The Effectiveness of Palembang Ferry Port Displacement

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Abstract. Ferry is an important mode for Indonesia as an archipelago country. One of the main routes for the commercial ferry in Indonesia is Palembang – Bangka trajectory. In 2013, there was displacement of Palembang ferry port from 35 Ilir port in central of Palembang to Tanjung Api-api port in the countryside of Palembang to improve ferry service quality. The displacement reduces travel distances of the ferry from 92 miles to 30 miles. To know the effectiveness of port displacement, this paper discusses analysis by operating expenses of the vessel, load factor, and the feasibility of fare. The results showed that operating expenses of vessel decreased by 9.09% after displacement. Load factor of passengers and vehicles shown increasing as well as the production. The analysis shows the minimum fare become decreasing proportionately with reducing of travel distance. With that result, the displacement is an appropriate way to improve the quality of Palembang ferry services.

1. Introduction
Ferry services are the important mode in Indonesia as the archipelago country. Palembang as one of the city in Indonesia with ferry services has trajectories access to Bangka Island. In December 2013, Ferry services in Palembang City had displacement from 35 Ilir Port to Tanjung Api-api port. The reasons for displacement are the operation of high-speed boats along a similar trajectory, change in enumeration method of passengers, restriction of boarding capacity, and erratic operation of the ferryboats [1], and also for enhancing the reliability, safety, and convenience of ferry transport services. Another reason is the geographic factors where 35 Ilir port located in the urban area and along the shallow depth of Musi River. River dredging continually should be done year by year if this port maintained and made enormous implementation costs.

The displacement of port decreasing travel time from 10 hours become 4 hours. Moreover, the Provincial Government of South Sumatra will develop the Tanjung Api-api area into an integrated port area and become a multi-modal for the development of road and rail transport in southern Sumatera [2].

The number of passengers for Palembang-Bangka ferry services before displacement shown an increase from 2010 until 2013 even not significant, however, the next year showed highly rise of it [3 - 7]. That’s slightly different with the number of vehicles, even though there increasing number but not
significant as shown in figure 1. As the data of the Ministry of Transportation (2016), Tanjung Api api only has one quay, contrasting with 35 Ilir port which has three quays. Furthermore, it assumed that an opening of an air route between Bangka and Palembang and the drop in the production of tin in ores at Bangka Island also affected the volume of transport [1].

The displacement reduces the travel distance from about 92 miles to 30 miles. The role of traveling distance is relevant to discuss because it influences both supply and demand through operating costs and generalized costs respectively [8]. Empirical study about fares and travel distance are limited [8], [9]. Accordingly, the objectives of this study are about the effectiveness of displacement of ferry services port from 35 Ilir port to Tanjung Api-api port, to know how effective the displacement from analysis of operating expenses of the vessel, the feasibility of fare, and load factor analysis in both ports.

![Number of Passengers & Vehicles Palembang-Bangka Ferry Transport](image)

**Figure 1.** Number of Passenger & Vehicle for Palembang – Bangka Ferry Transport

Source: [3-7]

2. Literature Review

A meaningful port performance evaluation will need the sets of assessment from various aspects of port [10]. Bichou (2007) in [11] indicated port performance through the output achievements by the success rate of service and categories into 3 (three) groups indicators, which are:

- Service performance and productivity of ships, this related to information concerning about port facilities,
- Service indicators, this related to the performance of traffic, length of time information about vessel service.
- Utilization indicators, these indicators purpose to measure the infrastructure.

There are some ways to assess the efficiency of ports depend on the aspects of port operation evaluated [10].

The performance to be evaluated is the efficiency of services [10] since the function of ports is facilitating the movement of passengers and vehicles then the efficiency of port service for passengers and vehicles are defied to assess.

The success of ship operators in financial aspect mainly on three factors [12]:

- Income in the form of freight rates,
- Interests and repayments,
- Voyage costs and Operating expenses of the vessel.

Factor mobility and transport costs are the two key ingredients that can’t set apart [13], while factor mobility will cause the change of transport cost and vice versa. The line of transport cost can show as
operating expenses where play an important role in the financial success of transport mode, in this case, are ship services [12]. Operating expenses can divide into fixed cost and variable cost [14]. Fixed cost can be asses by vehicle purchase or lease; insurance and registration; and vehicle taxes, otherwise variable cost can assess by maintenance and repair; fuel, fuel taxes and oil; and paid parking [14]. As one of mode, ferry has operating vessel component similar with other modes which divide into fixed cost and variable cost.

