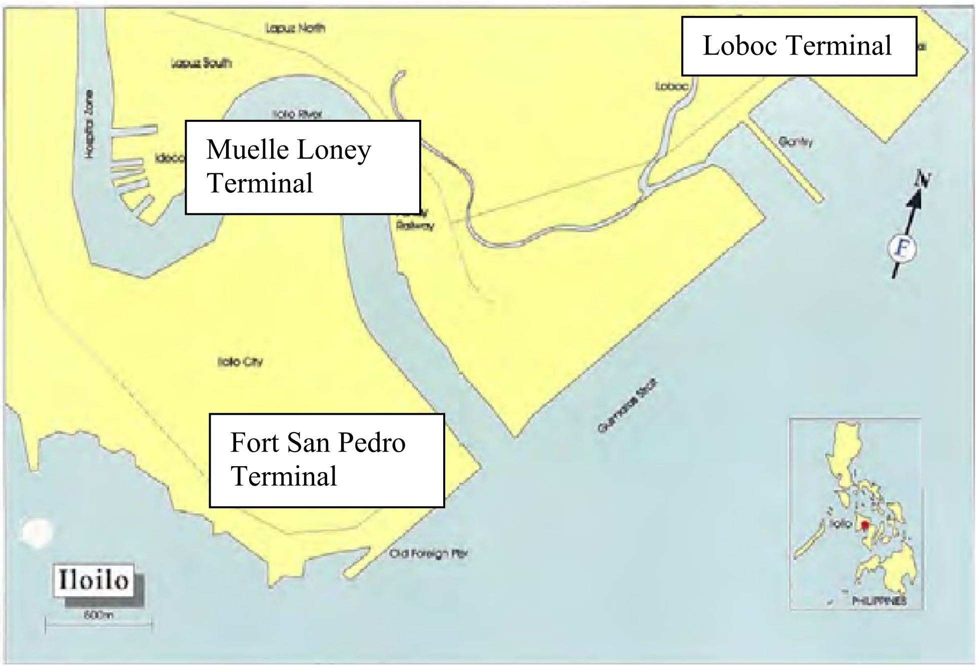


Figure 10. Iloilo Port (Source: PMO-Iloilo)


Figure 11. Tool ports North Harbor (upper left), CDO port (upper rigth), Sasa port (lower left) and Gensan port (lower right) (source: PPA and ICTSI)

Gensan port, otherwise known as Makar wharf, sits on a 5.5-ha area and handled 3,594,326-mt in 2019. About 1,627,822-mt (45.3%) were domestic cargo while 1966504 (54.7%) were foreign. Around 2,819,149 (78.4%) were containerized and the remaining 775,177 (22.6%) were breakbulk and dry bulk (in descending order). A total of 1,226 ships called at Gensan port in 2019 at an average of 40.12-hrs total dwell time per ship. The port with cargo handling operated by South Cotabato Integrated Port Services, Inc. (SCIPSI) an affiliate of ICTSI has no shore cranes and rubber-tired gantry cranes. Kudos Trucking Corp, a private terminal operator located in Davao, submitted an unsolicited proposal for the development, operations and maintenance of Gensan port pegged at PhP5.2-billion.

1.2.2. Landlord ports

The first major initiative by the government to promote competition in the port system was the privatization of the terminal operation of the MICT in 1987. A 25-year contract was awarded to the ICTSI giving them the rights to develop, operate and maintain the port within the contract period. This is the first successful case of the implementation of a "landlord" port model in the country. South Harbor followed suit after a decade later with the awarding of the terminal operation of the to a private company ATI. There are currently three landlord ports in the Philippines, namely MICT, South Harbor and Batangas port (in descending order of capacity). While they are technically owned by the PPA, the long-term concession period minimizes administrative risks on the side of the private sector and provides enough time to recuperate long-term and lumpy investments characterized by port infrastructures and superstructures.

MICT is situated between the South Harbor and North Harbor. It is the biggest container terminal and mainly handles export and import containers. MICT has been operated by ICTSI since 1987 under the management of the MICT PMO of PPA. The port with its 94-ha area, 1,300-m long berth, at an average draft of 13.5-mllw handled a staggering 23,981,084.13-mt cargo in 2019. Of the handled cargo, 23,873,318 (99.6%) were foreign trade and the remaining 107,766-mt were domestic. Almost all cargoes were containerized at 23,864,174-mt (99.96%) where 18,714,713-mt (78.4%) were imports and 5,149,461-mt (21.6%) were exports. There were 1,740 vessels, which were mostly foreign, that called at the port in 2019 at an average of 36.98-hrs total dwell time per ship. MICT's capacity increased to 3.3 million TEUs with the completion of the expansion works at Berth 7 in 2020 and has committed to replacing its fleet of RTGs with a more environmentally friendly hybrid model since 2018. At the end of 2019, the port has 16 STS and 49 RTGs. MICT is bullish in upgrading its facilities by refurbishing Berths 1 to 5 and their back up areas in preparation for the next 25 years of operation. These include the installation of an additional 450 reefer plugs for 40 footers and the upgrade of the yard infrastructure of Berths 1 to 5 by the end of 2022.

Figure 12. MICT berth 1-5 (left) and newly constructed berth 7 (right) (Source: ICTSI)

South Harbor is situated on the south of the Port of Manila, and divided up into 3 areas; the container terminal with Pier 3 and Pier 5, the general cargo terminal with Pier 9 and Pier 13, and the Ro-Ro terminal with Pier 15. The South Harbor has been operated by ATI since 1997 under the management of PMO South Harbor of PPA. The 85-ha port with a 1,986-m long berth averaging a depth of 12-mllw handled 6,062,327.07-mt of cargo in 2019 which were all foreign trade. Around 5,225,933-mt (86.2%) were imports and the remaining 836,394.07-mt (13.8%) were exports. Majority of the cargo handled 5,572,252-mt (91.9%) were containerized and the remaining 490,075.07-mt (8.1%) were breakbulk. A total of 1,191 foreign vessels called at the port with an average total dwell time of 67.14-hrs per ship. The port operates with nine STS cranes and 23 RTG cranes and is planning to expand the fleet to 11 STS and 28 RTG cranes upon completion of the Pier 3 berth extension project which will increase the port capacity form 1.5-million TEUs to 1.9-million TEUs.

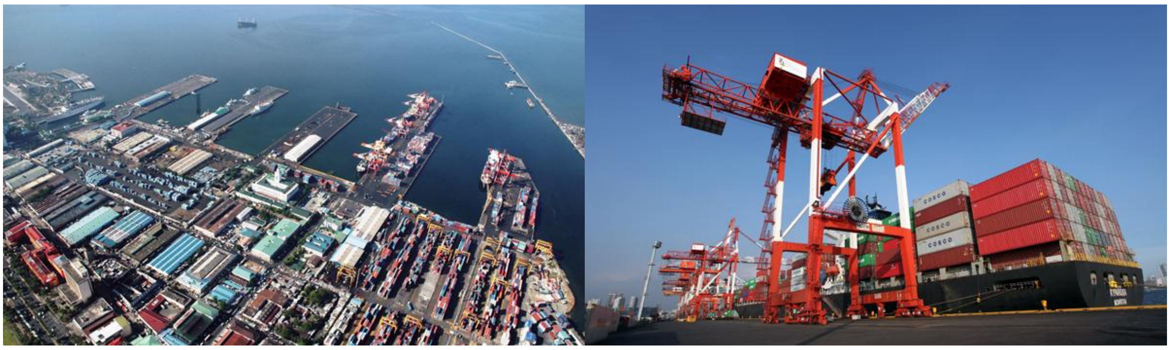


Figure 13. South Harbor overview (left) and Pier 5 (right) (Source: ATI)

The port of Batangas is located in the south of Luzon Island opposite the north shore of Mindoro Island, 110-km south of Manila. The hinterland is mainly Region 4-A also known as CALABARZON (Cavite, Laguna, Batangas, Rizal and Quezon Provinces). It is the most recent addition to the landlord port status when ATI was awarded a 25-year concession period in 2010. Since the concession ATI has doubled the number of STS and RTG to four and eight respectively in 2019. The 150-ha port with its 2,689-m long berth at 15-mllw average depth handled 2,495,559.18-mt in 2019 where 1,710,248-mt (68.5%) were foreign and 785,311.18-mt (41.5%) were domestic. Foreign cargoes were mostly containerized at 1,100,354-mt (64.4%) imports and 291,893-mt (17.1%) exports and the remaining 317,696-mt (18.6%) are breakbulk imports. Domestic cargo on the other hand is a good mix of containerized, breakbulk and a few dry bulk and liquid bulk (by descending order of throughput). The port connects the Luzon Island to the RRTS hence having a large number of ships at 34,336 that called at the port with an average total dwell time of 5.89-hrs per ship. The port complements the Manila port in the Philippines, but accounts for approximately only 5% of all containers in Manila because of its low level of services and remoteness from central Manila (JICA, 2016). However, an increase in volume is seen driven by the natural shift of south-bound cargoes, growing customer preference and sustained carrier momentum (ATI, 2020).

Figure 14. Batangas port Phase I (left) and Phase II (right) (source: ATI)

1.2.3. Private ports

Following the landlord port initiatives for MICT in 1987, Memorandum Circular No. 45 in 1993 directed all concerned government agencies to liberalize and promote increased competition in the support service sector, particularly land, air and sea transportation, communication, energy, insurance, and port services. In response to this, the PPA issued a permit to R-II Builders, to construct a 15-ha private port facility in a reclaimed area under Smokey Mountain Development Plan (SMDP). The port was then reorganized as Harbour Centre Port Terminal (HCPT) and envisioned to operate as a private commercial port directly competing with the ports in Manila. Furthermore, Memorandum Order No. 47 (2001) directed the PPA to assist in the technical evaluation of port-related land use in the reclaimed areas and expeditiously process applications for the permits for private commercial ports. With this PPA issued HCPT a permanent commercial permit to operate and handle (a) all types of domestic vessels and cargoes and (b) foreign vessels and cargoes chartered by the locators at Harbour Centre. In 2003, the PPA expanded HCPT's permit to handle foreign breakbulk traffic not limited to its locators. However, The PPA has not issued HCPT the permit to handle foreign containerized cargoes despite HCPT's satisfaction of the PPA's requirements for the issuance of the permit. Nevertheless, the success of the HCPT gave precedence for the private sector to get involved in port development and operation.

HCPT operates the 10-hectare multi-purpose port terminal inside the port-city complex called the Manila Harbour Centre strategically located within the heart of Manila's Port District. In 2019 it handled 5,300,791.14-mt where 4,325,998-mt (81.6%) were foreign and 974,794-mt (18.4%) were domestic cargo. Majority of the foreign cargo imports where 3,761,067-mt (87%) were breakbulk imports while the remaining foreign cargo were dry bulk imports (12%) breakbulk, dry bulk and a few transit cargo. In the same year, 522 vessels called at the port at an average total dwell time of 261.87-hrs per ship with only one STS crane in its operations. ICTSI in 2019 acquired additional shares from the previous 34.83% to about 50% of HCPT and is now on the transition of processing the recent acquisition of the remaining shares during the first quarter of 2021.

