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U.S. Port Investment Strategies and the Corresponding Economic Impacts Stemming from the Panama Canal Expansion

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Abstract This paper measures the economic impacts of the U.S. port investment strategies coping with the Panama Canal expansion. Using secondary import data, negative and positive estimates of the impacts were presented in this study. Reduced port activities into the West Coast Customs Districts negatively affect transportation and warehousing industries, among other effects. Still, they have simultaneous positive effects in other states from increased imports resulting from modal shifts and changes in the entry port located in the South and East coasts. This study applied the supply-driven National Interstate Economic Model that measures all interstate trade among the U.S. states to divert foreign imports from 15 Pacific Rim countries. For this purpose, the following assumption was adopted: larger ships using the canal will lead to a redirection of seaborne trade among U.S. (and other) ports and result in secondary effects, e.g., using different freight modes and regional growth spillovers. This study also accounted for the entry point change and significant port investments for foreign trade under alternative scenarios. The choice of ports for international trade depends on decisions about how to minimize multimodal delivery costs. The total direct reduction of transportation and warehousing activities associated with foreign imports in the West Coast ports was estimated at $3.3 billion, leading to total negative effects of $5.8 billion. Total positive impacts from the shift of transportation modes with the choice of an entry port and new warehousing activities for foreign imports in the selected 12 states varied. As expected, states that involved an entry port had the most prominent benefits, but Texas, New York, and New Jersey may be benefited through all the port enhancement projects in the U.S. Also, except for Transportation and Postal, and Warehousing industries, Construction is another dominant positive affected industry of the Canal expansion in the U.S.

Keywords Panama Canal expansion; economic impacts; port investment; international trade; National Interstate Economic Model (NIEMO)

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I. Introduction

To process increasing container capacity induced by growing international trade, the Panama Canal Authority decided to invest over $5 billion to expand the canal in 2006. The canal expansion project was finished and opened on June 26, 2016. The size limit of vessels through the Panama Canal was increased to 13,000 twenty-foot equivalent units (TEUs) from 4,800 TEUs before the expansion project (van Hassel et al., 2020). The expansion introduces a substantial potential significance to U.S. shipping routes, transportation systems relating to cargo distribution, port development, U.S. supply chains, and logistics companies. Indeed, because the expanded Panama Canal will accommodate an even greater flow of container trade between Asian countries and the U.S., the volume of trade arriving at ports in the Gulf and East Coast is also expected to increase as cargo shifts from the congested West Coast ports (CanagaRetna, 2013; Knight, 2008). Medina et al. (2020) demonstrated the expectation that the expanded canal increased the number of containers for large ports in the Gulf and East Coast by an average of 24%, compared to ports in the West Coast.

Many port expansion projects in the U.S. ports related to the Panama Canal expansion need to be evaluated about how they will contribute to the U.S. economy. However, the methodological approach that estimates the Panama Canal expansion effects on the U.S. economy is complicated because it involves multiple and simultaneous behavioral factors. Using spatially disaggregated input-output (IO) models helps resolve difficulties, but we must consider how reduced port activities in the West Coast ports negatively affect transportation and warehousing industries, and regional growth spillovers will be counterbalanced by positive effects in the states receiving more foreign imports.

The National Interstate Economic Model (NIEMO), which modeled all interstate trade relations among the U.S. states, is the only operational U.S. model among national type multiregional IO models. Notably, foreign imports need a supply-side IO model application as applied in this study (Park, 2008; 2011; Lee et al., 2012; Park et al., 2008; 2013). The supply-driven NIEMO that estimates supply-side impacts was applied for this study. This study also considered that larger ships passing through the canal would prompt to redirect sizable water-borne trade among U.S. ports, affecting the secondary use of the other freight modes.

This paper provided negative and positive estimates for the U.S. port investment strategies coping with the Panama Canal expansion using secondary import data available from WISERTrade (www.wisertrade.org). The choice of entry port of destination states combined with port investment scenario analysis for several ports located in the South and East coasts was considered to measure positive estimates. For negative estimates, reduced seaborne imports to the West Coast Customs Districts (WCCD), including Los Angeles Customs District, San Francisco Customs District, Columbia-Snake Customs District, and Seattle Customs District, were measured. California, Oregon, and Washington, which covers WCCD, would receive reduced international imports and experience reduced port activities. The following assumption was adopted: the reduced activities would negatively affect transportation and warehousing industries in the states. At the same time, simultaneous positive effects in the other states were considered from increased imports caused by the modal shift and the change of entry port.