In Indonesia government regulation, as stated in Ministry of Transportation number KM 58 year 2003 about the mechanism of ferry fare arrangement mention also that cost operation of the vessel can divide as two assessment which is direct cost and variable cost. The distance between the port and the location has a major impact on inland transportation costs [15]. Moreover, the number of passengers raise comparable with fares and travel distances [8].

Passengers fare become the foundation to measure port financial. Rationale passenger always choose the lowest fare for transportation cost [8] and the minimum fare of transport mode will make surplus consumers [8,9]. Fare schemes are designed with the costs and demand characteristics as a basis to maximize the underlying objective function of the company or the transport authority, profit maximization for the company will obtain while transport authorities maximize the welfare of the society [8]. Therefore, fare calculated based by operating expenses of vessel and feasibility of passengers and vehicles.

3. Methodology
The effectiveness assessment of the port adopt from [11], port selection criteria assess by this factors:
- The high frequency and productivity of port visits [16].
- The adequate of ports infrastructure [10].
- Low cost of ports [17].

The assessment of those factors by analysis of:
- Vessel operating expenses,
- Load factor,
- Passengers and fare feasibility, and
- Investment feasibility of ports.

The second analysis is supposed to reflect the performance of productivity of the port before and after displacement. Other analysis are supposed to see the economic effects of the port displacement because the to assess the maximize of operational efficiency is consider with economic objective [10].

The component of operating expenses of vessel adopt by [14] and regulation of the Ministry of Transportation number KM 58 year 2003, where are:
- Vessel depreciation cost,
- Vessel interest,
- Vessel insurance,
- Ship’s crews and employees,
- Fuel, lubricants, and grease,
- Repairs and maintenances,
- Terminal environments,
- Docking,
- Commercial,
- Water,
- 11. Management and administration cost.

Load factor analysis assesses to show production of passengers and vehicle before and after displacement. The load factor is an indication of the relationship between demand and supply of transport mode. Ferry in Indonesia not only used for passengers but also vehicles. Vehicles in this study calculated with the same unit standard. Vehicle units standardize based on regulation of the Ministry of Transportation number KM 58 year 2003. Ferry load factor rate by the percentage of passengers and vehicles production with vessel capacity.
Passengers and fare feasibility calculate by freight rates. Freight rates mean as the cost was incurred by the transportation project to do their activity. Freight rates will give the standard of minimum fare for transport cost. The passenger will not only consider transport against the cost of other goods but also choose the transport mode which gives the lowest generalized costs (travel resistance) for the specific traveling distance [8]. Theoretically, the relationship between fares and travel distance depends on underlying objectives and the costs- and demand functions [8] and cost increasing proportionately with travel distance [9]. Freight rates get from operating expenses of the vessel (OP) and ships investment (S) compare with productions (P).

\[ FR = \frac{OP \times S}{P} \]  

(1)

For analysis, production of ferry services which are passengers and vehicles convert as same unit standard as mention before. Minimum fare pose as freight rates (FR) and distances (d) [8]. So, the minimum fare formula is:

\[ F_{\text{min}} = FR \times d \]  

(2)

Secondary data used to figure out the assessment. Data from year 2013 to past are for assessing port before displacement and data from 2013 to now are for assessing port after displacement. Data sourced from the annual report of Palembang – Bangka Ferry and statistics of Directorate General of Transportation in Indonesia, take from year 2003 until 2017. Furthermore, evaluate before and after displacement to compare and appraise the effectiveness of port displacement.

![Diagram of Research Procedure](image)

**Figure 2.** Analytical Procedure of Research
After tracking down the research problem, the methodology of this research divide become three step as shown in figure 2. The first step is to develop of research instrument by study literature and theoretical basis. Furthermore, identify the evaluation to known the port performance. Next step; second step developing research by identify the factors that related to this research. Four factor is used to assess the effectiveness of ferry displacement where is vessel operating expenses, load factor, passengers and fare feasibility, and investment feasibility of ports. Over more the factor is chosen, data collection are developed with secondary data collection like explain in the last paragraph. The last step is analyzing the data and assess the factors to get the finding and conclusion about the effectiveness of ferry port displacement.

4. Analysis

4.1. Analysis of Operating Expenses of Vessel

Operating expenses of vessel adjust by the type of the vessel, as the mention in Directorate Jenderal of Transportation Indonesia in act No. KM 58 year 2003, about the mechanism of ferry fare formulation. Type of cost for the ferry in Indonesia depends on this two kind of cost, which are direct cost and variable cost.

