The Panama Canal Expansion: Impact on Logistics Developments and the Economy of Panama

By

Anthony M. Pagano, Ph.D
University of Illinois at Chicago

Onésimo V. Sánchez
Panama Canal Authority (ACP) Retired

Ricardo Ungo, Ph.D.
Old Dominion University

Ruben Lachman
Logistics Consultant (INTRACORP)

Abstract

The Panama Canal has recently opened a new set of locks which will allow much larger ships to transit the Canal. In addition, there are a variety of ports, ship services, free zones, intermodal services, etc. which make up the cluster of economic activities surrounding the Canal. The Canal and its Cluster can have a major impact on the economy of Panama. The objective of this paper is to develop a methodology to evaluate the future impact of additional logistic developments in the region along the Panama Canal route on the gross value of production in Panama and its relationship to global trade. This methodology utilizes an input-output model of the Panamanian economy to identify linkages between Canal activities and the rest of the economy. The methodology quantifies the direct, indirect and induced effects of Canal related activities on the economy of Panama. The model has a base year of 2014 and examines optimistic, probable and pessimistic scenarios for the years 2020 and 2025. The paper identifies linkages between areas of opportunity for Panama, the international logistics industry, and the Panamanian economy. We develop a manual analytical tool that can evaluate the impacts and perform a sensitivity analysis. The model estimates that the major sectors of the maritime cluster have an overall impact of 32% of the gross value of production of the entire Panamanian economy. The input-output model will be used to analyze the impact of potential logistics developments on the economy of Panama. The methodology that is explained in this paper can be replicated by other countries which would like to understand the possible impacts of proposed maritime investments on their economy.

Keywords: Panama Canal, Economy, Maritime Cluster, Input-Output

1. Introduction[1]

Recently, Panama's economy has grown at rates that exceed the average for Latin America. Economic growth has been supported by activities of the economy that are concentrated around world trade and the logistics associated with it. Since about the year 2000, economic growth has been due to the creation of a logistics cluster which includes air transportation, tourism, expansion of the Panama Canal, telecommunications, ports, free trade zones, financial services and many other activities directly or indirectly related to world trade in goods and services. These dynamic activities, however, exhibit weak links among themselves, still operating as loosely integrated islands.

The maritime logistics and transport sector is an agglomeration of activities that includes several economic and strategic activities of the economy: Panama Canal, Transshipment Ports, Fuel Sales to Ships, Agencies and Shipping Lines, Fishing, Rail Transport, Internal Maritime Transport, Ship Repair, Ship Registration, Inspections and Certifications and Ship Suppliers. This agglomeration of activities generated a total impact on the economy of around 12.6 % of GDP in 2014 (base year) , creating at least 113,000 direct and indirect jobs in the overall economy. The multiplier effect on new jobs, wages, and gross domestic product in the economy is significant, and needs to be calculated by means of an appropriate methodology. This methodology should identify the maritime sector in general as an agglomerative agent of the most dynamic activities of the economy. The Panama Canal, the most important among the activities that make up the maritime logistic and transport sector, stands out, representing around 54% of the total impact of this sector on the national economy.

The Panama Canal Authority (ACP) has advocated for a commercial strategy related to logistics for world trade, which is capable of influencing to a great extent the entire economy of the country. Several potential areas of commercial opportunities have been identified. These include:

1. A new Container terminal at the Pacific Entrance of the Canal (Corozal area). This new port facility is envisioned as a way to prepare for the future demand for transshipment operations for containers. This port will provide additional capacity of port infrastructure for international trade flows in the Pacific entrance of the waterway.

2. Commercial Development Plan of 1,200 hectares. This plan covers the development of a Master Plan that determines the best commercial use of the west zone at the Pacific entrance of the Panama Canal, including Logistic Parks.

[1] Much of the research in this paper was developed by ACP and INTRACORP (2016). See references for details.

3. Roll On-Roll Off Terminal. This terminal would receive ro-ro ships, with cars, buses and heavy equipment. This proposed facility will provide greater capacity for the storage and distribution of these loads at the Pacific entrance of the Canal.

4. Liquefied Natural Gas (LNG) Terminal. Such a terminal can provide the infrastructure to meet the potential demand electricity generation, LNG Bunkering or for the redistribution in the region.

5. Shipyard and Ship Repair Services. A shipyard will address the need to provide ships repair services, routine maintenance or emergency repairs services to the Atlantic and Pacific markets.