For the impact analysis with the NIEMO in this study, the following questions suggested practical implications for the possible economic impacts. For example, which ports would experience a potential increase in water freight when the Panama Canal is expanded? How can an IO model be combined with route-distance data? Especially, how do states with different delivery locations and time frames from each port make mode choices when measuring economic impacts? These complex questions were modeled in this study that had not previously been addressed in economic impact analyses in the U.S., combining scenario-based port investment strategies.

With the Suez Canal, the Panama Canal is assessed as the most strategic waterway important to global maritime trade (Miller and Hyodo, 2021). The technological and constructional innovations introduced new challenges in international trade and the global supply chain through the canal expansion. The implications suggested in this research provide essential information to understand the economic impact of the canal expansion on the U.S. economy and keep up with those challenges.

II. The Panama Canal Expansion and U.S. Ports

Taking a greater share of increasing global trade related to the canal's expansion, ports on the Atlantic and Gulf Coasts initiated efforts to enhance their infrastructure capacities (CanageRetna, 2013). There are several port enhancement projects in the region. The Port of Charleston prepared the harbor deepening project of the entire $300 million costs estimated in 2012 and fully funded $565 million for the project in 2019; this new project can accommodate the Post-Panamax vessels because it allows the Charleston Harbor to be deepened from the current 45 feet to 52 feet (South Carolina State Ports Authority, 2012; 2021).

After the canal expansion project was started, the Virginia Ports Authority, which operates the Port of Virginia, has conducted a $2.2 billion multi-phase terminal project. The project expands the Norfolk International Terminal capacity, enhancing infrastructure capabilities at the Craney Island and handling vessels transiting the required channel depth of 50 feet to 55 feet (Craney Island Eastward Expansion, 2013). The Port of Miami and the U.S. Army Corps of Engineers (USACE) signed the construction agreement in August 2012; the agreement permits the Port's Deep Dredge project to deepen the current 42 feet channels of the Port to between 50 feet and 52 feet with about $1 billion cost estimate (Miami-Dade County, 2013). The Port Authority of New York and New Jersey is working with the USACE to deepen the critical channels to 50 feet and accommodate larger and deeper-draft vessels. The Port Authority is also conducting a project to enhance on-port and inland rail connections and improve the port terminals (Port Authority of New York and New Jersey, 2013).

What are the plausible implications of the Panama Canal expansion? Several studies processed and discussed the plausibility with various assumptions. Knight (2008) reported that predicting the expansion impact as well as the timing and location of the impacts on freight distribution is very challenging because there is an inconsistency of economic assumptions relating to the Panama Canal expansion. Several recommendations suggested in his study are helpful for follow-up Panama Canal expansion studies. Remarkably, the complexity of timing and location of the impacts is associated with the potential port investment strategies corresponding to the Canal expansion. Several ports on the Atlantic and Gulf coasts initiated the expansion and modernization efforts. This ensures accounting for a greater proportion of global trade that will be transported directly through the expanded Panama Canal (CanagaRetna, 2013).

Moreover, Rodrigue (2010) outlined the Panama Canal function involves reliable grounds for the expansion, suggesting three main factors that affect the expansion: macroeconomic, operational, and competitive factors. After completing the canal expansion in 2016, Park and Park (2016) estimated impacts of U.S trade diversion due to the canal expansion from the ports of California, Oregon, and Washington to the Southern and East Coast seaports. The study by Park et al. (2020) also suggested a diverse spectrum of port development strategies in the U.S. responding to the canal expansion by estimating the U.S. trade change from the West Coast ports to the East and Gulf Coast ports.

In port range choice, van Hassel et al. (2020) analyzed the effects of the canal expansion on port choice for cargo distribution between the U.S. and Europe. Through a model designed for calculating transporting costs for the container, authors found that the expansion's impact on the competition between two ports in Europe is smaller than in the U.S. They also suggested that transport modes of ports and the hinterland in the U.S. and Europe are affected. Miller and Hyodo (2021) investigated the impact of the expanded Panama Canal on the Latin America and the Caribbean (LAC) ports with the DID (difference in difference) method. The finding of this study revealed that the canal expansion has positively affected container throughput volumes among LAC ports except for the regional transshipment port.