Direct cost calculated by fixed cost component which are vessel depreciation cost, interest, insurance, ship’s crews; and unfixed cost which are by fuel, lubricants, grease, repairs, maintenance, docking, environment, commercial, and water. Vessel depreciation cost \(D\) is the cost of depreciation which calculates by the price of ships \((SP)\) reduce with residual value \((r)\) and compare with depreciation time \((Dt)\) [14].

\[
D = \frac{SP-r}{Dt}
\]

As the mention of Directorate Jenderal of Transportation Indonesia in act No. KM 58 year 2003, residual value about 5% from the price of ships and depreciation time are 25 years for the new ship and 20 years for used ships. Almost RoRo ships for this Palembang - Bangka trajectories are used ships so have depreciation time 20 years. Interest cost defines as loan capital about 65% of the vessel's price and the prevailing interest rate. Ship’s crews pose as salary and allowance, where allowance cost must include meal allowance, premium, health and safety insurance, uniform and holiday allowance.

Variable cost calculated by terminal employees for the fixed cost, management cost and administration for the unfixed cost. Terminal employees calculate by salary and allowance as well as ship crews. Management cost and administration include managerial cost both in vessel and terminal, also commercial and environmental.

Table 1. Operating Expenses of Vessel

| Component                        | Before Displacement | After Displacement |
|----------------------------------|---------------------|--------------------|
| Direct Cost                      | Rp 59,872,778,682   | Rp 76,948,252,476  |
| Fixed Cost                       | Rp 51,194,880,097   | Rp 68,259,840,130  |
| Unfixed Cost                     | Rp 8,677,898,585    | Rp 8,688,412,346   |
| Variable Cost                    | Rp 1,412,320,028    | Rp 1,412,320,028   |
| Fixed Cost                       | Rp 1,261,000,025    | Rp 1,261,000,025   |
| Unfixed Cost                     | Rp 151,320,003      | Rp 151,320,003     |
| Operational Cost of Vessel per Year | Rp 61,285,098,710   | Rp 78,360,572,504  |
| Operational Cost per trip        | Rp 30,244,332       | Rp 25,203,883      |
Statistic data of transportation in Indonesia shown that before displacement from 2009 until 2012 only operated six ro-ro ships, after displacement in 2013 replenishment become nine ro-ro ships. It’s cause some components in direct cost increasing about 12.48% with the fixed cost increasing 14.29% and unfixed cost only 0.06%. The variable cost has the same value because the component price using one price to observe the comparison at the same year, as shown in table 1. The operational cost of vessel per year increase after displacement about 12.23% yet operational cost per trip decrease 9.09%. The operational cost per trip cheaper from 30.244 million rupiah to 25.204 million rupiah. The decreasing caused by increasing of average trips per year from 2026 trips before displacement to 3109 trips after displacement.

4.2. Analysis of Load factor
Load factor is an indication of the relationship between demand and supply of ferry. To determine the load factor of passengers and vehicles by evaluating ferry productivity. Passengers and vehicles productivity obtained from secondary data which is from the annual data of the ferry before the displacement and after the displacement to see both comparisons. Palembang – Bangka ferry using RoRo 750 GT, until 2013 in 35 Ilir port only operating six vessels, but after displacement to Tanjung Api-api port government adds three more vessels to give the best performance in ferry operating. As the data from 2003 until 2008, average vessel capacity is 115 passengers and 12 vehicles [5] but from 2008 until 2012 increase to 125 passengers and 18 vehicles per ship [6], [7]. The average of vessel capacity more increase after displacement in 2013 become 334 passengers and 28 vehicles [3], [4].

![Figure 3. Production and Capacity of Port From 2003 to 2016](image)

Based on data of Ministry of Transportation Indonesia from 2003 to 2016 as shown in figure 3, production and capacity of passengers always increasing. The capacity of vessel per year for passengers shown increasing significant in the start period of displacement in 2013 about 44.34% than last year. Nevertheless, production of passengers showed decreasing 17.90%. Likeness with passengers, the capacity of the vessel for vehicles increasing about 20.32% and production decrease about 8.13%.
### Table 2. Load factor