The Bacolod Real Estate Development Corporation (Bredco) port is the second largest private commercial port in the Philippines in terms of cargo throughput. It is located in Bacolod city, Negros Occidental of the Visayas island. In 2019, the 26-ha port with a 2,400-m long berth and 7-mllw depth handled 5,180,680.27-mt cargo where majority were domestic cargo at 4,266,133-mt (82.3%) and 914,547-mt (17.7%) foreign cargo. Around 2,998,579-mt (58%) were containerized and the remaining are a good mix of breakbulk, dry bulk and liquid bulk (in descending order). Its one STS crane helped in processing 19,487 vessels at an average of 8.55-hrs total dwell time per ship.

Davao region in the Mindanao Island houses two of the top-five private commercial ports namely, Davao International Container Terminal (DICT) and Terminal Facilities Services Corporation (TEFASCO) while a third port owned in part by ICTSI Hijo port is currently under-performing. DICT and Hijo ports catered to the excess container handling capacity of the congested Sasa port. DICT, which started its operations in 2013, is arguably the most modern container port terminal in the Philippines outside of Manila. It is a joint venture between the Anflo Management and Investment Corporation (ANFLOCOR) and Dole-Stanfilco, the leading producers and exporters of fresh Cavendish bananas in the Philippines. DICT operates using the latest terminal operating system (TOS) Navis N4 that powers the efficient movement of incoming and outgoing containerized cargoes. They have two (2) Panamax and another two (2) post-Panamax ship capable STS crane and seven RTGs, 720 reefer plugs, two-berthing areas totalling 256-m long or 2,903-sq.m, cargo sheds totalling 8,320-sq.m, a 5,184-sq.m warehouse, and, cold storage facilities that is able to handle 35,500 boxes all located in their 1.6-ha port facilities in Brgy. Bayawa, Panabo City which is 27-kms away from Sasa port. The port which has 8.8-ha reserved area for expansion also has an average draft of 15-m is the only port in Mindanao that can accommodate Panamax vessels. DICT handled 3,144,846-mt in 2019 which were mostly containerized cargo with 1,798,424-mt exports and 1,146,945-mt imports. There were 538 vessels that called at the port in the same year at 31-hrs total dwell time per ship at an average. In 2012, ICTSI partnered with the Hijo Resources Corp to develop the Hijo International Port. It has a berth of 274-m with a draft of 13-m. The port area is 20-ha and is adjacent to the PEZA declared Hijo Industrial Estate economic zone. Hijo port is approximately 47-kms from Sasa port. The port was underperforming, handling only 165,465-mt in 2019 and ICTSI pulled out one of their STS cranes in 2017.

TEFASCO is a sister-company of Solid Lines which operates its own wharf in Brgy. Ilang, Tibungco, less than 5 kilometers away from Sasa Port and primarily to service the ships of its sister company but also other ships diverted from the congested Sasa Port. In addition to its 400-meter berthing space, the port has three (3) cargo sheds, one (1) cold storage warehouse and a 15,000-sq.m. CY. Further across the national road is a 30-ha warehouse complex operated by another TEFASCO sister company. It handled 1,953,790-mt in 2019 with 1,149,623-mt (59%) foreign and 804,167-mt (41%) domestic cargo. Cargoes were a good mix of 990,183-mt (51%) containerized, 897,698-mt (46%) dry bulk and breakbulk for the remaining.

Figure 15. HCPT (upper left), DICT (upper right) and TEFASCO (below) (Source: HCPT, DICT and TEFASCO)

1.3. Research Purpose

The Philippines as an archipelagic nation depends primarily on the maritime industry in moving goods for both inter-island trade and global trade. The country is still undoubtedly considered a developing nation but displayed one of the highest growth rates in the Asia-Pacific region prior to the global pandemic. Despite being hit hard by the pandemic with the service sector leading its economy, the vibrant population and young workforce among other economic drivers are the nation's hope to bounce back its shrunk economy. It is very important therefore to provide an enabling environment for growth through ease of doing business and efficient infrastructure – one of the two major factors identified as the biggest hurdle for the past decade. While recently the government has been keen and bullish in providing critical infrastructures such as roads, airports and seaports, fiscal constraint is still a bottleneck. That is why one of the pillars of the government's so-called 10-point economic agenda is "Accelerate annual infrastructure spending to account for 5% of GDP, with Public-Private Partnerships playing a key role".

Private interest, however, especially in the maritime industry need not be initiated as much as it needs to be better facilitated. Many argue the anti-competitiveness tendency of the PPA given its charter. This is not to say that the agency is not performing well, in fact it is performing too well in its mandate as a GOCC aptly as its performance is evaluated in this manner. This, however, may not be what the industry needs to promote organic growth and service efficiency. It is one thing to theorize the implications of the charter but it's another thing to measure the effect of competitiveness and efficiency of the maritime sector through the participation, or lack thereof, of the private sector.

This study (1) explores the level of private participation at different categories of privatization in terms of port expansion and investments in cargo-handling equipment, (2) evaluate the efficiency of ports at different categories of privatization and compare which port group are more efficient; and (3) evaluate average efficiency of ports vis-à-vis private participation per region. Implications of the elasticities of the input variables are also cross-examined with the tendency of the ports at different levels of privatization to invest in port expansion and cargo-handling equipment. The efficiency of ports using ship total dwell time as input variable was also examined given the recent exposure of port-congestion as a major blockade in an ever-integrated global supply-chain.

2. Literature Review

Port performance has been rigorously evaluated in literature particularly starting with optimising operational productivity of cargo-handling at berth and in the container yard and providing baseline optimal port indicators (De Weille & Ray, 1974) (UNCTAD, 1976). There have also been attempts at deriving a summary evaluation of port productivity, such as measuring a single factor productivity (De Monie, 1987) or by comparing actual with optimum throughput over a specific time period (Talley, 1998). Recent studies, however, focused on port productivity as econometric tools that measure firm efficiency were being mainstreamed.

Efficiency in economics refers to the relationship between the observed values of outputs and inputs with the optimal values of the outputs and inputs used in a production process (Karlaftis, Tsamboulas 2012). Efficiency can be categorized as allocative efficiency and technical efficiency. Allocative efficiency is the ability of the firm to optimize inputs given their prices and is associated with cost minimisation and profit maximisation. Technical efficiency on the other hand, is the ability of the firm to obtain the maximum output given that firms do not use the same amount of inputs to produce the same amount of outputs. There have been many efforts on estimating firm efficiency but the majority in literature centers on two main approaches namely, the non-parametric data envelopment analysis (DEA) and the parametric stochastic frontier analysis (SFA).

Frontier and efficiency measurement was first introduced by Farrell (1957) wherein definitions and a computational framework for both technical and allocative efficiency were established. Charnes et al. (1978) introduced the DEA method. The DEA frontier is formed as the piecewise linear combinations that connect the set of best practice observations, yielding a convex production possibility set. DEA does not require explicit a priori assumptions on the production function, however, as a deterministic frontier approach it also does not allow for random error. Since it does not include a random error term there is no need to assume specification of random error distribution. On the other hand, if random error exists, measured efficiency may be confounded with these random deviations from the true efficiency frontier. Moreover, statistical inference and hypothesis tests cannot be conducted for the estimated efficiency scores (Boame, 2004). Introduced by Aigner et al. (1977) and Meeusen and van den Broeck (1977), the SFA has an advantage of allowing for random shocks and measurement error and enables inference on the structure and determinants of firm efficiencies.

There have been different perspectives in examining the determinants of efficiency. Several empirical studies support private sector participation and, similarly, regulations promoting privatization as an indicator of higher efficiency in ports. Cullinane et al. (2002) used a port-function matrix to analyse the administrative and ownership structures of major container ports in Asia, concluding that size and private governance increase efficiency. Cullinane et al. (2006) compared DEA and SFA in estimating the technical efficiency of the world's largest container ports. They concluded that high levels of technical efficiency are associated with scale, greater private-sector participation and with transhipment as opposed to gateway ports. Coto-Millan et al. (2016) in their study on the effects of public regulation on technical efficiency in Spanish ports from 1986 to 2012 concluded that policies focused on the promotion of port autonomy, privatisation and inter-port competition had a positive impact on the efficiency of the Spanish ports. Similarly, Barros (2003) concluded that reforms on privatization and decentralization on Portuguese ports improved overall efficiency. Niavis and Tsekeris (2012) in their study on South-Eastern Europe container ports concluded that private terminals, when combined with the involvement of an international terminal operator, improved the efficiency score. While Yuen et al.(2013) investigated the operational efficiency of 21 major Chinese container ports and found a positive impact of Chinese ownership on the container terminal efficiency, but that the impact is negative on ports where the Chinese party had a controlling stake. Nuñez-Sánchez and Coto-Millán (2012), used a parametric distance function approach in their study of the impact of public regulation on ports' economic efficiency for the period 1986–2005. They found that technical progress and scale efficiency gains improved the total factor productivity in the period, whereas technical efficiency losses reduced the total factor productivity. Finally, Coto-Millán et al. (2015) analysed the technical efficiency of seven sub-sectors operating under the Spanish port system and found that 2003 port reform promoted greater efficiency among all port sectors.

On the other hand, there have also been studies concluding no effects or negative effects of private participation as a determinant for efficiency. Liu (1995), using a translog function applied on 28 UK ports, did not find a significant difference between private or publicly owned ports when the policy environment is competitive. Notteboom et al (2000) using a Bayesian SF model also argued that port ownership does not have a significant effect on port performance. Moreover, Baird (2000) further examined factors promoting inefficiencies on private ports. The study argued that due to the specific lumpy nature of port investments, principal agent problems may arise in the private sector because of capital market imperfections. Finally, Coto-Millán et al. (2000) used a stochastic frontier cost function to estimate the economic efficiency of Spanish ports, through panel data of 27 Spanish ports, from 1985 to 1989 and found that the type of organisation has a significant effect on economic efficiency, but ports with autonomy are less efficient.

The proliferation of empirical studies claiming either negative, positive or absence of impacts of private participation on port efficiency indicates the distinctiveness of each country or region's maritime industry. It is important therefore to look at the determinants of technical efficiency at some level of locality. In this study the parametric SFA is used to evaluate the effects of private sector participation in the technical efficiency of Philippine ports.

3. Stochastic Frontier Analysis

Econometric models constructed from economic data have long aided in policy making through statistical inference. SFA is one parametric tool that utilizes econometric models to estimate production function frontiers and the (in)efficiency relative to those frontier (Kumbhakar, et. al., 2015). Since the introduction by Meeusen and van den Broeck (1977) and Aigner, et. al. (1977) model specifications have been nuanced.