The regional impact of the Panama Canal expansion on the U.S. import volumes was examined by Medina et al. (2020). This research suggested that import volumes of ports in the Gulf and Atlantic coasts increased compared to ports on the Pacific coast. Another study by Medina et al. (2021) explored the effect of the canal expansion on the import volumes of relatively small ports in the Gulf and Atlantic coasts and found that small ports close to a prominent port in the Gulf and Atlantic coasts benefitted from the expansion.

III. Model and Data

Foreign imports diversion was only focused on this research because total foreign imports in the West Coast region account for more than five times of total trade in the U.S. than total foreign exports. This research adopted the supply-side NIEMO model for the canal expansion impacts on the U.S. national economy at the state level to account for the import diversion. International imports input data were collected from WISERtrade. The WISERTrade data were used for estimating the effects of trade diversion from the WCCD. For the origin countries traded to the WCCD ports, 15 Pacific Rim countries[1] were selected. Three years' average value of total imports from 2010 through 2012 was used to mute any outlying effect. The second column in Table 1 presents the data for WCCD.

Margins to total foreign imports were also derived: the truck and rail margins were calculated for transportation modes, and the warehousing margin was separately calculated. The use-table of the National IO Account available from the Bureau of Economic Analysis was applied for the margin calculation. The total imports of each Customs District have multiplied these margins for calculating the TW (transportation and warehousing) activities related to foreign imports. Other columns in Table 1 display the resulting outcomes by each WCCD.

[1] China, Japan, Republic of Korea, Hong Kong, Singapore, Australia, Taiwan, Malaysia, Philippines, Indonesia, New Zealand, Macao, Papua New Guinea, Brunei, and Thailand.

Table 1 Foreign seaborne imports traded to the West Coast Customs Districts and the associated transportation and warehousing costs

CD	TI	RC	TC	WC
Los Angeles	169,518	4,060	10,954	4,109
San Francisco	23,734	568	1,534	575
Columbia-Snake	9,452	226	611	229
Seattle	28,832	690	1,863	699
Total	231,536	5,545	14,962	5,613

Note: 1. Imports values are averaged from 2010 through 2. CD: customs district 3. TI: total imports 3. RC: rail costs 4. TC: truck costs 5. WC: warehousing costs
Unit: $ million

This study used the modal proportions collected from the FAF3 data to distribute TW costs headed to other states. The Origin-Destination State Database for 2007 in FAF3 provides substantial freight flow information by every primary freight transportation mode at the major metropolitan and state levels. However, there is an issue regarding the data's accuracy (Park et al., 2011). As Rodrigue (2010) and Knight (2008) identified, 12 states[2] were chosen, including ports potentially impacted by the Panama Canal expansion. And TW costs decreasing from each WCCD state were allocated to these states.

From the FAF3 database for 2007, the proportion of foreign imports distributed to the 12 destination states by truck and rail modes was calculated. The distribution process of TW costs is explained in Equation 1. As suggested in Table 1, the operational TW activity values associated with foreign imports distributed to each state were estimated using the allocation portions to each selected state and TW costs. The calculated results are presented in Table 2.

$$ {}^{k}\mathrm{OV\_IMP}_{i}^{j} = {}^{k}\mathrm{C}_{i} \times \mathrm{PR\_IMP}_{i}^{j} \quad (1) $$

where, OV_IMP = operational activity values of foreign imports
C = transportation cost of each WCCD state,
k= transportation or warehousing costs
i = the origin state of the WCCD ports,
j = the destination state,
PR_IMP = the proportion of foreign imports defined as $\frac{\mathrm{I\_TR}_{i}^{j}}{\mathrm{TI}_{i}}$,
TI = total imports, and
I_TR = foreign imports value distributed by truck and rail modes.

[2] They are Alabama, Delaware, Florida, Georgia, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, South Carolina, Texas, and Virginia.

Several basic assumptions were made in this analysis. First, foreign imports currently arriving in the WCCD ports and being transported to the other South and East coast states via truck and rail modes will be directly shipped to the destination ports. Second, each customs district's water-borne distance to destination ports is identical to the over-land geographical distance between core cities of origin and destination states. Third, the freight that would arrive at destination ports will travel an additional maximum of 100 miles by truck. Utilizing Google maps to find the principal cities of destination states and highway distance miles from each origin point to the destination cities were approximated. Finally, in addition to dollar values of the imports data, the weight information of foreign imports from WISERtrade was applied with the following dollar per ton-mile assumptions to calculate transportation costs per ton-mile (water-borne: $0.0074/ton-mile, truck: $0.2619/ton-mile, and rail mode: $0.0228/ton-mile; Ballou, 2004).