| Year | Production per year | Trip per year | Average of Vessel Capacity | Vessel Capacity per year | Load Factor (%) |
|------|---------------------|---------------|---------------------------|-------------------------|-----------------|
|      | Passengers          | Vehicles      | Passengers                | Vehicles               | Passengers      | Vehicles |
| 2003 | 39920               | 11602         | 3456                      | 115                    | 12              | 397440   | 41472 | 10.04 | 27.98 |
| 2004 | 50792               | 15798         | 998                       | 115                    | 12              | 114770   | 11976 | 44.26 | 131.91 |
| 2005 | 21768               | 11352         | 852                       | 115                    | 12              | 97980    | 10224 | 22.22 | 111.03 |
| 2006 | 42836               | 22182         | 1664                      | 115                    | 12              | 191360   | 19968 | 22.39 | 111.09 |
| 2007 | 47488               | 18826         | 1410                      | 115                    | 12              | 16920    | 16920 | 29.29 | 111.26 |
| 2008 | 89671               | 30561         | 2268                      | 115                    | 12              | 27216    | 27216 | 34.38 | 112.29 |
| 2009 | 78187               | 11456         | 2525                      | 125                    | 18              | 45450    | 45450 | 24.77 | 25.21 |
| 2010 | 86474               | 26294         | 2544                      | 125                    | 18              | 45792    | 45792 | 27.19 | 57.42 |
| 2011 | 209733              | 26868         | 2866                      | 125                    | 18              | 51588    | 51588 | 58.54 | 52.08 |
| 2012 | 271777              | 31466         | 3110                      | 125                    | 18              | 55980    | 55980 | 69.91 | 56.21 |
| 2013 | 189240              | 26735         | 3019                      | 334                    | 28              | 84532    | 84532 | 18.77 | 31.63 |
| 2014 | 330295              | 75609         | 2949                      | 334                    | 28              | 82572    | 82572 | 33.53 | 91.57 |
| 2015 | 269669              | 37326         | 3168                      | 334                    | 28              | 88691    | 88691 | 25.49 | 42.09 |
| 2016 | 326339              | 77195         | 3301                      | 334                    | 28              | 92420    | 92420 | 29.6  | 83.53 |

Table 2 showed that production of ferry passengers and vehicles increased year by year but load factor shown the fluctuating graph. Before the displacement in 2012, as shown in table 2, the load factor showed the best number which is 69.91% for passengers. But, In 2013 as shown in table 3, the load factor of passengers and vehicles become lowest that before and after years. The displacement makes the production of ferry become decreased; even the capacity increased. After that year, the production of passengers and vehicles increasing again and likewise of the load factors.

### Table 3. Load factor After Displacement

| Year | Production per year | Trip per year | Average of Vessel Capacity | Vessel Capacity per year | Load Factor (%) |
|------|---------------------|---------------|---------------------------|-------------------------|-----------------|
|      | Passengers          | Vehicles      | Passengers                | Vehicles               | Passengers      | Vehicles |
| 2003 | 39920               | 11602         | 3456                      | 115                    | 12              | 397440   | 41472 | 10.04 | 27.98 |
| 2004 | 50792               | 15798         | 998                       | 115                    | 12              | 114770   | 11976 | 44.26 | 131.91 |
| 2005 | 21768               | 11352         | 852                       | 115                    | 12              | 97980    | 10224 | 22.22 | 111.03 |
| 2006 | 42836               | 22182         | 1664                      | 115                    | 12              | 191360   | 19968 | 22.39 | 111.09 |
| 2007 | 47488               | 18826         | 1410                      | 115                    | 12              | 16920    | 16920 | 29.29 | 111.26 |
| 2008 | 89671               | 30561         | 2268                      | 115                    | 12              | 27216    | 27216 | 34.38 | 112.29 |
| 2009 | 78187               | 11456         | 2525                      | 125                    | 18              | 45450    | 45450 | 24.77 | 25.21 |
| 2010 | 86474               | 26294         | 2544                      | 125                    | 18              | 45792    | 45792 | 27.19 | 57.42 |
| 2011 | 209733              | 26868         | 2866                      | 125                    | 18              | 51588    | 51588 | 58.54 | 52.08 |
| 2012 | 271777              | 31466         | 3110                      | 125                    | 18              | 55980    | 55980 | 69.91 | 56.21 |
| 2013 | 189240              | 26735         | 3019                      | 334                    | 28              | 84532    | 84532 | 18.77 | 31.63 |
| 2014 | 330295              | 75609         | 2949                      | 334                    | 28              | 82572    | 82572 | 33.53 | 91.57 |
| 2015 | 269669              | 37326         | 3168                      | 334                    | 28              | 88691    | 88691 | 25.49 | 42.09 |
| 2016 | 326339              | 77195         | 3301                      | 334                    | 28              | 92420    | 92420 | 29.6  | 83.53 |