The cross-sectional SFA model is given as:

$$y_i = \alpha + x'_i\beta + \varepsilon_i \tag{1}$$

$$\varepsilon_i = v_i - u_i \tag{2}$$

$$v_i \sim N(0, \sigma_v^2) \tag{3}$$

$$u_i \sim F \tag{4}$$

Where, y_i represents the logarithm of output of the *i*th firm, x'_i is a vector of inputs, and β is a vector of technology parameters. The composite error term ε_i consists of v_i, normally distributed measurement and specification error, and, u_i one-sided inefficiency term. The v_i and u_i are assumed to be independent of each other and independent and identically distributed across observations.

SFA in general, is done in two steps (1) model parameters θ are obtained by maximizing the log-likelihood function $l(\theta)$ where, $\theta = (\alpha,\ \beta', \sigma_u^2, \sigma_v^2)'$ and, (2) inefficiencies are obtained through the mean of the conditional distribution $f(u_i|\underline{\varepsilon_i})$ where , $\underline{\varepsilon_i} = y_i - \underline{\alpha} - x'_i\underline{\beta}$. The independence assumption between v_i and u_i is the basis of the form of the likelihood function. Given the composite error term defined as (2), its probability density function is the convolution of the two component densities taking the form (5).

$$f_\varepsilon(\varepsilon_i) = \int_0^{+\infty} f_u(u_i) f_v(\varepsilon_i + u_i) du_i \qquad (5)$$

Hence, log-likelihood function for a sample of n firms is given as (6). Battese and Coelli (1988), exploited the conditional distribution of u given ε and estimated inefficiencies using the mean $\underline{u} = E(u|\underline{\varepsilon})$ of this conditional distribution. Hence, estimates of the technical efficiency can be derived as (7).

$$l(\theta) = \sum_{i=1}^{n} log\ log\ f_\varepsilon(\varepsilon_i|\theta) \qquad (6)$$

$$Eff = e^{-\underline{u}} \qquad (7)$$

The availability of a richer dataset allows for relaxing of some assumptions giving a more realistic interpretation of empirical studies. Pitt and Lee (1981) were the first to extend the model (1–4) to longitudinal data with the normal-half normal SF model (8)

$$\begin{gathered} y_{it} = \alpha + x'_{it}\beta + \varepsilon_{it} \quad i = 1, \dots, N,\ \ t = 1, \dots, T_i \\ \varepsilon_{it} = v_{it} - u_i \\ v_{it} \sim N(0, \sigma_v^2) \\ u_i \sim N^+(0, \sigma_u^2) \end{gathered} \qquad (8)$$

A generalized normal-truncated normal case has been proposed by Battese and Coelli (1988) where the estimation of an SFA model with time-invariant inefficiency can also be performed by through fixed-effects estimation techniques (Schmidt and Sickles, 1984). This allows inefficiency to be correlated with the frontier regressors and avoiding distributional assumptions about u_i. The time-invariant nature of the inefficiency term above is not practical especially in the presence of empirical applications based on long-panel datasets. Cornwell et. al. (1990) proposed the following SFA model with individual-specific slope parameters to account for time-variation,

$$\begin{gathered} y_{it} = \alpha + x'_{it}\beta + v_{it} \pm u_i, \qquad i = 1, \dots, N,\ \ t = 1, \dots, T_i \\ u_{it} = \omega_i + \omega_{i1}t + \omega_{i2}t^2 \end{gathered} \qquad (9)$$

where model parameters are estimated by extending the fixed and random-effects panel-data estimators. The quadratic specification allows for a unit-specific temporal pattern of inefficiency but requires the estimation of a large number of parameters (N × 3). Kumbhakar (1990) proposed a ML estimation of a time-varying SF that does not restrict the temporal pattern of u_{it} given as (10) where $g(t)$ is specified as (11)

$$u_{it} = g(t) \times u_i \qquad (10)$$

$$g(t) = \left\{1 + e^{\gamma t + \delta t^2}\right\}^{-1} \qquad (11)$$

In 2005 Greene proposed a time-varying SFA normal-half normal model with unit-specific intercepts, obtained by replacing α of (9) with α_i in (12). This specification coined as true fixed (random) effects (TFE/TRE) disentangles time varying inefficiency from unit-specific time-invariant unobserved heterogeneity α_i. Greene cautioned that depending on the research objective, one can argue that a portion of the time-invariant unobserved heterogeneity does belong to inefficiency.

$$y_{it} = \alpha_i + x'_{it}\beta + \varepsilon_{it} \tag{12}$$

Another thing to consider in the model are exogenous variables that can affect distribution of inefficiency. These variables may shift the frontier function and the inefficiency distribution. Kumbhakar, Ghosh, and McGuckin (1991) and Huang and Liu (1994) proposed to parameterize the mean of the pre-truncated inefficiency distribution with the inclusion of the following specifications.

$$u_i \sim N^+(\mu_i, \sigma_u^2)$$
$$\mu_i = z'_i\varphi \tag{13}$$

where u_i is a realization from a truncated normal random variable, z_i' is a vector of exogenous variables (including a constant term), and ψ is the vector of unknown parameters to be estimated (the so-called inefficiency effects). In this approach z_i' may include interactions with input variables and allows to test the hypothesis that inefficiency is neutral with respect to its impact on input usage. In this paper, three model specifications will be tested (1) Time-variant SFA model (2) Time-variant True-fixed effects model, and (3) Time-variant model with exogenous variable. The 'frontier' R-package by Coelli and Henningsen (2020) will be used to run the three models.

When running a SFA model, one critical consideration is the relevance of the inefficiency term u with respect to the composite error term ε. Upon running the model we see four model parameters to decide whether inefficiency is existent relative to the frontier. The sum of parameterized variance of v and u is given as $\sigma^2 = \sigma_v^2 + \sigma_u^2$. While γ is the share of the variance of u in the total variance. If γ is zero, the inefficiency term u is irrelevant, and the results should be equal to the OLS results. If it is one then the noise term v is irrelevant, and all deviations from the production frontier are explained by technical inefficiency. However, a t-test of the null hypothesis γ=0 is not valid because it is bound to the interval [0, 1] and cannot follow a t-distribution. Instead, a likelihood ratio test can be done to check whether adding the inefficiency term u significantly improves the fit of the model. A generalised likelihood ratio test compares the log likelihood value of the restricted model to that of the unrestricted model.

4. Data and Methodology

4.1. Analytical Framework

To answer the three research objectives stated above, this paper uses three analytical methods. Firstly, a trend analysis on throughput, port expansion, cargo-handling equipment and average dwell-time by port group will be done to answer objective (1). Secondly, an SFA approach on estimating technical efficiencies of ports will be used to compare which port group or level of privatization generates a higher technical efficiency answering objective (2). Lastly, using the estimated technical efficiencies from the SFA model, a spatial analysis on regional port efficiency will be done to see if private participation improves efficiency at regional level answering objective (3).

4.2. Data

Cullinane et. al. (2006) argued that in an industry characterised by significant, lumpy and risky investments panel data gives potential benefits of a dynamic analysis. To estimate the parametric production function frontier, panel data from 46 ports under the jurisdiction of the PPA over a 21-year period (1999-2019) was used. The data used in this research was gathered from Philippine Ports Authority annual reports, annual reports of private ports, and Philippine Statistics Authority. To estimate the production frontier, 12 input variables and one exogenous variable were tested. The descriptive statistics of these variables are summarized in Table 2.

4.3. Descriptive Analysis

The specification of input and output variables should reflect the actual objectives of the firms. Cargo throughput is indicative of the objective of the port and will be the output variable in this study. A production function is characterized by capital, labour, and raw materials. In the 2005 study of Cullinane et. al., the port terminal area, quay length, number of quay-side gantry cranes, and number of rubber-tyred gantry cranes were used as input variables since ports rely heavily on equipment and information technology rather than being labour-intensive. Furthermore, the unavailability of data, Cullinane et. al. (2006) derived information on labour inputs from a pre-determined and highly correlated relationship to terminal facilities. The authors cautioned the applicability of assumed correlated relationships for other port scenarios. The unavailability of data and possible incongruity of labour estimation in the Philippine context led to the decision not to include labour as an input variable. For the raw materials component, net service time, total dwell time and number of vessels were also tested as input variables given that each unit of these variables add to cargo throughput. These input variables are also used to explore the efficiency of these ports with respect to port congestion. Additional variables tested were number of vessels, Net tonnage or the maximum tonnage capacity of ships calling at the ports and sum of length of vessels to check if longer, bigger and deeper ships have an effect in efficiency.

To account for changes in demand Gross Regional Domestic Product (GRDP) was also tested as an exogenous variable. There are 17 regions in the Philippines and one of the conditions for their delineation is industry agglomeration. Theoretically these regions also delineate natural port catchment areas. In summary, 12 input variables were initially tested. Based on the significance and sign test, however, only the port area, number of cranes, ship dwell-time and service time were applicable for the models. Following tests in model specifications therefore are based on these input variables.

4.4. Trend Analysis by Port Group

To explore the level of private participation at different levels of privatization in terms of port expansion and investments in cargo-handling equipment section 5.1 presents a trend analysis on throughput, port expansion, cargo-handling equipment and average dwell-time by port group. Changes on trends were closely examined, explaining major milestones in cargo throughput such as change in management in the case of Batangas port and major port developments such as for DICT and MICT. The section also establishes which port groups are more engaged in port development and purchase of cargo-handling equipment which in section 5.2 is further evaluated if it translates into improvements in technical efficiency.

4.5. Stochastic Frontier Analysis

To evaluate the efficiency of ports at different categories of privatization and compare which port groups are more efficient an SFA approach on estimating technical efficiencies of ports is presented in section 5.2. Three SFA models were tested on this study namely (1) Error components frontier (Battese and Coelli, 1992) with Time-variant efficiencies, (2) Error components frontier (Battese and Coelli, 1992) with true fixed individual effects and observation-specific efficiencies; and (3) Technical efficiency frontier (Battese and Coelli, 1995) with exogenous variable.

Table 2. Descriptive statistics per variable

Variable	Mean	Standard Error	Standard Deviation	Kurtosis	Skewness	Range
Output Variable						
Throughput (mt)	2062407	138530.4	3935337	14.89	3.65	27861039
Input Variables						
Number Vessels	3603.83	200.06	5683.13	7.52	2.56	34671
Net Tonnage	2678752	135369.2	3845535	6.33	2.42	24799300
Length of Vessel (m)	186024.6	8587.35	243947.1	7.16	2.28	1797079
Draft of Vessel (m)	9582.84	486.05	13807.66	9.1	2.69	90478.81
Service Time (hrs)	65982.56	3543.05	100650.1	60.58	5.67	1528354
Total Dwell Time (hrs)	12360.32	1246.79	35418.42	21.49	4.33	288522.2
GRDP (thousand Php)	8.01E+08	41132114	1.17E+09	8.01	2.8	6.29E+09
Draft (mllw)	9.25	0.1	2.8	-0.88	0.55	11
Crane	0.85	0.08	2.31	14.42	3.71	16
RTG	1.69	0.23	6.67	24.47	4.76	49
Stacker	1.84	0.32	9.12	54.23	7.21	75
Berth (m)	666.93	32.64	927.3	12.72	3.36	5403.5
Port Area (sqm)	128881.3	7810.95	221891.6	12.66	3.34	1496100

The Time-variant efficiencies model is given by:

$$y_{it} = \alpha + x'_{it}\beta + \varepsilon_{it} \qquad i = 1, \ldots, 46, \; t = 1999, \ldots, 2019 \qquad (14)$$

$$\varepsilon_{it} = v_{it} - u_{it}$$

$$v_{it} \sim N(0, \sigma_v^2)$$

$$u_{it} \sim N^+(0, \sigma_u^2)$$

where y_{it} is the cargo throughput of port *i* at year *t*, x'_{it} is the vector of input variables port area, number of cranes and service time of port *i* at year *t*, β is the set of elasticities to be estimated and ε_{it} is the composite error containing the normally distributed v_{it} statistical noise and u_{it} inefficiency with half-normal distribution.