Table 2 Decreased transportation and warehousing activity values of foreign imports stemming from the diversion from each West Coast Customs District to various states

States	Los Angeles		San Francisco		Columbia-Snake		Seattle	
	TPV	WHV	TPV	WHV	TPV	WHV	TPV	WHV
AL	85	23	1	0	0	0	2	1
DE	2	1	0	0	0	0	1	0
FL	107	29	5	1	0	0	2	1
GA	193	53	6	2	0	0	9	3
MD	28	8	1	0	0	0	7	2
MA	41	11	7	2	0	0	3	1
NJ	468	128	7	2	5	2	20	5
NY	435	119	75	21	3	1	60	16
PA	121	33	7	2	1	0	20	5
SC	31	8	2	1	0	0	2	1
TX	910	249	33	9	92	25	9	3
VA	36	10	4	1	1	0	4	1
Total	2,456	672	148	40	103	28	139	38

Note: TPV – Transportation value; WHV – Warehousing value
Unit: $ million

Figuring out the change of transportation activity costs in destination states by modal shift and the choice of entry port, the following scenarios account for port investment plans located on the Atlantic and Gulf coasts and four possible vessel service routes presented by Ashar (2006) were developed. Therefore, each scenario addresses the entry point port change corresponding to the U.S. major port investment strategies for foreign trade associated with the Panama Canal expansion. The following scenario sentence is applied to Table 3.

Scenario: *All foreign imports would be directly shipped to (a) destination through the deepened Panama Canal and then distributed to the other states by equivalent or smaller vessels*

Table 3 Scenarios by ship destination and distribution state type

Scenarios	Destination
Scenario 1	Port of Miami
Scenario 2	Port of Charleston
Scenario 3	Port of Virginia
Scenario 4	Port of New York and New Jersey

All scenarios in Table 3 stand for the traditional route strategy a vessel serves suggested and analyzed by Ashar (2006). Table 4 represents the resulting change of transportation activity values in destination states by each scenario.

Table 4 Change of transportation activity values of foreign imports diverted from each Customs District to various states

States	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	DT	ΔTAV	DT	ΔTAV	DT	ΔTAV	DT	ΔTAV
AL	720	110	640	110	900	109	1,190	85
DE	1,160	5	640	5	250	5	340	5
FL	2,700	3,816	580	174	970	173	1,270	173
GA	490	293	110	293	490	292	800	292
MD	1,090	54	570	54	230	54	330	55
MA	1,490	86	970	87	580	87	310	87
NJ	1,270	790	750	793	360	796	0	799
NY	1,270	960	750	963	360	967	2,900	4220
PA	1,190	240	670	241	280	242	230	242
SC	590	53	2,600	3,605	430	53	750	53
TX	1,180	1118	1,060	1,119	1,390	1114	1,630	1112
VA	970	73	450	73	2,800	3,855	330	73
Average	1,177	633	816	626	753	646	840	602
Total	14,120	7,598	9,790	7,516	9,040	7,747	10,080	7,220
Units	mile	Million dollars	mile	Million dollars	mile	Million dollars	mile	Million dollars

Note: 1. DT = distance 2. ΔTAV = Baseline truck and rail activities values – Alternative water and truck activities values

As a primary tool of application to regional and national security problems, NIEMO has been developed by Park et al. (2007) and applied with the combination of various econometric methods to quantify the economic costs associated with human-made and natural disasters. Theoretical and empirical application topics include major U.S. seaport closures (Park et al., 2007; 2008), a US theme park closure (Richardson et al., 2007), US border closures (Gordon et al., 2009), a Foot-and-Mouth disease (Lee et al., 2012), and the Gulf Oil spill (Park et al., 2013). We applied the supply-side NIEMO model that Park (2007; 2008) and Park et al. (2008; 2013) elaborated for this part of the study. Equation 2 suggests the supply-side NIEMO structure in a matrix form:

$$X^{I} = V(I - BC)^{-1} \qquad (2)$$

where, X^{I} = the total input row vector,
V = a row vector of value-added factors,
B = $(\hat{X}^{d})^{-1}Z$ and $\hat{X}^{d}$ is the diagonal matrix of X^{d},
X^{d} = the column vector of total output,
Z = the matrix of direct technical flows between industries, and
C = the interregional trade flows matrix.