In this paper, we will carry out a scenario analysis to determine the contribution of the ACP's commercial strategy on the national economy, especially its capacity to reduce logistical costs in the productive sector of the economy and thus raise the competitiveness of Panama. An input-output model will serve as the basis for this analysis to identify linkages between Canal activities and the rest of the economy. The methodology quantifies the direct, indirect and induced effects of Canal related activities on the economy of Panama. We develop an analytical tool that evaluates the impacts and performs sensitivity analyses. It was developed from previous versions of analytical tools being applied or utilized in related research of the Panamanian economy. See for example ACP and INTRACORP (2016), INTRACORP (2015a) and INTRACORP (2015b) which are discussed in the next section.

2. Previous Studies

Previous studies of clusters center on clusters in general, transportation clusters and maritime clusters. Lu, *et al* (2016) studied industrial clusters in the Pearl River Delta. They found a relationship between industrial clusters at different stages and the productivity of other industries or clusters. Delgadoa, *et al* (2014) utilized county level data in the US to analyze clusters of different types. Their findings indicate that industries located in strong clusters have higher employment and patent growth. They argue that strong clusters enable economies of agglomeration to take place.

Rivera, *et al* (2014) examine logistics clusters in the US also using county level data. They define a logistics cluster as a geographic concentration of firms providing logistics services, including 3PL's, transportation carriers, warehousing providers and forwarders. They also include suppliers of these activities in their definition. Kumar, *et al* (2016) utilize county level data in the US to examine transportation and logistics clusters in the US. They find that these clusters are primarily located in metropolitan areas.

Maritime cluster studies include Brett and Roe (2010) who examine the possible maritime cluster in the Dublin area. De Langen (2002) analyzes maritime clusters in the Netherlands. He argues that there are a variety of factors that affect cluster performance. These are the presence of agglomerative economies, internal competition among cluster participants, and entry and exit barriers. Pardali, *et al* (2016) investigate the cluster at the port of Piraeus in Greece. They find that necessary preconditions for successful cluster formulation are met there, despite the lack of a formally recognized cluster. Stavroulakis and Papadimitriou (2016) develop a topology of strategic factors concerning competitiveness within maritime clusters, critical linkages with other industrial clusters and their differentiation. Finally, Zhang and Lam (2013) identify four types of maritime clusters based on the functions taking place and use a model borrowed from biology to analyze the clusters.

There are three previous studies that are of note. One is Pagano, *et al* (2016a) which examined the impact of the Panama Canal expansion on the maritime cluster. The authors used a gravity I-O model to estimate economies of agglomeration and supply chain network effects. They found that the Canal and the Ports are the driver industries. These are the most important cluster industries whose growth drives the other cluster activities. But, they did not look at the impact of cluster growth on the economy of Panama.

In a second study, Pagano, *et al* (2016b), the authors looked at the demand and supply of trans-oceanic sea services. Such demand and alternative sources of supply would affect the demand for maritime cluster services in Panama. In a third study, Pagano, *et al* (2012) examined the impact of the Panama Canal Expansion on the Panamanian economy. The analysis was performed using an Input–Output (IO) model. The analysis was further developed through the use of a computational general equilibrium model that allows the exploration of the interactions of different variables. A gravity model formulation was then used to estimate the economies of agglomeration and network effects that result from the Canal Expansion on the Panama Canal Maritime Cluster. This last paper serves as the theoretical basis for this current analysis. The authors state:

> "CGE Models can estimate how the expansion of activity in one sector may have economy-wide effects. This model uses economic data to estimate the reaction of an economy to changes in policy, technology, or other external factors. The model consists of a series of equations that define economic variables in terms of identities. The model is developed through tables of transaction values that follow the lines of an IO model describing an economy in terms of sectors, commodities, and factors of production. These models also include estimates of different elasticities including Substitution, Armington, and Expenditure among others." Pagano, *et al* (2012, p. 708)

Additional relevant studies include ACP and INTRACORP (2016), which evaluated the impact of a new commercial strategy for the Canal areas on the contribution to international trade and the Panama logistics cluster. Another study for the Panama Maritime Chamber, INTRACORP (2015a) examined the components of the maritime cluster. Based on the same methodology, an economic and social impact study of the Colón Free Zone was carried out that same year, INTRACORP (2015b). Another related study of the logistics for the location of concrete plants was conducted in INTRACORP (2015c). This study developed an input-output regional model for the Panama metropolitan area, focusing on the driver sectors of the economy and the construction industry. A strategic government plan was developed using an input-output model of the entire economy of Panama, INTRACORP and EPYPSA(2014).

But, what will be the impact on the Panama economy if cluster components are further developed? This is the question that we now turn. In the next section, we develop a model of the Panamanian economy, implemented through an analytical tool, to estimate these impacts and we examine the aggregate economic impact of a hypothetical project, within the proposed commercial strategy.