The True-fixed effects model on the other hand, replaces (14) with: (15)

$$y_{it} = \alpha_i + x'_{it}\beta + \varepsilon_{it} \quad i = 1, \ldots, 46, \; t = 1999, \ldots, 2019$$

where α_i is the individual fixed effects of port *i* at year *t.* Finally, Exogenous model appends (14) with the following specification:

$$u_{it} \sim N^+(\mu_{it}, \sigma_u^2)$$

$$\mu_{it} = z'_{it}\varphi \qquad (16)$$

where z_{it}', is the GRDP of the region where port *i* is located at year *t*.

4.6. Spatial Analysis on Technical Efficiency

A spatial analysis using a Geographic Information System (GIS) software is presented in section 5.3. The technical efficiency output in section 5.2 were used to examine which regions show high levels of technical efficiency and whether there is a strong private participation on those regions. As mentioned above, the Philippines is divided into 17 administrative regions which delineation was based on the following criteria (Mercado, 2002):

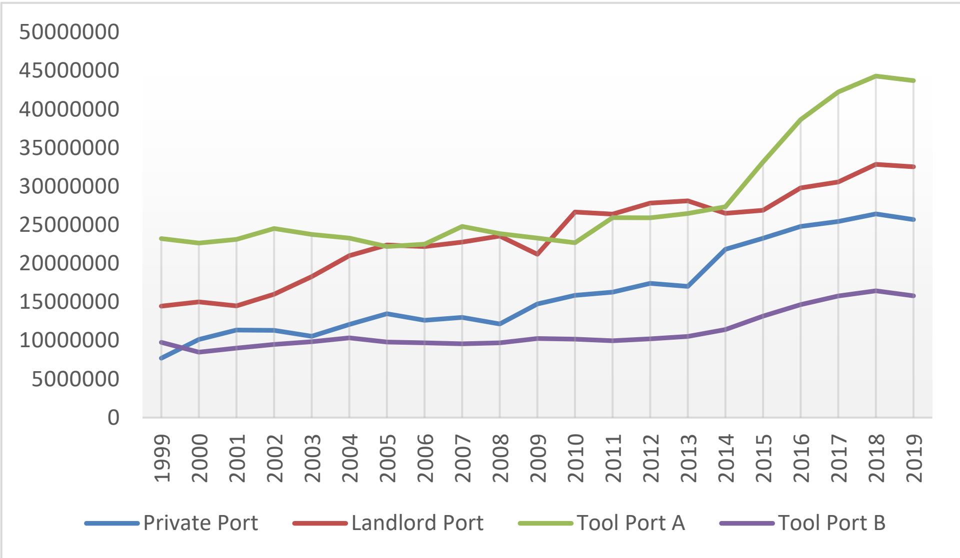
- Physical characteristics or geographic features (terrain, climate, soil, fertility, topography, land area and population)
- Homogeneity and functionality of administrative and plan implementation factors (number of provinces and cities, administrative factors coinciding with planning regions, regional boundaries coinciding with political boundaries, optimal distribution of public services and availability of financial resources)
- Functionality of economic development factors (existence of transportation and communication facilities, proposed and on-going development programs and projects in the areas)\
- Commonality of ethnic and socio-cultural features (culture, religion, literacy and existing number of schools)

Not only does regional divisions provide a good basis for inter-port competition because of the above criteria but the regional perspective is important when dealing with policy and development implications as regions play an important role in development planning in the Philippines.

5. Results and Discussion

5.1. Trend Analysis

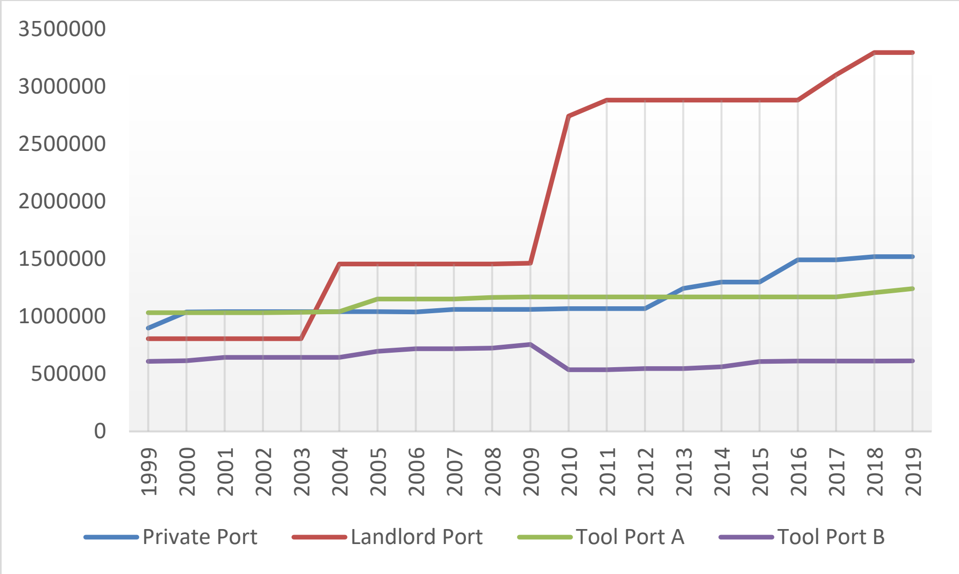
There is a steady increase in cargo throughput for all port classifications as shown in Figure 16. The major PPA ports had an average annual growth rate (AAGR) from 1999 to 2019 of 3.93% with private ports leading the growth at 6.70% followed by landlord ports at 4.43%. Private ports showed the steepest spike in 2014 at a 28% growth from the previous year largely because of DICT reaching full operations. Landlord ports had two milestone years 2011 and 2017. A growth of 14% versus previous year was seen in 2011 in part because of the inclusion of Batangas port but largely because of MICT port expansion. The steepest growth for landlord ports were in 2015-2018 where 21% growth was seen in 2015 at the completion of yard 7 in MICT and further expansion and additions of STS cranes the following years. In the same period, tool A and B ports also experienced its steepest increase at 15% and 11% respectively. From 1999-2019, tool A ports had the largest share of volume at an average of 35.31% distributed among six ports that fell into this classification. Landlord ports followed at 30.01% led by MICT covering 20.4% of the overall volume in the country followed by private ports at 20.62% from the 17 ports that fell in this category. Lastly, the 20 tool B ports captured 14.07% of the total cargo throughput of the country from the same time period.



	Private	Landlord	Tool A	Tool B	Total
AAGR	6.70%	4.43%	3.45%	2.62%	3.93%

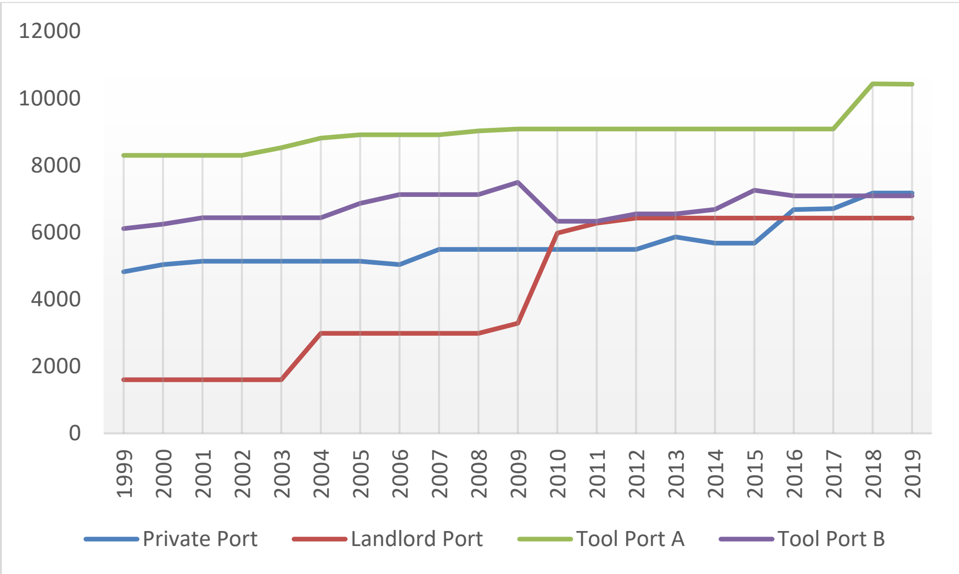
Figure 16. Cargo Throughput in metric tons (1999-2019)

In terms of port area as shown in Figure 17, landlord ports seem to show a dramatic increase. It should be noted, however, that in 2010 Batangas port operation, which was previously handled by the PPA, was handed over to ATI for a long-term concession coupled with development rights thus becoming a landlord port. A slight decline for the tool ports B category in the same year is attributed to this transfer. Much of the expansion, however, for landlord ports came from the development of MICT yard 7. While the AAGR of port area for all ports was 3.67%, landlord ports in general showed more expansion in the past two decades at 9.37%, followed by private ports at 2.8% whereas the tool ports A and B had a sluggish expansion of about 0.95% and 0.34% respectively. The same pattern can also be seen for berth/quay length as shown in Figure 18 where the AAGR for all ports are at 1.64%. Lanlord ports leading with 2.5% AAGR followed closely by private ports at 2.24% AAGR then by tool ports B at 1.87% while tool ports A berth expansions were marginal.