The USC Sectors used in the NIEMO model are easily convertible to other U.S. sector systems (Giuliano, 2010a; 2010b; Park et al., 2007; Park et al., 2009); they are explained in Table 5.

Table 5 Definition of USC Sector system

USC sector	Description
USC01	Live animals and live fish & Meat, fish, seafood, and their preparations
USC02	Cereal grains & Other agricultural products except for Animal Feed
USC03	Animal feed and products of animal origin, n.e.c.
USC04	Milled grain products and preparations, and bakery products
USC05	Other prepared foodstuffs and fats and oils
USC06	Alcoholic beverages
USC07	Tobacco products
USC08	Nonmetallic minerals (Monumental or building stone, Natural sands, Gravel and crushed stone, n.e.c.)
USC09	Metallic ores and concentrates
USC10	Coal and petroleum products (Coal and Fuel oils, n.e.c.)
USC11	Basic chemicals
USC12	Pharmaceutical products

USC13	Fertilizers
USC14	Chemical products and preparations, n.e.c.
USC15	Plastics and rubber
USC16	Logs and other wood in the rough & Wood products
USC17	Pulp, newsprint, paper, and paperboard & Paper or paperboard articles
USC18	Printed products
USC19	Textiles, leather, and articles of textiles or leather
USC20	Nonmetallic mineral products
USC21	Base metal in primary or semi-finished forms and in finished basic shapes
USC22	Articles of base metal
USC23	Machinery
USC24	Electronic and other electrical equipment and components, and office equipment
USC25	Motorized and other vehicles (including parts)
USC26	Transportation equipment, n.e.c.
USC27	Precision instruments and apparatus
USC28	Furniture, mattresses and mattress supports, lamps, lighting fittings, and illuminated signs
USC29	Miscellaneous manufactured products, Scrap, Mixed freight, and Commodity unknown
USC30	Utility
USC31	Construction
USC32	Wholesale Trade
USC33	Transportation
USC34	Postal and Warehousing
USC35	Retail Trade
USC36	Broadcasting and information services
USC37	Finance and Insurance
USC38	Real estate and rental and leasing
USC39	Professional, Scientific, and Technical services
USC40	Management of companies and enterprises
USC41	Administrative support and waste management
USC42	Education Services
USC43	Health Care and Social Assistances
USC44	Arts, Entertainment, and Recreation
USC45	Accommodation and Food services
USC46	Public administration
USC47	Other services except public administration

IV. Results

Since this study assumed that foreign imports would be directly shipped to the destination ports in each scenario, TW activities values presented in Table 2 would decrease in the WCCD states. New TW activities that would occur in each designated state were quantified to measure positive impacts. The transportation activity benefit by transportation mode shifting in destination states was measured to calculate the difference between baseline and alternative transportation modes. The decreased warehousing activity values were allocated to destination states to be increased, assuming the warehousing margin is identical in the nation. Note that any change in other transportation-related costs did not account for the short term in this analysis.

The supply-side NIEMO model separately estimated the reduced impacts of TW activities for foreign trade in the origin states and the increased impacts in destination states by each scenario. A Type I multiplier was calculated that measures the indirect impact contribution to direct impact, defined as the sum of direct and indirect impacts relative to the direct impact.

The reduced impacts in the WCCD states are summarized in Figure 1. The reduced impacts associated with TW activities negatively affected the national economy. The top three states (upper figure) and top ten USC sectors are demonstrated in Figure 1.

Direct impacts of the operational activity reduction in California, Oregon, and Washington are measured as \$3.2 billion, \$0.13 billion, and \$0.18 billion, respectively. The total impacts were estimated at \$5.8 billion, where the most affected state was California (\$-4,926 million, 85%); Washington (\$-296 million, 5.1%) and Oregon (\$-212 million, 3.7%) followed. Also, the most impacted sectors include USC sectors 33 (Transportation), 34 (Postal and Warehousing), and 30 (Utility) of which losses are \$3,109 million (53.7%), \$818 million (14.1%), and \$144 million (2.5%), respectively. The Type I multiplier of this case was 1.6.

