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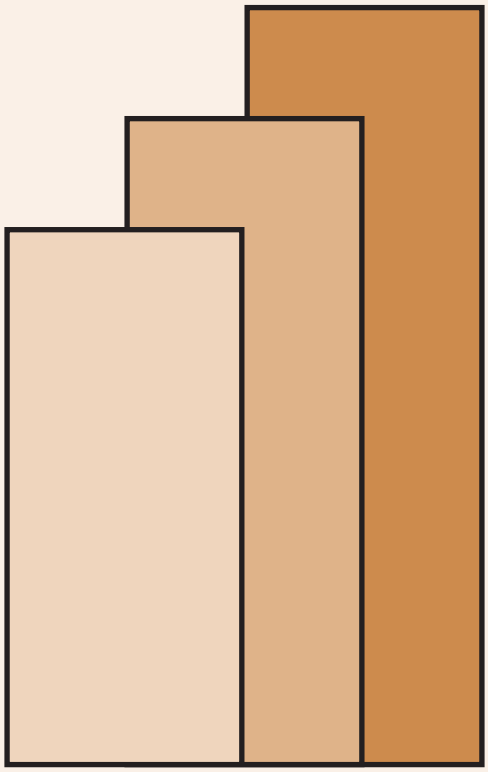

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The Impacts of Roll-on/Roll-off (Ro-Ro) Transport System in the Philippines

Kris Francisco[1]

Abstract

It is well recognized in the literature that a country's transport system plays a central role in its development. In this paper, we show the economic impacts of improvements in the transport system by studying experience of the Philippines with the Roll-on/Roll-off (Ro-Ro) policy that promotes the use of Ro-Ro ferry terminal system. Using difference-in-difference strategies in analyzing agricultural household income and children's education, we find that the operation of Ro-Ro ports largely benefitted the households living near the Ro-Ro ports. More specifically, our estimates suggest that agricultural households gained higher income from the operation of these ports because both agriculture and non-agriculture related activities were stimulated. Our results also imply the boost in non-agriculture related activities on the islands where the Ro-Ro ports are located. Meanwhile, our analysis on children's education reveals an increase in school attendance of males and females in municipalities near the Ro-Ro ports. We likewise confirm that there was an increase in family income in these areas, thereby suggesting the increased capacity of households to send children to school. As a whole, our study demonstrates some examples of short-run and long-run impacts of improving a country's transport system. Likewise, it highlights the importance of an efficient and affordable transport system in an archipelagic country like the Philippines.

Keywords: Transport system, Roll-on/Roll-off policy, Agriculture, Education

[1] The paper was initially drafted when the author was working as a Research Analyst II at the Philippine Institute for Development Studies (PIDS). Data used in the analyses are property of PIDS.

1. Introduction

It has long been recognized that a country's transport system plays a central role in its development. Over the years, researchers have looked at the impact of investing in transport infrastructure and produced numerous studies showing evidence of economic growth[2], increases in productivity[3] and reduction of income inequality[4]. In an archipelagic setting like the Philippines however, the role of transport system is more fundamental because it is needed to link the 7,500 islands together to facilitate the movement of goods and services within the country. Moreover, it is essential in fostering inclusive growth by connecting small island economies together and increasing the mobility of the population.

The Philippine transport system is composed of road, railway, water and air; where road transport accounts for 98 percent of passenger traffic and 58 percent of cargo traffic[5] and water transport is the dominant mode of inter-island transfer. Inter-island connectivity in the country is relatively weak and is often blamed for its uneven economic development. Basilio et al. (2010) explains that the consequences of weak inter-island connectivity are poverty and underdevelopment because it limits trade opportunities and economic integration. Although achieving inclusive growth has always been a priority goal of the government, much of the economic growth in the country is not felt by the poor since they are mostly found in rural areas. The weak logistics network caused by the country's inadequate infrastructure remains as a critical constraint to the livelihood opportunities in rural communities (ADB, 2012). A heavier impediment to rural development is the fact that most transport infrastructure are located in Manila, which is the country's capital city[6]. Data from the Philippine Statistics Authority (PSA) shows that most of the economic growth in the country comes from the National Capital Region (NCR), where Manila is located. In 2012 to 2014 for instance, the NCR region contributed about 35-36 percent of growth, while the rest of the regions showed only less than 5 percent, except for Calabarzon, Central Luzon and Central Visayas[7].