3. A Model of the Economy of Panama

Figure 1 displays the model of the economy of Panama that was used in this analysis. The economy of Panama is related to a variety of factors as shown in the figure. One is the international economy. Since a large portion of the economy is related to world trade, the international economy plays a big role in shaping the local economy. The major economies that are related to Panama include the United States, European Union, China, Japan, Korea, and Singapore. These are the largest users of the Panama Canal and thus have the biggest impact on Panama. Gross Domestic Product (GDP) of Panama was related to the GDP's of the major economies using data from 1996 to 2012. We used our understanding of the Panamanian economy to develop this model.

Panama's GDP is also affected by the performance of the maritime and logistic clusters as well as other activities as shown in the figure. This includes the performance of the driver sectors: the Canal and the Ports. Representative sectors include the Canal, logistics and telecommunications, tourism, which includes hotels and travel agencies, and network businesses such as banking and real estate. The GDP of Panama was related to the output of these maritime businesses using data from 1997 to 2012 and our knowledge of the Panamanian economy. The models estimate GDP in current prices in millions of US dollars.

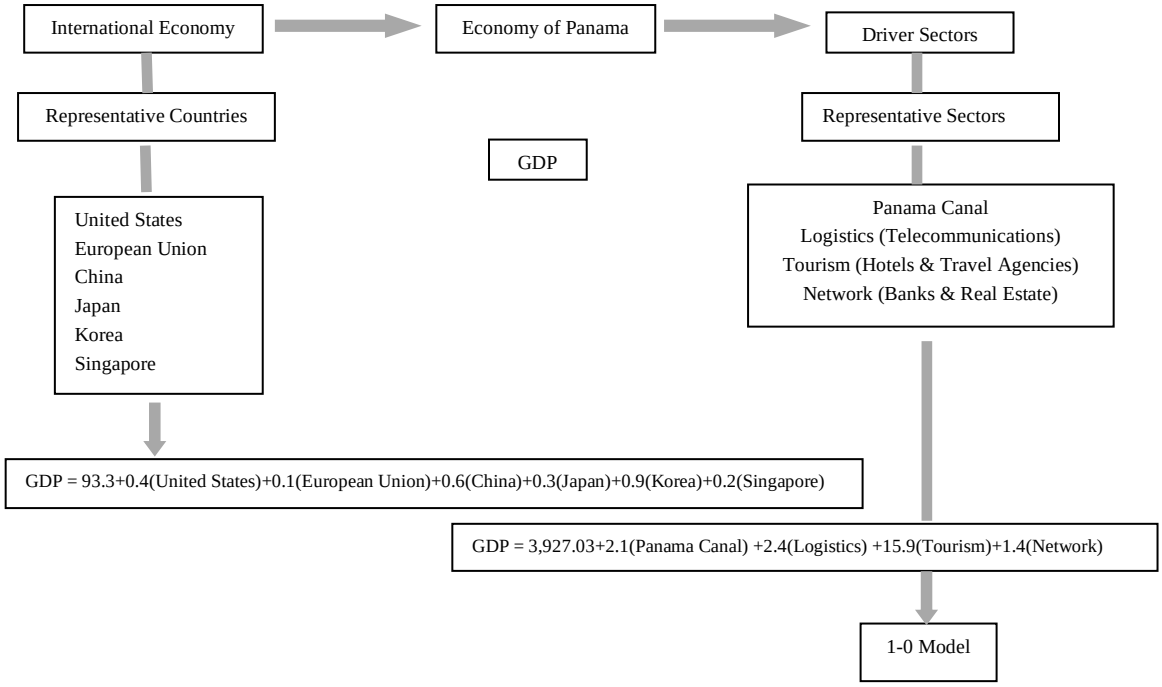
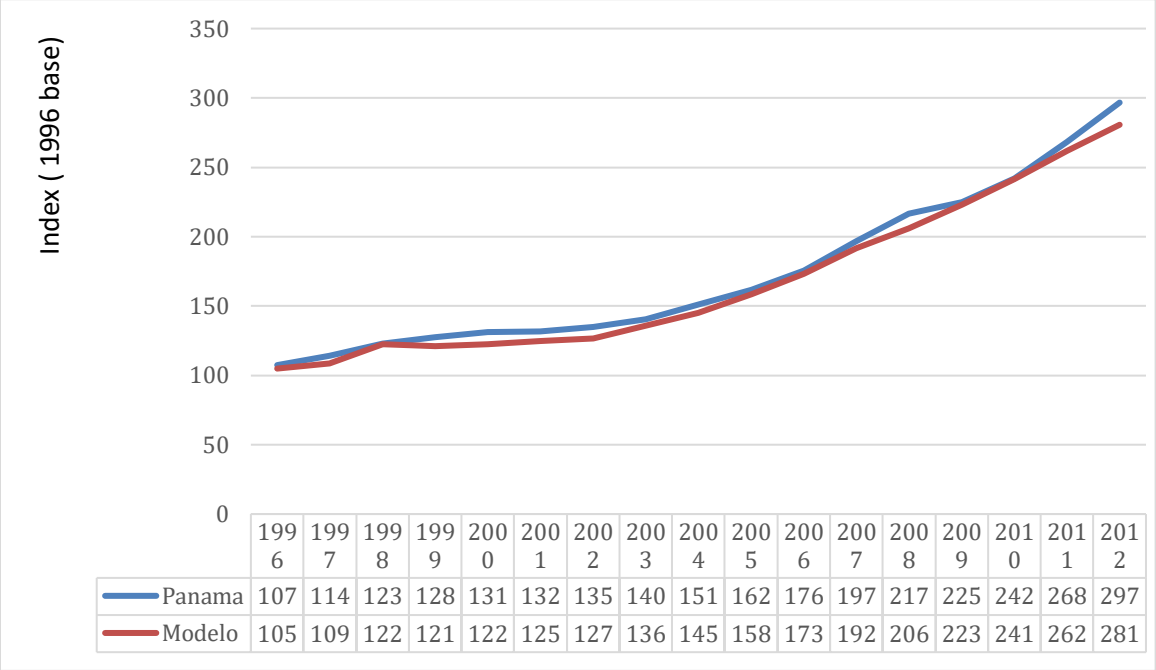