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4.3. Analysis of Feasibility of Passengers and Fare
Operational expenses of vessel per year before displacement about 61 billion rupiah and increase after displacement about 78 billion rupiah because of the addition of vessels. As well as ships investment, before displacement about 51 billion rupiah and after displacement about 68 billion rupiah. The increasing of production from period 2003 to 2008 and 2009 to 2012 make minimum fare become decrease about 65.65%. After displacement, travel distance reduced from 92 miles become 30 miles. It makes fare minimum become lowest 34.08%.

| Year   | 2003 - 2008 | 2009 - 2012 | 2013 -2016 |
|--------|-------------|-------------|------------|
| OP     | Rp 61,285,098,710 | Rp 61,285,098,710 | Rp 78,360,572,504 |
| S      | Rp 51,194,880,097 | Rp 51,194,880,097 | Rp 68,259,840,130 |
| P      | 310567      | 593669      | 1473698    |
| d      | 92          | 92          | 30         |

Table 4. Fare Minimum

Table 4 shown the significant graphic of decreasing fare minimum of this ferry trajectory. The analysis shows that the production of passengers and vehicles after displacement of 1.5 million unit of passengers and make the fare minimum become 58,276 rupiah.

5. Summary
The comparison of before and after displacement shown effectiveness. Displacement of the port from the urban area to the countryside of Palembang city reducing travel distance of about 62 miles. The analysis showed that operational expenses of vessel become reduce even though ferry services operated three more vessels. The direct cost is shown significant number because of reducing of the travel distance of the port. In the first year of displacement, the load factor of passengers and vehicles decrease. Some aspect effect of this decreasing, this aspect would be interested in studying intrinsic.

The displacement of port reducing travel distance. Travel distance is an important factor when determining the fare level for public transport [8]. The generalized cost will increase with travel distance in all cases [9]. From the data, Palembang-Bangka trajectories reducing travel distance with the movement of the port from 92 miles become 30 miles. As the distance decrease, fare minimum becomes the lowest almost twice than before displacement; it’s only 58 thousand rupiah per unit passengers.

This study only settled the effectiveness in load factor, operational expenses of vessel and feasibility of fare. Although the results were constrained with the secondary of data, this study builds upon others research to develop ports and ferry services in Indonesia.

References
[1] Oda J 2009 Bajoe-Kolaka & Palembang-Muntok Ferry Terminal Development
[2] Directorate General of Land Transportation Indonesia 2013 Pelabuhan Penyeberangan Tanjung Api-api Percepat Konektivitas Palembang – Bangka [Online]. Available: http://dephub.go.id/post/read/pelabuhan-penyeberangan-tanjung-api-api-percepat-konektivitas-palembang-bangka-59975. [Accessed: 30-Apr-2018].
[3] Ministry Of Transportation Indonesia 2016 Transportation Statistics
[4] Ministry Of Transportation Indonesia 2015 Transportation Statistics
[5] Ministry Of Transportation Indonesia 2010 Transportation Statistics
[6] Ministry Of Transportation Indonesia 2012 Transportation Statistics
[7] Ministry Of Transportation Indonesia 2013 Transportation Statistics
[8] Mathisen T A 2006 The relationship between travel distance and fares, time costs and generalized costs in passenger transport Trafikdage på Aalborg Univ. 2006(8049) p 1–10
[9] Jørgensen F and Preston J 2015 The Relationship Between Fare and Travel Distance J. Transp. Econ. Policy 41(3) p 451–68
[10] Tongzon J L and Ganesalingam S 1994 An Evaluation of ASEAN Port Performance and Efficiency Asian Econ. J. 8(3) p 317–30
[11] Sutomo H and Soemardjito J 2012 Assessment Model of the Port Effectiveness and Efficiency (Case Study: Western Indonesia Region) Procedia - Social and Behavioral Sciences 43 p 24–32.
[12] Koehn S 2008 The economic determinants of vessel operating expenses: A semi-parametric Approach Marit. Econ. Logist. 10(3) p 275–94
[13] Behrens K and Picard P M 2011 Transportation, freight rates, and economic geography J. Int. Econ. 85(2) p 280–91
[14] Litman T A 2011 Transportation Cost and Benefit Analysis: Techniques, Estimates and Implication, Second edition (Victoria Transport Policy Institute)
[15] Tongzon J L 2009 Port choice and freight forwarders Transp. Res. Part E Logist. Transp. Rev., 45(1) p 186–95
[16] De Langen P W 2007 Port competition and selection in contestable hinterlands; the case of Austria Eur. J. Transp. Infrastruct. Res. 1(7) p 1–14
[17] Mazzarino M and Dipartimento I 2004 Analysis and assessment of port / shipping choice criteria in the ro-ro sector: a case study on the Italy-Greece axis 61(2003) p 395–428