	Private	Landlord	Tool A	Tool B	Total
AAGR	2.80%	9.37%	0.95%	0.34%	3.67%

Figure 17. Port Area in meters squared

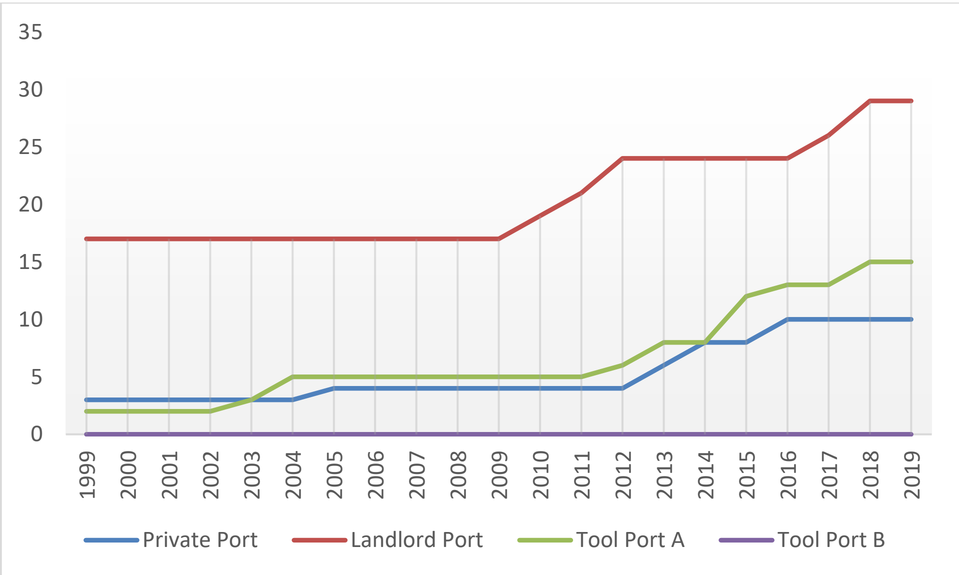


	Private	Landlord	Tool A	Tool B	Total
AAGR	2.24%	2.5%	0.00%	1.87%	1.64%

Figure 18. Berth Length in linear meters

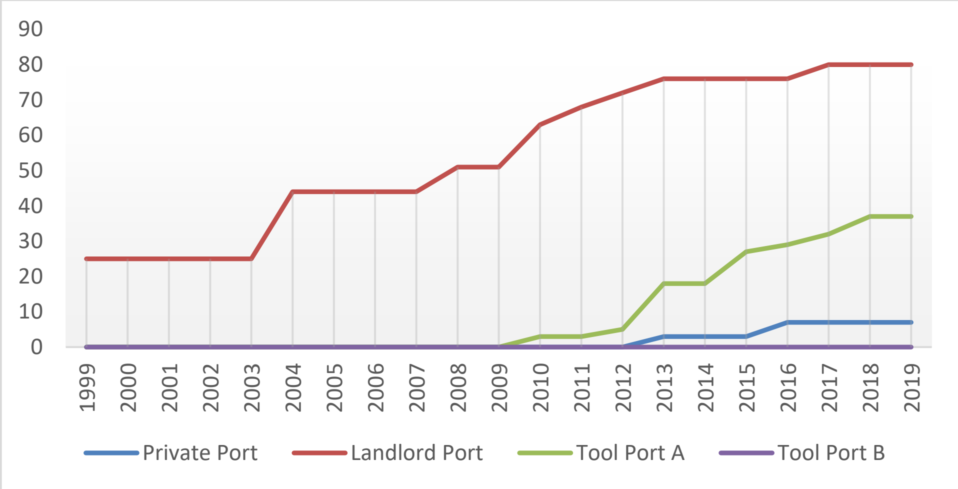
In terms of cargo-handling equipment, as shown in Figure 19 and Figure 20, landlord ports still dominate but tool A ports outperformed private ports. As stated above, tool ports are ports operated by PPA, but some services such as cargo-handling are awarded to the private sector. It makes sense for the private sector as cargo-handlers to purchase cargo-handling equipment on tool ports. However, port expansion is still under the authority of the PPA and so has high financial risk. Tool A ports however have longer contract periods at around 5-10 years which allows them to invest in more cargo-handling equipment. From the port expansions and purchase of cargo-handling equipment, it is clear how great the participation of the private sector is. Landlord ports in particular is a clear industry leader in capital outlay investments. It's important to note that on top of PPAs share in cargo-handling and other port dues, PPA also collects concession fees from these landlord ports.

Arguably PPA may favour landlord ports over private ports because of the additional fee. As a matter of fact we see that where there is competition between landlord, tool and private ports, private ports are at a disadvantage. One evidence of this is the case of the port of Manila and HCPT where despite having met all requirements, HCPT still has not been awarded a permit to cater to foreign containerized cargo where it would be in competition with the tool port A South Harbor and MICT. This is also felt in other private commercial ports such as DICT where the company is mulling over their planned expansion pending the Sasa port modernization project under unsolicited proposal. PPA can easily press on regulations that are favorable to the financial viability of the project.



	Private	Landlord	Tool A	Tool B	Total
AAGR	7.08%	2.82%	12.19%	N/A	4.69%

Figure 19. Number of ship-to-shore cranes

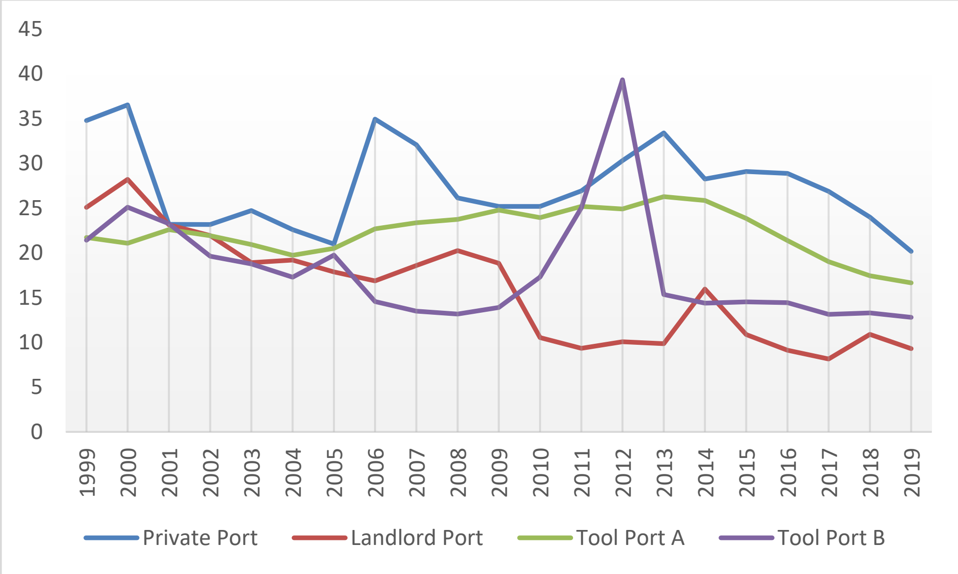


	Private	Landlord	Tool A	Tool B	Total
AAGR	6.67%	7.00%	20.50%	N/A	9.44%

Figure 20. Number of rubber-tyred gantry cranes

As shown in Figure 21, landlord port exhibited the steepest downward trend in its average total dwell time per ship at -2.53% AAGR. It's interesting to note the three local maxima in 2008, 2014 and 2018. We can see a pattern in which after an upward trend in average dwell time is observed immediately 1-2 years afterwards, port expansion and purchase of cargo-handling equipment follows (see Figures 17 and 18) which shows how versatile landlord ports are in improving its services. Tool port B, on the other hand, has a very peculiar pattern especially in the period of 2009-2013. It can be seen that landlord ports and private ports as well as tool port A to a slight extent, follows this upward trend in the same period. This may be indicators of spill over to other ports due to port congestion. This steep peak suggests the sluggish approach of the government ports in reacting to port congestion. We know from above discussions that tool ports A and B have marginal port expansion while at the very least tool ports A were able to purchase cargo-handling equipment. This indicates that more often, when tool ports A and B experience congestion spillage to competing private ports are prevalent. This is evident in the case of Sasa port where spillage enabled participation of the private sector at the construction of DICT and HIPSI and development of TEFASCO in 2013 onwards.

The inability of the government to provide the needed infrastructure and other capital outlay can be explained by the gaps in the charter of PPA. Firstly, government bureaucracy becomes a barrier that extends the design phase into years such as what happened to the Sasa port modernization project. To cut through the red tape, PPA has changed its strategy from public financing to PPP scheme. Majority of the Philippine port development projects in the pipeline right now are unsolicited PPP proposals. Unsolicited PPP proposals seem to be the favoured modality given that with the proper requirements it could be implemented faster in addition to having no financial requirements on the side of the government. Unsolicited proposals as defined under Republic Act (RA) 6957 otherwise known as the Philippine Build-Operate-Transfer law as amended by RA 7718 do not require any funding from the government and lets the private sector recuperate its investments through long-term concession periods of at least 25 years. Examples of this scheme are the proposals for Sasa, Gensan and Iloilo port. Secondly, PPA is not incentivised to address port congestion. While clearly it is under their mandate, the audit for the PPA as a GOCC is done annually and as can be seen in their performance indicators most are in terms of their financial records. When your performance as an organization is audited annually it is not surprising to focus on short term investments such as dredging and port maintenance rather than the lumpy and long-term investment for port expansion and development. Lastly, the PPA does not necessarily lose income from cargo spillage. PPA still earns from cargo-handling services and other port dues from private commercial ports. Comparing long-term huge fiscal requirements from accommodating growth in cargo throughput and the marginal opportunity cost from the spillage, as a GOCC that is not penalized for congestion and audited for its fiscal performance it may be more strategic to allow spillage.



	Private	Landlord	Tool A	Tool B	Total
AAGR	-1.08%	-2.53%	-1.14%	0.68%	-2.31%

Figure 21. Average dwell time per ship in hours

5.2. Stochastic Frontier Analysis

Based on the econometric specification described in section 2.2, we proceed to estimate a Cobb-Douglas production function using maximum likelihood method for three model specifications. Table 3 shows the model parameters for deciding which method is practical. The TFE model had a gamma close to 1. This indicates that the composite error term is explained mostly by inefficiency whereas statistical noise is not significant. This will greatly affect the coefficient estimates and ultimately the estimates for individual port efficiencies. The same is true for the model considering exogenous variables GRDP. Rejecting the TFE model means that the efficiency estimates will consider difference in technology as part of the inefficiency which is relevant to this study since we are trying to compare the efficiencies of ports with minimal cargo-handling equipment such as tool ports A and B from landlord ports and private ports that heavily invests on port expansion and state of the art cargo-handling equipment. On the other hand, rejecting the model with an exogenous variable indicates that GRDP is not a good indicator for demand in ports. This implies that increase in demand might not be equally distributed among ports. In a region, some ports may attract more cargo while other ports fail to get an equitable share of the additional cargos.

The time variant model passed the gamma and likelihood ratio test. The 0.7278 gamma indicates that both statistical noise and inefficiency are important for explaining deviations from the production function but that inefficiency is more important than noise. Table 4 shows the coefficients of the estimated production frontier model with time effects for 46 Philippine ports in the period of 1999-2019. It can be seen that all coefficients are statistically significant and have the right sign. The Returns to Scale (RTS), or simply the sum of all coefficients in the case of a Cobb-Douglas production function, at 1.496 indicates that increase in input effects results in a larger increase in output. The greatest input elasticity is service time (0.684), followed by number of cranes (0.457) and lastly area (0.355).