Figure 1 - A Model of the Economy of Panama

The two models were used in simulations of Panama GDP, world GDP and sector GDP, as shown in Figure 1. The coefficients are estimates, which, in turn, are based on previous analysis, and our knowledge of the Panamanian economy. Sector GDP was aggregated across all cluster elements. Figure 2 shows an index of actual and simulated Panama GDP. As can be seen by the figure, there is a very close relationship between the simulated ("Modelo") and actual. The actual and simulated index numbers are shown in the lower part of the figure. This is a good indication that the model is a reasonable forecasting tool.

Figure 3 shows the relationship between actual and simulated Panama GDP from 1997 to 2012. Again, there is a very close relationship between the actual and the simulated. These model results then are used in the input-output model.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Panama	107	114	123	128	131	132	135	140	151	162	176	197	217	225	242	268	297
Modelo	105	109	122	121	122	125	127	136	145	158	173	192	206	223	241	262	281

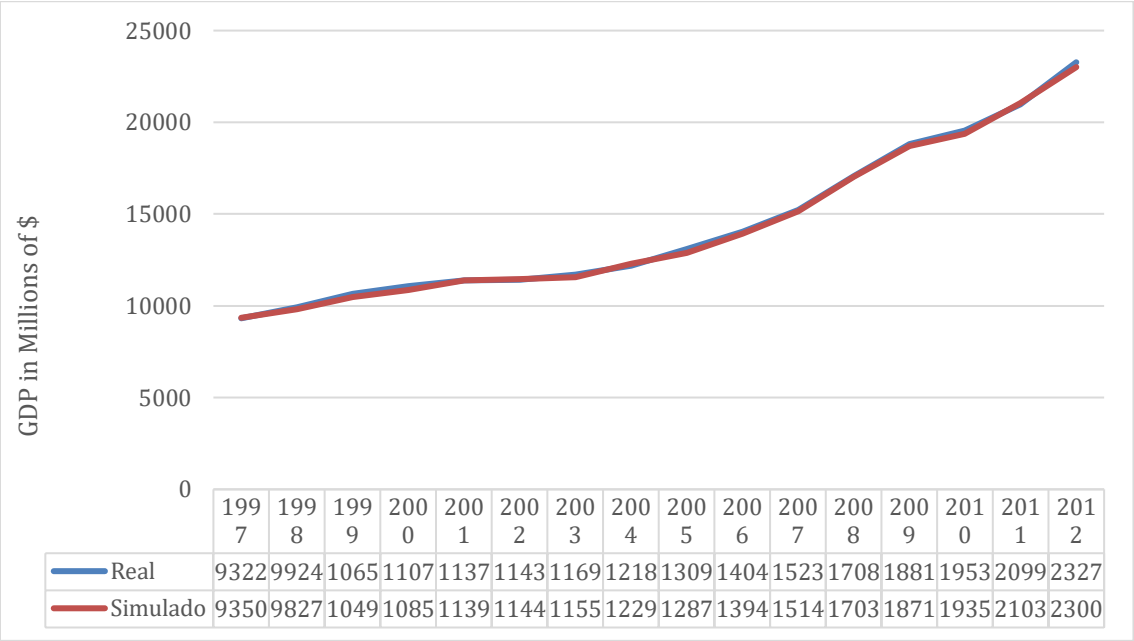
Figure 2 - Relationship between World and Panama Economies

4. Alternative Scenarios

The input-output(I-O) model allows us to perform a comparative static analysis for three possible scenarios from 2020 to 2025. These are: most likely, optimistic, and pessimistic. Based on the I-O model for the base year 2014, the scenarios are built on an association between variables that are related to the behavior of the world economy and the national economy.