Total positive impacts acquired from the transportation modes shifting and new warehousing activities in destination states by scenarios 1 to 4 were estimated as \$11,761 million, \$12,603 million, \$12,228 million, and \$11,138 million, respectively. The positive effects of the entry port's state were largest in each scenario, but Texas followed for all scenarios. Through the fact that the total positive effects of scenarios 2 and 3 were greater than those of scenarios 1 and 4 if considering transportation and warehousing gains, the entry ports located in the South Atlantic region may have a higher gain to the U.S., indicating the U.S. port enhancement projects associated with the canal expansion may be in line with this direction.

As entry port and transportation modes changed and warehousing activity of foreign imports to 12 South and East Coast states increased, the positive impacts were estimated to be dominant in USC sectors 33, 34, and 31 (Construction) in each scenario except scenario 4. In scenario 4, USC sector 43 (Health Care and Social Assistances) substituted for the Construction sector. The average shares of these three major sectors in each scenario accounted for almost 73% of the total gains. Type I multipliers of scenarios 1 to 4 were in the range between 1.5 and 1.7.

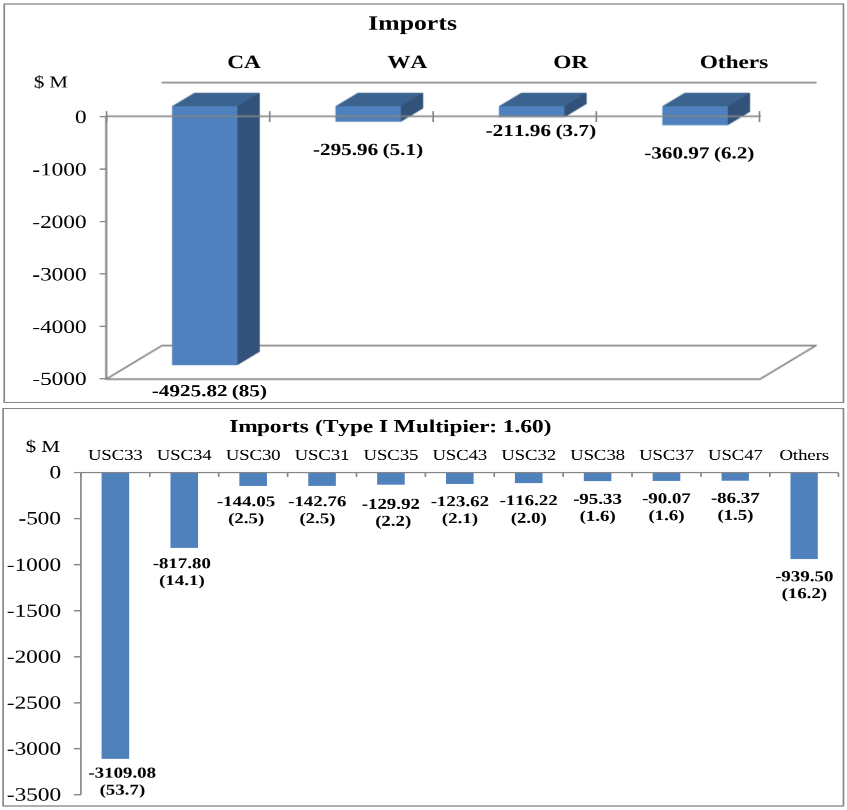

Figure 1 Impacts of reduced transportation and warehousing activity values in the West Coast states by top three states (upper figure) and by top ten USC Sectors (bottom figure)

Note: 1. The negative sign = economic losses. 2. The value in parenthesis is the ratio to total impacts. 3. Others in the upper graph: 47 states, D.C., and the rest of world excluding top three states. 4. Others in the bottom graph: 37 other USC sectors excluding the top ten sectors.