Table 3. Model performance

SFA Model	*gamma*	*sigmaSqU*	*sigmaSqV*	*lrtest*	*Decision*
Time-Variant	0.7278282	0.4451604	0.1664680	2.2e-16	Accept
True Fixed Effects	~1	3.9864e-01	3.9864e-09	2.2e-16	Reject
Exogenous Model	~1	1.6984e+03	6.9919e-02	2.2e-16	Reject

Table 4. Production function estimation and efficiency effects

	ESTIMATE	STD. ERROR	Z VALUE	PR(>|Z|)	SIGNIFICANT
(Intercept)	1.592	0.398	3.999	6.37E-05	***
LCrane	0.457	0.126	3.632	0.000281	***
LArea	0.355	0.084	4.224	2.40E-05	***
LServiceTime	0.684	0.051	13.423	< 2.2e-16	***
sigmaSq	0.612	0.116	5.261	1.43E-07	***
gamma	0.728	0.053	13.838	< 2.2e-16	***
time	0.020	0.004	5.416	6.10E-08	***
sigmaSqU	0.445	0.116	3.838	0.000124	***
sigmaSqV	0.166	0.008	19.878	< 2.2e-16	***
sigma	0.782	0.074	10.522	< 2.2e-16	***
sigmaU	0.667	0.087	7.677	1.64E-14	***
sigmaV	0.408	0.010	39.755	< 2.2e-16	***
Returns to Scale	1.496				
Average Efficiency	**0.572**				
No. of Observations	807				

The efficiency estimates are rather low with ports operating between 10% and 90% of the maximum possible efficiency. However, looking at the efficiency histogram (Figure 22) we see that there are more observations of above 70% than below 30%. Comparing efficiency to output (Figure 23) we see that the efficiency estimates are highly correlated with the output quantity also evidenced by the narrow confidence interval towards the right part of the line graph. The largest ports all have an above-average efficiency estimate, while only a very few of the smallest firms have an above-average efficiency estimate. We can also see that tool ports A and landlord ports, with exceptions notably Batangas port, are relatively more efficient. Tool ports A agglomerate on the upper right side of the graph indicating a good relationship of output and efficiency especially since majority lie above the line. The landlord ports MICT and South Harbor while also in the upper right side of the graph lie below the line because of some private and tool ports A and B that are relatively at the higher spectrum of efficiency-output ratio. Majority of the tool ports B, however, lie below the line as well as a few private ports.

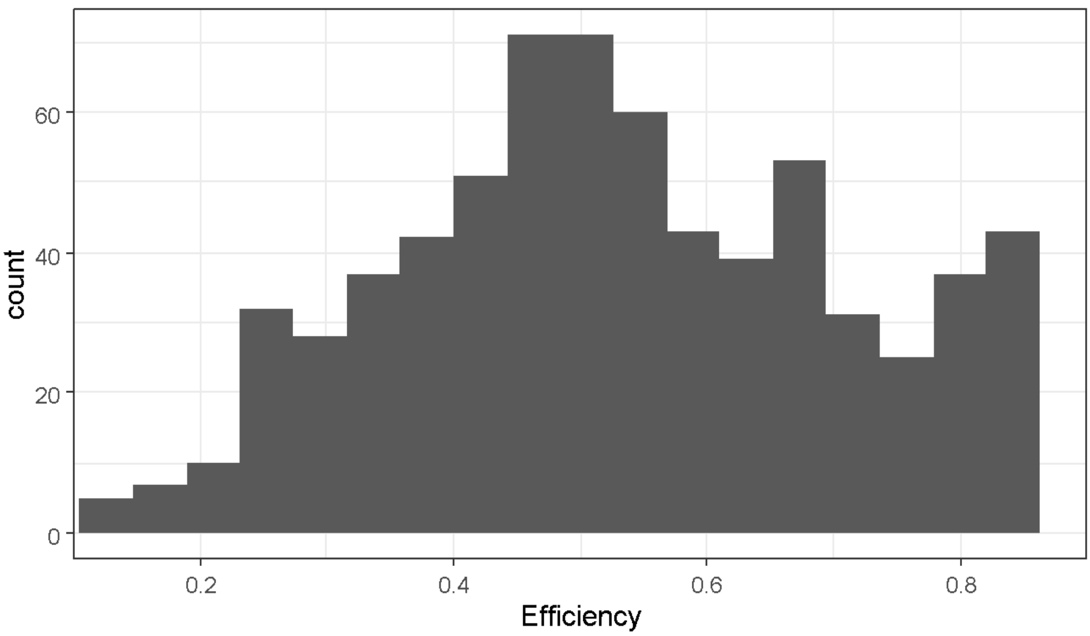


Figure 22. Efficiency estimates histogram

Figure 24 summarizes the performance of ports by classification. On average, landlord ports are the most efficient at above 71.2% followed by tool ports A at 67% and closely followed by private ports at 62.6%. The average efficiency of tool port B is 47.5%. While landlord ports have the highest average efficiency, we can see in Table 6 that the most efficient port is Daima Shipping Incorporated, a private port, followed by MICT a landlord port.

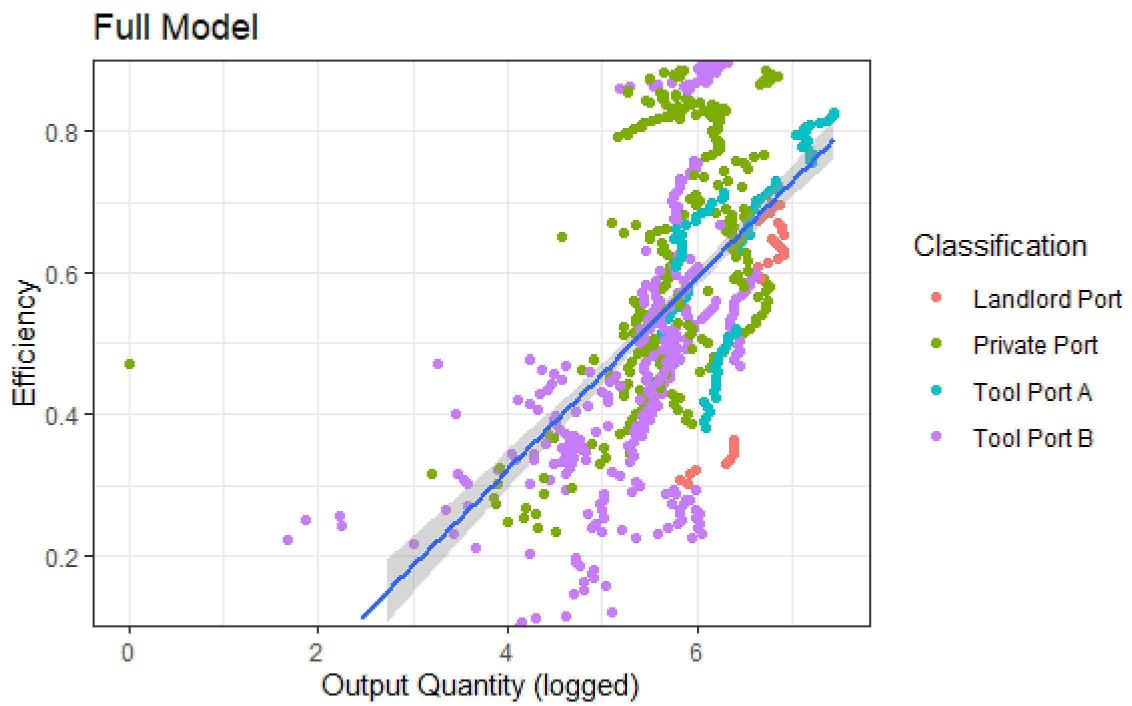


Figure 23. Output efficiency per port classification

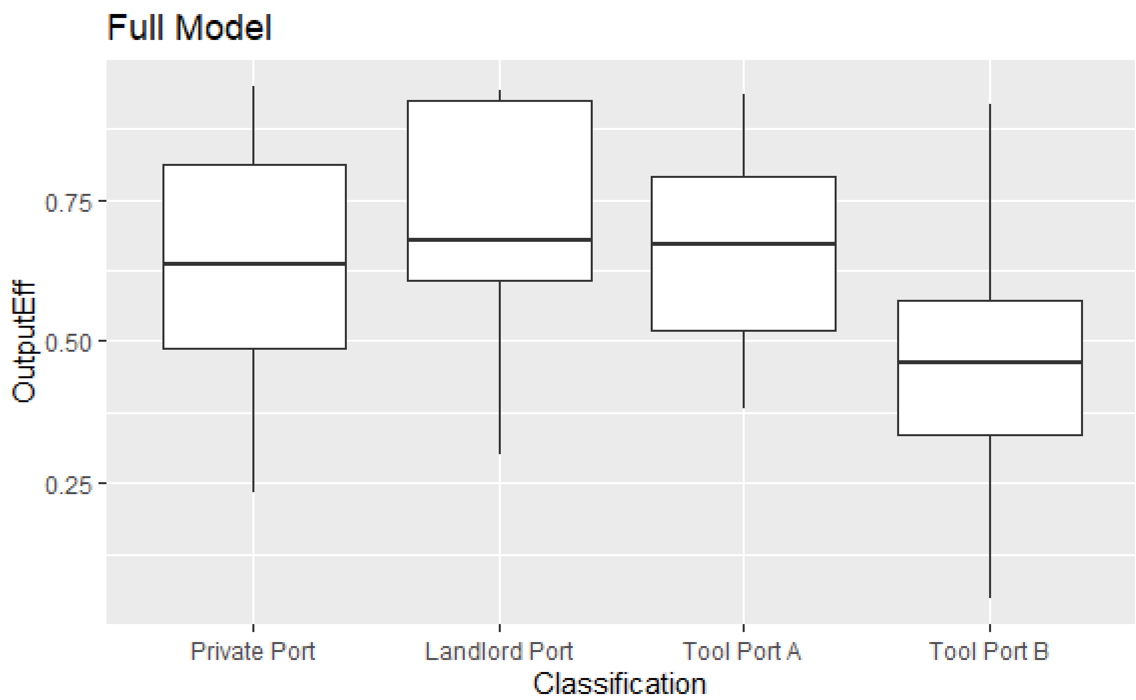


Figure 24. Box plot of efficiency by port classification

As mentioned above, port congestion is a major issue in the efficiency of ports. Recent events showed how important it is to reduce ship dwell time to address vulnerabilities in the supply-chain. Dwell time is defined as the sum of service time and waiting time of ships in the port. As such, this study also explores a model with dwell-time as the only input variable, which in effect considers the effect of other unobserved variables as part of the (in)efficiency and composite error term. Table 5 shows the model parameter values for the SFA model with time variation and dwell time as the only input variable to estimate cargo-throughput. Dwell time as an input variable is statistically significant and has the right sign. The parameter γ (0.875) suggests that both inefficiency and statistical noise are important for explaining deviations from the frontier, but that inefficiency is more important than noise. Lastly, the significant value of the time parameter indicates that time-effects are relevant. Efficiency, however, is quite low with average efficiency at 38.5%.