4.1 Most Likely Scenario 2020 – 2025

In this period, a slight recovery of the world economy is stimulated by the growth of the United States and the European Union. Both the United States and the EU are expected to grow between 1.5% and 2.5% in the five-year period. It is also assumed that countries like Singapore and Korea will grow at the rates that are currently growing. China stabilizes its growth rate. Panama's economy grows as a whole according to the trends determined during the previous five-year period according to IMF projections. In the case of free trade zones, air transport, telecommunications, the Panama Canal, ports, and other sectors of maritime activity, increases in technology are assumed by changing the input-output ratio, increasing the Gross Value of Production / Employment.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Real	9322	9924	1065	1107	1137	1143	1169	1218	1309	1404	1523	1708	1881	1953	2099	2327
Simulado	9350	9827	1049	1085	1139	1144	1155	1229	1287	1394	1514	1703	1871	1935	2103	2300

Figure 3 - Impact of Driver Sectors on the Economy of Panama

4.2 Optimistic Scenario 2020 – 2025

The world economy grows at the same rate as the most likely scenario. Panama's economy is growing at a faster pace than the most likely scenario because the Panama Canal, ports and air transport grow at a faster rate due to the expansion of the canal, the operation of new port areas and the expansion of the air transport network. Tourism maintains the pace of growth of the likely scenario and, in general, there is greater linkage with the rest of the national economy. The Mining and Quarrying sector maintains its current growth rate as a result of the development of the Minera Panama project. Technological parameters change in all sectors of the economy. It is assumed that the economy of Panama will grow at an annual average rate of more than 2% per year faster in real terms than the most likely scenario.

4.3 Pessimistic Scenario 2020 – 2025

At the international level, the United States, the European Union, Japan, Korea and Singapore all maintain the same level of growth as the likely scenario. China decreases its growth by at least 0.5% on average per year compared to the likely scenario. In Panama, the free trade zone sector falls substantially, affecting important linkages in the country. This decreases the growth rate of the most likely scenario by an average of 0.5% per year. The political-administrative environment affects the rational expectations of the investors, and tourism reduces its growth by

at least 1% per year. In addition, Cuba develops a logistical sector for world trade, especially in the maritime component and a canal is constructed by Nicaragua, which also affects investment decisions reducing Panama's potential competitiveness.

5. An Analytical Tool to Measure the Impact of New Developments

5.1 Estimated Growth Rates for Each Scenario

The first step in the process of developing an analytical tool is to estimate growth rates of exports for each of the scenarios. The export of goods and services from Panama depends on worldwide exports. In recent years, Panama's exports are growing at a faster pace than exports of goods worldwide because the country has a variety of factors which enhance its competitive advantage, including the canal, ports and strategic location. The optimistic scenario is based on an average annual rate of Panama's exports of 14.3% which is Panama's recent history (2005-2012). An average annual rate of Panama's exports of 8.4% was considered the likely scenario, which is similar to Singapore's average annual growth (exports or GDP) for the same period. This means that it is assumed that in an optimistic scenario the economy of Panama would grow at its current rate and that in the most likely scenario, a mature Panama would grow at the same rate as Singapore. Singapore was used because its maritime and logistics cluster is similar to that of Panama. Finally, an arbitrary rate of 4% for Panama's export growth was considered in a pessimistic scenario, with this rate being roughly half that of the probable scenario.

5.2 Estimated GDP for Each Sector

Sector GDP was estimated in two ways. One is through the input-output analysis. The input-output model consists of 56 sectors in 2014. I-O data , intermediate consumption, GDP and employment where obtained from the National Income Accounts, Recent Tables of Supply and Demand (rectangle matrix) for 244 sectors and primary data from previous studies with the Canal. The model was used to develop multipliers which incorporate both the direct, indirect, and induced effects on sector and national GDP.

Second, a trend analysis was done by relating the GDP for each sector to an index of exports of goods and services. Data for the years 1996 – 2012 was utilized in the trend analysis. The results of both analyses are shown in Table 1.

In the table is shown the results for each of the cluster sectors. Sector GDP is shown for the base year of 2014 and then for 2020 and 2025. Optimistic, Most Likely and Pessimistic estimates are shown for each forecasted year. Two sets of forecasts are shown, one developed from the I-O analysis and one that resulted from the simple regression analysis for each sector. As can be

seen in the table, the I-O and regression results, for the most part, yield similar results. Most likely results are highlighted in the table.