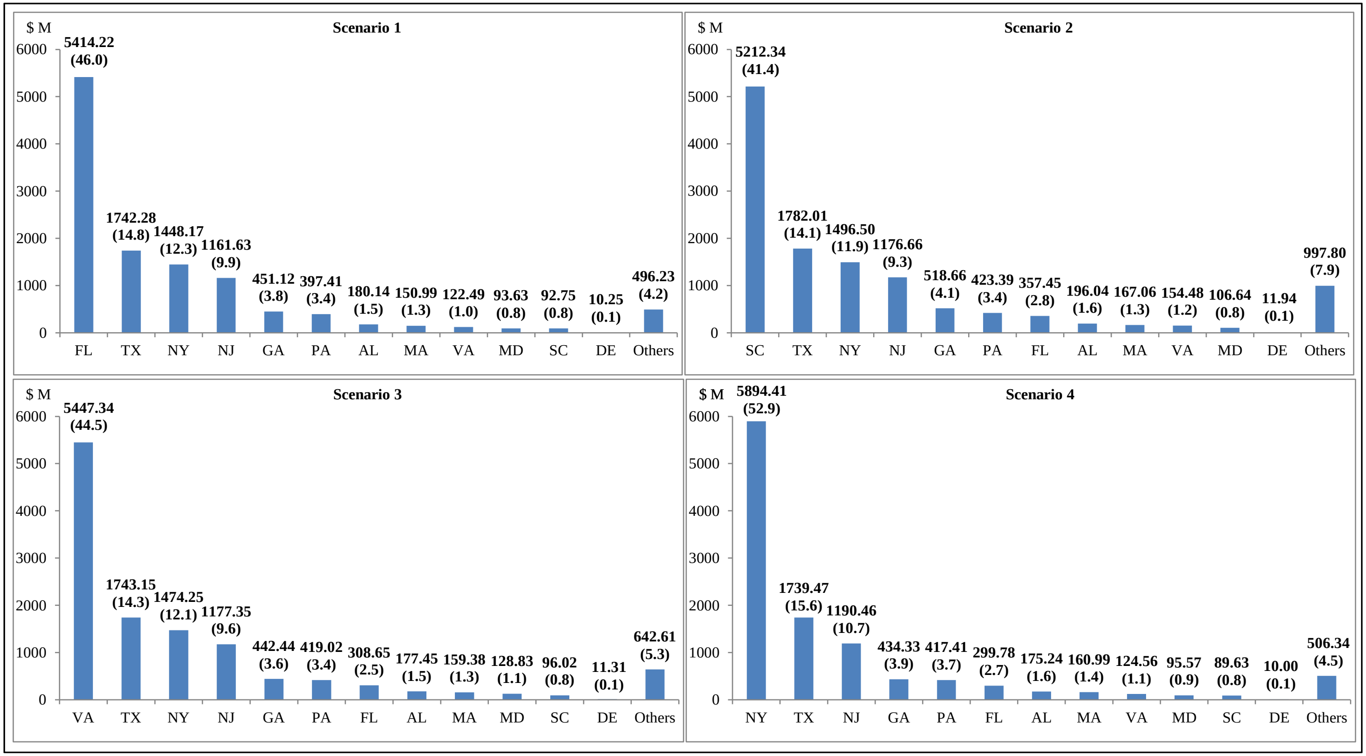

Figure 2 Positive impacts of the change of transportation mode and warehousing activities in other states for 12 destination states by scenario

Note: 1. The value in parenthesis is the ratio to total impacts. 2. Others: 47 states, D.C., and the rest of world excluding top three states