Table 5. Production function estimation and efficiency effects (Dwell time model)

	ESTIMATE	STD. ERROR	Z VALUE	PR(>|Z|)	SIGNIFICANT
(Intercept)	3.417	0.270	12.631	< 2.2e-16	***
LDwellTime	0.758	0.054	14.147	< 2.2e-16	***
sigmaSq	1.371	0.321	4.276	0.000	***
gamma	0.875	0.030	28.723	< 2.2e-16	***
time	0.015	0.002	6.162	0.000	***
sigmaSqU	1.199	0.321	3.732	0.000	***
sigmaSqV	0.172	0.009	19.151	< 2.2e-16	***
sigma	1.171	0.137	8.553	< 2.2e-16	***
sigmaU	1.095	0.147	7.464	0.000	***
sigmaV	0.414	0.011	38.303	< 2.2e-16	***
Returns to Scale	0.758				
Average Efficiency	0.385				
No. of Observations	807				

We see in Figure 25 that efficiency is highly correlated with firm size and larger ports are relatively more efficient. Unlike the full model, landlord ports seem to dominate in terms of efficiency, with Batangas port as an exception, and tool A ports come in second. MICT and South Harbor are unmistakably located at the upper right side of the graph relatively way above the regression line indicating a very good efficiency-output ratio. While tool A ports follow, half are above the regression line and half are below. On the other hand, while efficiency shifted lower, most of the private ports are located above the line. The efficiency distribution of both services and private ports shifted downwards with services ports relatively showing lowest efficiencies. Finally, tool B ports efficiency also shifted lower but most are also located below the regression line indicating a relatively poorer efficiency-output ratio.

Figure 26 shows that clearly landlord ports are more efficient, with Batangas port as an exception, at above 79.2% efficiency followed by tool A ports at 49.1% and then by private ports at 40.6%. The average efficiency of tool B ports are around 27.3% with Nasipit port as an outlier. We can see in Table 6 that there are some huge shifts in the ranking of efficiency in favor of landlord ports.

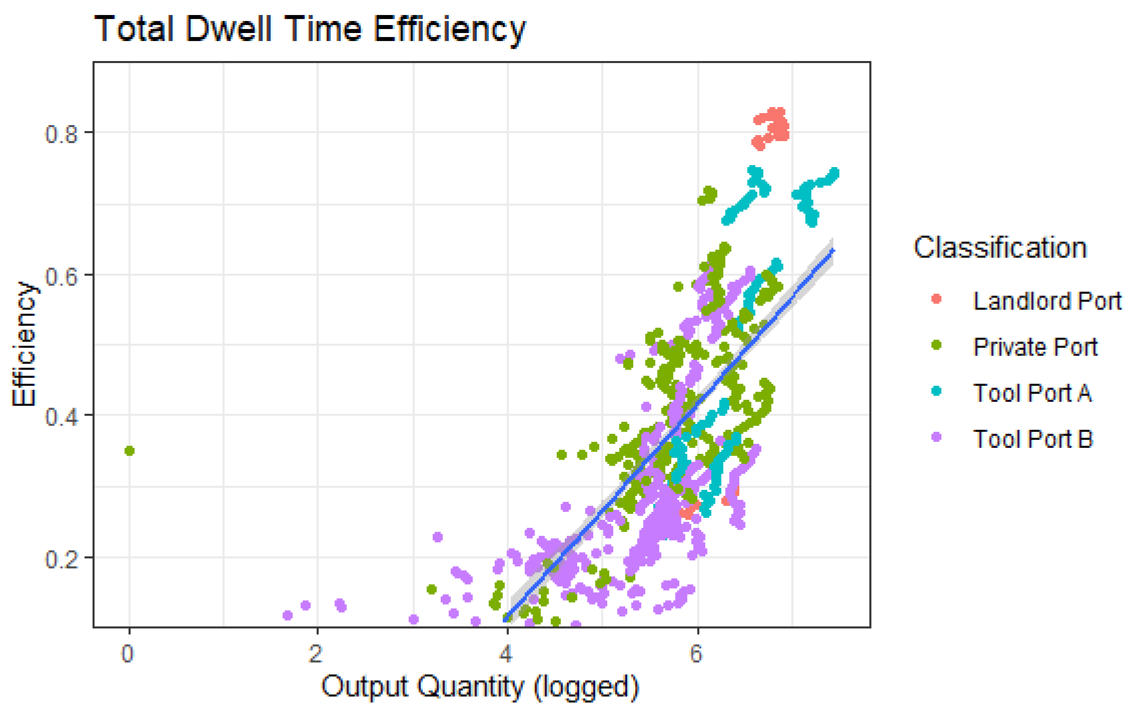


Figure 25. Output efficiency per port classification (Dwell time model)

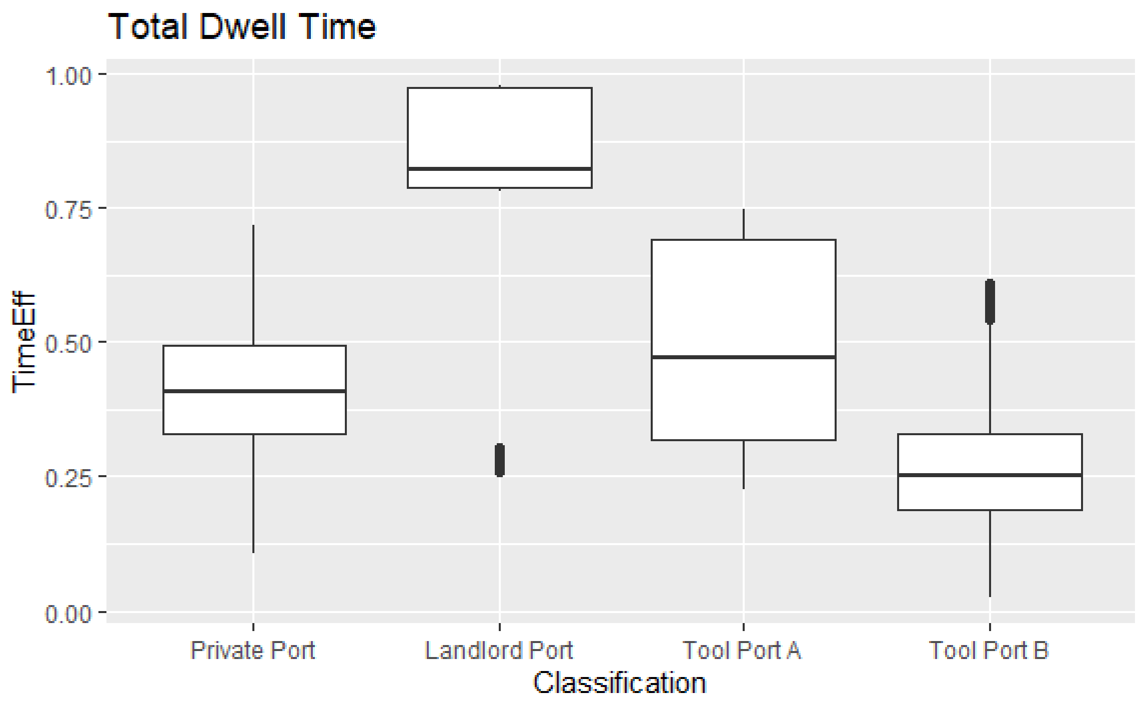


Figure 26. Box plot of efficiency by port classification (Dwell time model)

Table 6. Average efficiency per port

Port	Classification	Average Efficiency (Full Model)	Average Efficiency (Dwell Time)
Daima	Private Port	0.9476	0.7116
MICT	Landlord Port	0.9286	0.9744
Davao	Tool Port	0.9204	0.7128
Gensan	Tool Port	0.9013	0.5574
Energies	Private Port	0.8810	0.4913
Nasipit	Services Port	0.8807	0.5640
HCPTI	Private Port	0.8761	0.5820
Banago	Private Port	0.8457	0.4544
SLHBTC	Private Port	0.8343	0.6175
KTC	Private Port	0.8247	0.5881
BPSC	Private Port	0.8245	0.3954
TEFASCO	Private Port	0.8001	0.5956
NCR North	Tool Port	0.7918	0.7092
R2	Private Port	0.7449	0.4999
Ozamiz	Services Port	0.7148	0.4184
CDO	Tool Port	0.6797	0.5700
MGC	Private Port	0.6666	0.4559
Kudos	Private Port	0.6664	0.3604
Tagbilaran	Services Port	0.6618	0.3635
NCR South	Landlord Port	0.6468	0.8063
DICT	Private Port	0.6351	0.4956
Iligan	Services Port	0.5699	0.3573
Seafront	Private Port	0.5661	0.3281
Samar	Services Port	0.5445	0.2781
Panay	Services Port	0.5360	0.2986
ZDN	Services Port	0.5338	0.2919
BREDCO	Private Port	0.5269	0.3936
Dumaguete	Services Port	0.5121	0.2769
DUCOMI	Private Port	0.4939	0.2928
Palawan	Services Port	0.4919	0.2759
Legazpi	Services Port	0.4819	0.2431
PNOC ESB	Private Port	0.4569	0.3345
Zamboanga	Services Port	0.4524	0.3153
HIPSI	Private Port	0.4426	0.3289
Ormoc	Services Port	0.4281	0.2605
Butuan	Services Port	0.4068	0.1854
Surigao	Services Port	0.4043	0.2286
Masao	Services Port	0.3969	0.2203
Masbate	Services Port	0.3846	0.2025
Quezon	Services Port	0.3054	0.1553
SFI	Private Port	0.3023	0.1472
Pulupandan	Services Port	0.2943	0.1745
Batangas	Landlord Port	0.2940	0.2531
Calapan	Services Port	0.2936	0.1643
Currimao	Services Port	0.2049	0.1060
Bataan	Services Port	0.0795	0.0399

5.3. Spatial Analysis

In Figure 27 we see that regions with more private ports and tool A ports are more efficient which could indicate that there is a healthy competition. Especially for regions with only tool B ports operating, efficiency is quite low such as in region I led by Currimao port, region V led by Masbate port, region VIII led by Samar and Ormoc ports, and region XIII led by Nasipit port. While Nasipit port is among the top efficient ports in terms of the full model (see Table 6), regional efficiency is quite low which could indicate that there is a disparity in the allocation of throughput throughout the region as compared to port capacities. This is particularly clear when looking at the dwell-time efficiency where Nasipit port drastically fell from the overall efficiency rankings.

Outside the NCR, the most efficient region is region XI (Davao region) where the private ports DICT and TEFASCO and Davao tool A port are located followed by region VI (Western Visayas) where the private ports Banago and BREDCO are located and finally region X where the private port Daima and Cagayan de Oro tool A port are located. The dwell-time model efficiencies as seen in Figure 28 is particularly alarming for regions with less private participation. At an average efficiency of 0.385 for all ports in the Philippines in terms of dwell-time, which in itself is quite low, regions I, V, VIII and XIII had regional efficiencies below national average. Interestingly though, while region XI still follows NCR in terms of dwell-time efficiency, region X led by the tool A Cagayan de Oro port outperformed region VI with more private commercial port participation (Banago and BREDCO ports).