Finally, the input-output results are used to estimate overall macroeconomic variables for the entire Panamanian economy. These are shown in Table 2 for 2020 and 2025 for Optimistic, Most Likely and Pessimistic scenarios. In the table, Gross Value of Production (Output), GVP, is shown. For an industry, it is a measure of an industry's sales or receipts. This includes sales to final consumers and sales to other industries that are intermediate outputs. It is also a measure of an industry's value added plus intermediate goods. Measures of the GVP provide a measure of the importance of that industry to the economy.

However, for the economy as a whole, GVP involves double counting. That is, it includes both sales of intermediate goods and final products. It is a useful measure of the total transactions or total economic activity. Sales of intermediate goods must be subtracted to obtain GDP.

6. Assessment of investments in projects related to logistics for world trade

Let´s assume a hypothetical investment in a commercial development project that is related to the logistics for world trade (such any port project) for an amount of $1,200 million which will create a future revenue stream of $240 million.

The steps to assess the hypothetical case of investment for logistics for world trade (i.e. ports) follow.

Table 1 - Sector GDP Estimates Using I-O and Trend Analysis
(Sector GDP in Current Prices, Millions of $B , 1B=1 USD)

			2020			2025		
		2014	14.3%	8.4%	4.0%	14.3%	8.4%	4.0%
			Optimistic	Most Likely	Pessimistic	Optimistic	Most Likely	Pessimistic
Railroad	i-o	142.2	274.9	233.4	222.5	501.4	323.9	299.1
	Regression Results		383.6	238.5	160.9	782.8	375.0	203.7
Pipeline	i-o	19.5	37.8	32.1	30.6	68.9	44.5	41.1
	Regression Results		59.0	37.5	26.0	118.1	57.7	32.3
Trucking	i-o	1,575.6	3,046.8	2,587.3	2,466.6	5,556.7	3,590.0	3,315.4
	Regression Results		4,186.5	2,657.6	1,840.6	8,393.6	4,095.9	2,290.9
Inland Water Transport	i-o	35.3	68.4	58.0	55.3	124.7	80.5	74.4
	Regression Results		53.1	34.9	25.1	103.4	52.0	30.5
Ports	i-o	562.6	1,131.4	923.8	883.7	2,063.4	1,281.8	1,187.8
	Regression Results		1,565.4	1,017.3	724.5	3,073.5	1,532.9	885.9
Panama Canal	i-o	2,232.6	4,490.1	3,666.3	3,229.3	8,189.0	5,087.2	4,340.6
	Regression Results		6,040.0	3,967.6	2,860.3	11,742.4	5,917.1	3,470.6
Air Transportaion	i-o	853.2	1,716.0	1,401.1	1,353.5	3,129.6	1,944.1	1,819.3
	Regression Results		2,739.3	1,733.3	1,195.7	5,507.6	2,679.7	1,492.0
	i-o	723.1	1,398.3	1,187.4	1,132.0	2,550.2	1,647.6	1,521.6
Travel Agencies			643.2	546.2	520.7	1,173.1	757.9	699.9
Handling and			200.0	169.8	161.9	364.7	235.6	217.6
			555.1	471.4	449.4	1,012.4	654.1	604.1
	Regression Results		1,275.4	822.9	581.0	2,520.8	1,248.6	714.3
Real Estate Agencies	i-o	6,200.1	11,989.5	10,181.3	9,706.2	21,866.4	14,127.3	13,046.5
	Regression Results		14,175.0	9,276.6	6,659.2	27,653.8	13,884.6	8,101.9
Hotels	i-o	443.6	857.8	728.4	694.4	1,564.4	1,010.7	933.4
	Regression Results		1,251.9	799.4	557.6	2,497.0	1,225.0	690.9

Table 2 - National Economic Projections Using I-O Model Results

(Millions of $B, 1B=1USD)

		Gross Value of Production	Intermediate Goods and Services	GDP	Gov Income	Consumer Disposable Income	Investment	Mixed Income	Employment
	2014	73,728.3	29,876.5	43,784.0	4,483.0	14,139.3	20,336.0	4,825.7	1,695,143
	Optimistic	125,083.8	50,948.7	74,019.0	7,758.7	23,887.2	34,304.8	8,068.3	1,895,566
2020	Most Likely	122,032.7	49,765.7	72,154.0	7,520.6	23,289.7	33,458.0	7,885.6	1,763,222
	Pessimistic	111,257.0	44,656.5	66,532.7	6,513.1	21,779.6	30,879.2	7,360.7	1,607,526
	Optimistic	179,801.1	72,942.8	106,700.5	11,283.1	34,233.7	49,316.5	11,867.2	2,055,218
2025	Most Likely	174,145.5	70,740.9	103,247.7	10,855.8	33,132.2	47,745.7	11,514.0	1,943,002
	Pessimistic	124,304.5	49,893.5	83,702.6	8,320.3	27,613.0	39,190.5	8,578.8	1,386,908

6.1 Stage 1 - Construction of the I-O Matrices for 2018-2019

In order to calculate the increase in the Infrastructure Construction sector, we applied the following steps:

1. The values of the projections for 2020 of the Gross Domestic Product from the International Monetary Fund are used and the regression models of the Most Likely scenario are used to estimate values for each of the cluster sectors.