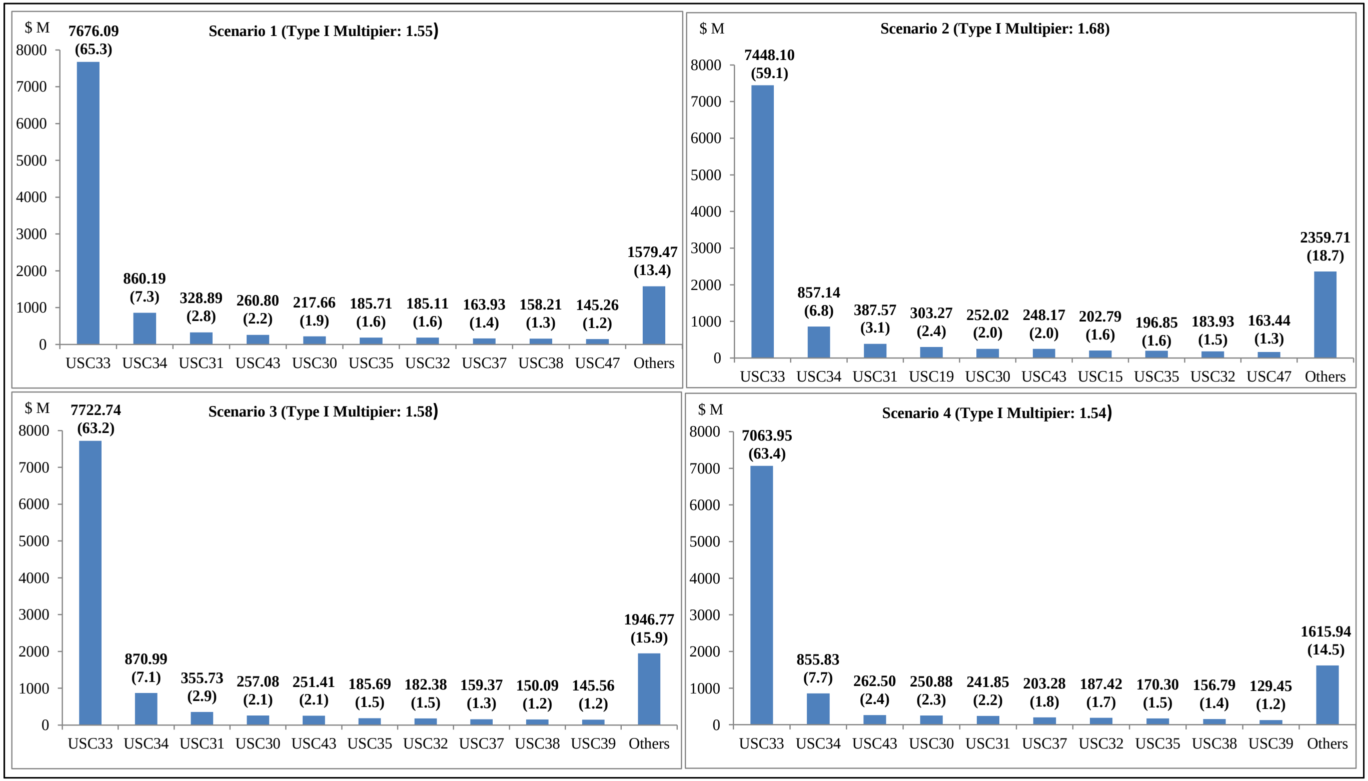

Figure 3 Positive impacts of the change of transportation mode and warehousing activities in other states for top ten USC sectors by scenario

Note: 1. The value in parenthesis is the ratio to total impacts. 2. Others: 47 states, D.C., and the rest of world excluding top three states

V. Conclusions and Discussion

Estimating the U.S. economic effects of the Panama Canal expansion has raised many analytical difficulties because simultaneous responses of the impacted and the other states in the U.S. should be considered. Developing plausible scenarios that account for port investment strategies and are applied to the appropriate economic impact model is another challenge. These challenges were addressed in this study empirically.

Estimating the effect of a new entry port's choice, this study set up multiple scenarios that account for the entry port change. The supply-side NIEMO model was applied for this analysis. The total direct reduction of TW activities associated with foreign imports in the West Coast ports was estimated at $3.3 billion, leading to the total negative economic impact of $5.8 billion. Total positive effects from the transportation modes shifting with the choice of an entry port and new warehousing activities in the selected 12 states varied. As expected, states that involved an entry port had the most prominent benefits, but Texas, New York, and New Jersey may be benefited through all the port enhancement projects in the U.S. Also, except for Transportation and Postal and Warehousing industries, Construction is another dominant positive affected industry of the Canal expansion in the U.S.

The Panama Canal expansion resulted from technological and constructional innovations and introduced new challenges to international trade and the global supply chain. The implications suggested in this research provide essential information to stakeholders such as policymakers and port enhancement projects' managers. They can understand the economic impact of the canal expansion on the U.S. economy and keep up with those challenges.

However, this study has several limits. First, the impact analysis with the MRIO model in this study is appropriate for short-term effects. An uncountable number of prices adjust in the longer term, and the economic impacts analyzed for the longer term are inconceivable. The change of an entry point port for foreign trade in the other U.S. regions did not account. It needs to understand each state's behavioral change in the region depending on minimizing multimodal delivery costs. Third, this study only focused on the shift in TW activities values for imports and could not account for the port investment amount planned exclusively for deepening channels in the South and East coasts. A parallel foreign export-based analysis will be the next analytical step to be taken. The demand-side NIEMO will be helpful for the new research. It is also valuable for add results simulated from multiple entry points and how the numerous shipping deliveries may reduce the operational costs in the U.S. Finally, a local multimodal freight modeling (Giuliano, 2010b) may be helpful to measure the local delivery costs instead of the 100-mile assumption in this study.

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