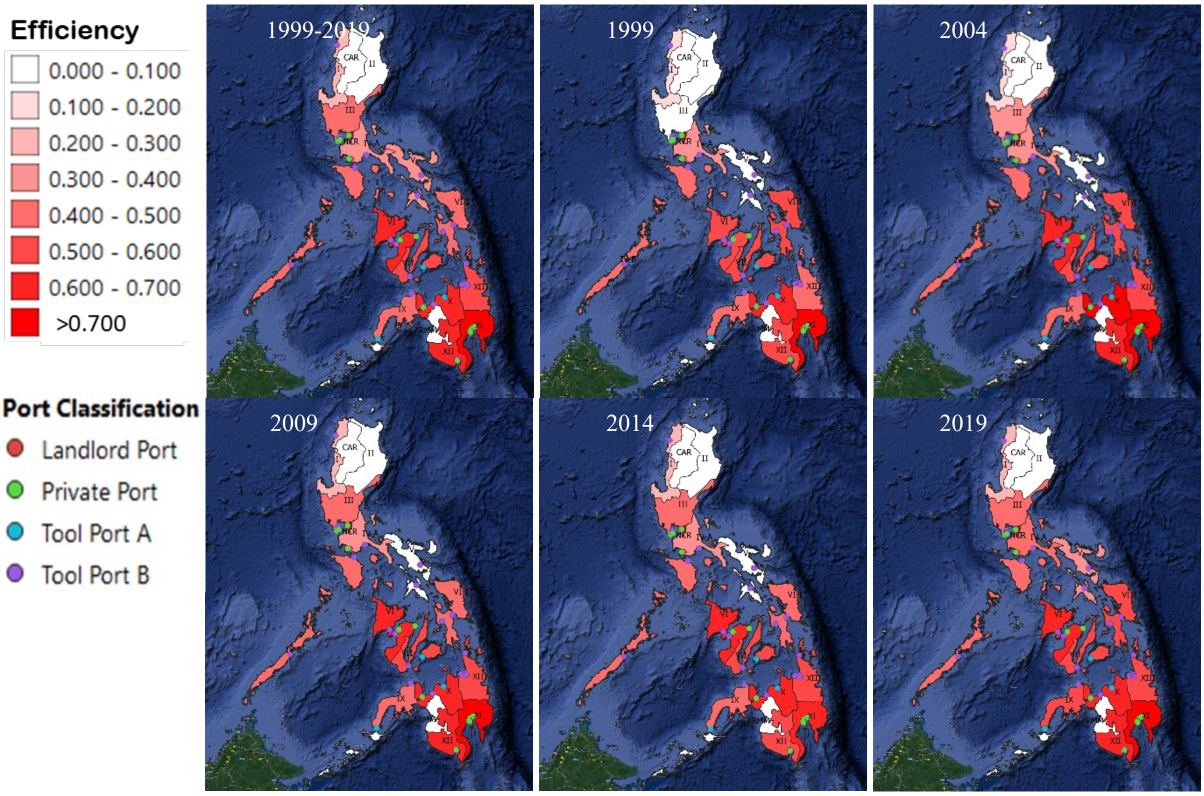


Figure 27. Efficiency per region 1999-2019 (full model)

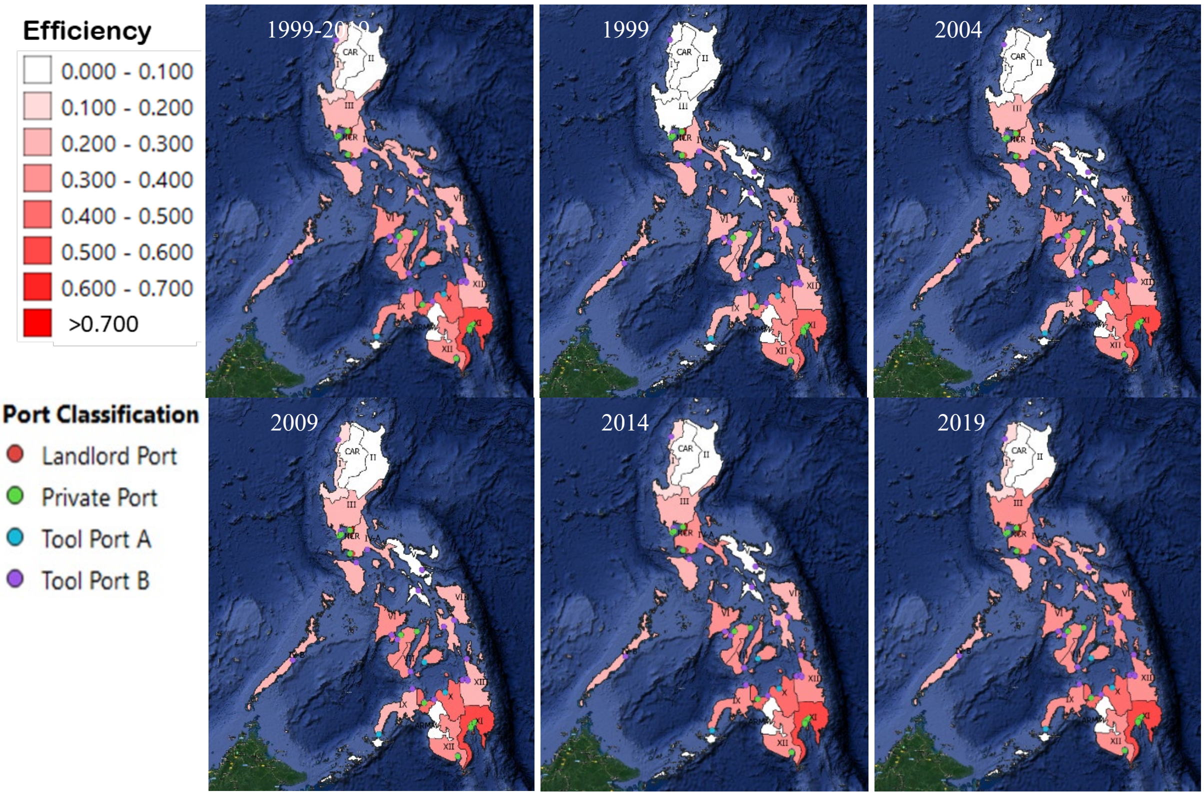


Figure 28. Efficiency per region 1999-2019 (dwell-time model)

5.4. Summary

In terms of private participation in port development, using simple descriptive trend analysis we see that ports with higher private participation are more aggressive in capital outlay, i.e. landlord ports for port expansion and tool A ports for cargo handling equipment. This implicates that while the government has some fiscal constraints, private participation is crucial in bridging capital gaps and improving the critical infrastructures in the maritime sector. When comparing port efficiency and privatization efficiency estimates using SFA shows that port expansion and purchase of cargo-handling equipment translates into technical efficiency with landlord ports leading for both models whereas tool B ports performed poorly especially for dwell-time. Private ports and private cargo-handling operators given longer concession periods allowing for capital recovery improve the efficiency of ports in the Philippines especially on matters of dwell-time. Investigating regional competition and efficiency using estimated efficiencies as input for spatial analysis revealed that NCR, regions XI and VI are the most efficient characterized by larger private participation through landlord and private ports while regions I, V, VIII, XIII having only tool ports B showed below national average efficiency for full model and alarmingly low dwell-time efficiency. Private participation in the maritime sector therefore allows healthier inter-port competition and efficiency. It can be said that PPA is performing very well in its mandate as a government corporation but could be at the expense of port congestion. Landlord ports were the most efficient set-up but regulatory capture must be considered, i.e. favoring landlord ports with extra concession fees over fully privatized ports. Given a pro-competition policy environment, Public-Private Partnership can be a good strategy in an increasingly financially viable maritime industry. Further study must be done on the effect of cargo-handling rates and other port-dues as well as regulations limiting private participation in the technical efficiency of Philippine ports.

6. Conclusions

One of the challenges of the Philippines as with other governments of developing nations are its fiscal constraints. The economy of the Philippines is growing and with it is the demand for better infrastructures and enabling environment. The role of the private sector in bridging some infrastructure gaps notably on projects which are both financially and economically viable is increasingly recognized as evidenced by one of the strategic pillars of the current administration that is harnessing private participation through Public-Private Partnerships (PPP). This is a step to a good direction when it comes to promoting competition and therefore efficiency of ports. What's troubling, however, is that most port development projects in the pipeline are unsolicited PPP proposals. On paper, this sounds good since there will be no counterpart financing on the side of the government while PPA will still earn through concession fees, cargo-handling share and other port dues, however, unsolicited means it was not planned by the government. As the primary port operator and regulator in the Philippines, PPA must be on top of port developments and not just react to the individual plans of the private sector. For example, Sasa port development will have implications in the already worsening congestion in metropolitan Davao as it plans to re-divert some of the spillage attracted by DICT. DICT on the other hand has become more attractive as new coastal and diversion roads that connect to the catchment area of the ports in Davao region and cargos need not merge with the traffic at Davao city inner roads. PPA is in the position to have a more holistic approach to port development as its role is becoming more of a regulator than operator.

The study shows that ports under the PPA with private participation are more aggressive in capital outlay, precisely landlord ports for port expansion and tool A ports for cargo handling equipment. Such strategy also translates into technical efficiency wherein landlord ports seem to dominate in technical efficiency for both models whereas tool B ports performed poorly. Furthermore, massive investments of landlord ports allowed less expanding tool A and private ports to overtake in terms of efficiency on the full model but translated positively when looking at dwell-time efficiency. Conversely, tool ports B that lagged in capital outlay had alarmingly low dwell-time efficiency. Comparing regional efficiency, we see that NCR, region VI and region XI are the most efficient characterized by larger private participation through landlord and private ports. Unlike NCR where ports are quite concentrated in one area (port of Manila) making Batangas port unattractive given industry agglomeration, region VI and XI ports are more dispersed wherein in region XI, ports follow a linear development along the Davao gulf. While agglomeration has its own merits, congestion around metro Manila shows that roads and other infrastructure could not keep up.

There is a need to develop a robust Philippine port masterplan with the changing climate of the maritime industry in the country. The private sector is getting more engaged and the PPAs role might have to evolve in the following years. It's imperative to show caution in maintaining a competitive environment especially because the early private players such as ITCSI and ATI is becoming more dominant with their acquisition of existing private ports such as HCPT and unsolicited proposals to develop, maintain and operate major baseports and regional gateway ports such as Iloilo port, Gensan port and North Harbor. While currently the PPA has excellently been operating as a GOCC, there is a need to shift towards regulation as a primary role. With this, more empirical studies are needed to aid in research-based policy making such as the effect of previous regulations like changes in the cargo handling rates and other port dues set by the PPA. Furthermore, the study showed that landlord ports seem to be the most efficient among port classifications, however, whenever there is inter-port competition between different port classifications such as in the case of the private port HCPT competing with landlord ports South Harbor and MICT, and tool A port North Harbor, HCPT had regulatory disadvantage in that PPA did not approve its request for permit to handle foreign container cargos despite passing the requirements. Nevertheless, results of this study provide a good baseline for future empirical quantitative research on the efficiency of the maritime industry in the Philippines.

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