2. First, we estimated the 2019 I-O matrix and then the 2018 I-O matrix. The former matrix is closer to the Most Likely scenario for 2020 therefore the estimated values would be closer.

3. The new gross value of production (GVP) for the entire economy for 2019 is:

$$GVP_{2019} = \frac{(GDP_{2019} * GVP_{2020})}{GDP_{2020}} \quad (1)$$

4. Calculate for each sector, the new GVP using the national GVP in 2019.

$$GVP\ Sector_{2019} = \frac{(GVPSector_{2020} * GVP\ National_{2019})}{GVP\ National_{2020}} \quad (2)$$

5. Furthermore, we calculated the new value of productivity:

$$\text{Productivity} = \text{GVP} / \text{Employment} \quad (3)$$

6. The employment of each sector is computed as

$$\text{Employment} = (\text{GVP} / \text{Productivity}) * 1{,}000{,}000 \quad (4)$$

7. The same steps are performed to generate the new 2018 matrix based on the 2019 matrix.

6.2 Stage 2 - Analysis of the Growth of the Infrastructure Construction Sector

It is assumed that the Infrastructure Construction sector will grow by $ 1,200 million dollars. For each year of construction, we calculate:

- Government Income / GVP
- Income available for consumption / GVP
- Revenue available for investment / GVP
- Mixed Income / GVP
- GVP / Employment
- GDP / GVP
- Intermediate Goods / GVP

. Taking into account that the hypothetical investment would be $ 1,200 million in two years (each year would increase $600 million), which represents an increase of 8.9% in the sector GVP Infrastructure Construction. After that, we compared the actual national totals with the changes that would be made if the sector increased. The results are shown in Table 3. Indirect Impacts were also calculated. These are shown in Table 4.

Table 3 - National Totals With and Without New Investment

	Without Investment	With Investment	% Change
National intermediate consumption	**42,302.10**	**42,603.40**	**0.71%**
Government revenue	6,392.70	6,478.60	1.34%
Income available for consumption	19,796.90	19,899.20	0.52%
Available for investment income	28,440.20	28,545.00	0.37%
Mixed-income	6,703.00	6,703.00	0.00%
Value-added (GDP)	**61,332.80**	**61,625.80**	**0.48%**
National GVP	**103,702.80**	**104,297.10**	**0.57%**
National employment	1,472,211	1,483,559	0.77%

Table 4 - Indirect Impacts

	Direct impact (GVP)	Indirect impact (intermediate consumption)	Total induced effect (wages + mixed)	Total employment (direct + indirect)	Total impact	Effect multiplier
Construction sector	7,271.9	3,686.6	1,711.9	138,858	12,670.4	1.74
National	104,297.1	42,603.4	26,602.2	1,483,559		

In Tables 3, we found that the national GVP increased 0.57% with the new investment of $1,200 million and the national employment increased 0.77%. In Table 4, the multiplier effect in terms of GVP was 1.74, which is quite positive. This means that targeting projects that reinforce the logistics cluster of the country we obtained larger multipliers.

7. Other potential extensions of this work

The linkages that can be analyzed through the input-output model also allow for the creation of a Satellite Account to evaluate the role of the Panamanian economy's impact on individual logistics activities. The degree of linkage produced by the national economy on the development of logistics activities can be assessed using this model.

Also, the input-output model based on the respective production functions of all sectors facilitates the evaluation of what logistics represents as intermediate goods and services in the national accounts. For example, it is possible to determine the portion of logistics in the Gross Domestic Product of the economy. By adding in intermediate goods and services, an estimate of the Gross Value of Production can be obtained. This tells the impact of logistics activities not only on the economy, but its impact internationally.

In summary, it is possible to measure the cost of logistics for the whole national economy, its impact internationally and thus the importance of "logistic cost" on main macroeconomic variables, such as consumption.

8. Conclusions and Recommendations

The main objective of this paper is to develop a methodology to systematically evaluate the economic impact of projects that are part of sectors related to the logistics for world trade. (i.e. new commercial developments around the Panama Canal). The new strategy promotes activities related to the role played by the Republic of Panama in the development of logistics for world trade. The contribution of this paper is to:

• Identify the linkages that occur between the commercial development opportunity areas, international logistics and the rest of the national economy, evaluating the contribution of commercial developments from an inclusive perspective. This allows for the quantification of the linkages that would occur with the growth of sectors that drive the economy and the effect that would be generated by the increase in other base or strategic sectors.

• Quantify the multiplier effects, direct, indirect and induced impacts of the commercial development strategies that reinforce Panama’s logistics cluster with greater analytical detail as to what it represents in its influence on all sectors of the economy.

It should be noted that intersectorial linkages must be produced based on an inclusive and sustainable development model capable of promoting the highest incidence in the entire economy.

Impact analysis was based on an input-output model that quantifies these linkages. For example, how a port, which is a driver sector, is linked to the construction and different sectors including the electricity sector, banking, air transport, hotels, restaurants and agricultural sectors. Thus, direct, indirect, induced impacts and the consequent multiplier effects are measured throughout the country's economy.

The methodology can provide basic information for the development of communication plans for all stakeholders for new inclusive commercial development activities which will extend the potential of Panama's logistics cluster.

Finally, the methodology developed in this paper can be readily replicated by other countries interested in estimating the impacts of new logistical developments on their economy. The methodology can be used to rank alternative projects to achieve the maxim impact on their economy.

References

AUTORIDAD DEL CANAL DE PANAMA (ACP) AND INTRACORP, 2016, La Nueva Estrategia Comercial del Canal y Su Contribución al Conglomerado Logístico Internacional y Del País: un Análisis de Escenarios. Informe Final. Panama City, Panama, April.

BRETT, V, and ROE, M, 2010. The potential for the clustering of the maritime transport sector in the Greater Dublin Region. Maritime Policy & Management, 37(1), 1-16

DELGADOA, M, PORTER, M, E, and STERN, S, 2014, Clusters, convergence, and economic performance. Research Policy 43, 1785–1799

INTRACORP, 2015a, Impacto económico del sector marítimo de Panamá. Informe, Cámara Marítima de Panamá, Panama City, Panama.

INTRACORP, 2015b, Impacto económico y social de la zona libre de Colón. Informe, Colón, Panama.

INTRACORP, 2015c, Estudio de localización de plantas de concreto. Informe, Panama City, Panama.

INTRACORP and COTRANS, 2015, Análisis del ambiente socioeconómico en la realización del estudio del puerto de corozal. Informe. Panama City, Panama.

INTRACORP and EPYPSA, 2014, Plan estratégico del gobierno panameño (2014-2019). Informe, Panama City, Panama.

KUMAR, I, ZHALNIN, A, KIM, A, and BEAULIEU, L, J, 2016. Transportation and logistics cluster competitive advantages in the U.S. regions: A cross-sectional and spatio-temporal analysis. Research in Transportation Economics (forthcoming)

DE LANGEN, P, W, 2002, Clustering and Performance: The Case of Maritime

Clustering in the Netherlands. Maritime Policy and Management, 29(3), 209-221.

LU, R, RUAN, M and REVE, T, 2016. Cluster and co-located cluster effects: an empirical study of six Chinese city regions. Research Policy 45, 1984–1995

PAGANO, A M, LIGHT, M K, SANCHEZ, O, and UNGO, R, 2012. Impact of the Panama Canal Expansion on the Panamanian Economy. Maritime Policy and Management, 39(7) 705-722.

PAGANO, A, M, WANG, G, SANCHEZ, O, UNGO, R, AND TAPIERO, E, 2016a. The Impact of the Panama Canal Expansion on Panama's Maritime Cluster. Maritime Policy & Management, 43(2), 164-178.

PAGANO, A, M, ZOU, B, SANCHEZ, O, and NORUZOLIAEE, M, 2016b. The Demand and Supply of Trans-Oceanic Sea Routes: The Case of Asia-US Trade. International Journal of Decision Sciences, Risk and Management, 6,(3), 205 -224.

PARDALI, A, KOUNOUPAS, E, and LAINOS, I, 2016. Can Clusters be Bi-Polar? Exploring the Case of the Piraeus Port–Maritime Cluster. Maritime Policy and Management, 43(6), 706-719.

RIVERA, L, SHEFFI, Y and WELSCH, R, 2014. Logistics Agglomeration in the US. Transportation Research Part A, 59, 222-238.

STAVROULAKIS, P, J, and PAPADIMITRIOU, S, 2016. The Strategic Factors Shaping Competitiveness for Maritime Clusters. Research in Transportation Business & Management, 19, 34–41

ZHANG, W, and LAM, J, S, L, 2013. Maritime Cluster Evolution Based on Symbiosis Theory and Lotka–Volterra Model. Maritime Policy and Management, 40(2), 161-176.