In 2003, a policy intervention was done to improve the connectivity of small island economies in the Philippines. The government implemented the Roll-on/Roll-off (Ro-Ro) policy to establish a seamless inter-island connectivity between Luzon, Visayas and Mindanao[8], which aims to enhance local trade and tourism. This policy was able to integrate the road with water transportation, by allowing the vehicles to directly board the ship without unloading their cargo and be easily transferred from one

[2] See for instance Easterly and Rebelo, 1993.
[3] Studies such as Calderon and Serven, 2003, Demetriades and Mamuneas, 2000, Canning, 1999, Fernald, 1999, Baltagi and Pinnoi, 1995, Holtz-Eakin, 1994, Aschauer, 1989.
[4] Some examples are Estache, 2003, Brenneman and Kerf, 2002, Jalan and Ravallion, 2002, Galiani et al., 2002, Jacoby, 2000, Gannon and Liu, 1997, Lee et al., 1997, Lavy et al., 1996, Ferreira, 1995, Behrman & Wolfe, 1987.
[5] Asian Development Bank. (2012). Philippines Transport Sector Assessment, Strategy and Road Map. Manila, Philippines.
[6] See Lambino (2010) for a detailed discussion.
[7] Accessed from http://nap.psa.gov.ph/grdp/datacharts.asp on 13 February 2017.
[8] See Appendix 1 for a map of these major island groups.

island to another, through the Ro-Ro ferry terminal system (RRTS). The Ro-Ro policy was the government's attempt to expand the country's transport system with minimal investment. Instead of investing in new port infrastructure, the authorities allowed the conversion of existing ports into Ro-Ro ports and encouraged private sector participation.

By definition, the RRTS is a network of Ro-Ro ferry terminals that link the country together through Ro-Ro ships. This system is composed of three nautical highways namely Western, Central and Eastern Nautical Highway, which started operation in 2003, 2008 and 2009, respectively. It also borrows some links from the pre-existing Maharlika/Pan-Philippine Highway[9]. The RRTS was essentially designed to reduce the cost of inter-island transfer within the country and serve as an alternative option to the Load-on/Load-off (Lo-Lo) system. Prior to 2003, the Lo-Lo system is the dominant mode of shipping. However, it was too costly for small-scale shippers as its containerized method usually involves layers of fees for cargo handling and wharfage. By eliminating the need for containerization, the RRTS significantly reduced the cost of inter-island shipping and travel time. Estimates show that it was able to cut the travel time between Mindanao and Luzon by about 12 hours. It was also able to lower the cost of freight and passenger transport by about 30 percent and 40 percent, respectively (ADB, 2012). Furthermore, the operation of the RRTS expanded the scope of regional markets by introducing new inter-island connections.

In this study, we aim to track the economic changes in areas near the Ro-Ro ports, to provide empirical evidence on the impact of the Ro-Ro policy. More specifically, we seek to investigate two things. First, we examine changes in agricultural household income. Our analysis is motivated by the fact that one of the primary goals of implementing the Ro-Ro policy is to stimulate local trade by reducing transport cost. Rationally, we expect that the operation of the Ro-Ro ports will immediately affect the income of agricultural households in the short-run. Second, we aim to study the effect on children's education by looking at the changes in their school attendance. Our curiosity for this topic arises from the possibility that welfare gains of parents can also be transferred to children through human capital investment. In this analysis, our goal is to capture the long-term impact of the Ro-Ro policy.

Our study will be useful to policymakers because it will serve as a reliable guide on the effectiveness of the Ro-Ro policy. More importantly, it is the first to offer an empirical assessment on the economic impacts of this policy as previous studies remain descriptive. The rest of our paper is organized as follows: in Section 2, we explain the empirical strategies used for each of our topic then we cite of data sources in Section 3. In section 4 we present our results and finally, give our conclusions in Section 5.

[9] See Appendix 2 for the map of these nautical highways.

2. Empirical Strategy

We investigate our each of our topics using two empirical models that are designed using difference-in-difference (DID) structure from the seminal work of Ashenfelter and Card (1985). The advantage of this empirical design is that it enables us to compare the differences in between our control and treatment group before and after the Ro-Ro policy was implemented. We conduct our analysis at the household level for agricultural household income, and at the municipality-level for children's education.

2.1. Agricultural Household Income

To analyze the impact of Ro-Ro ports on agricultural household income, we develop a DID model that closely resembles the model of Bruhn and Love (2011). This model takes advantage of the cross-time variation in Ro-Ro port operation. As previously mentioned, the nautical highways started operating at different time periods beginning in 2003 until 2009. Hence, for every time period of our panel data, we identify agricultural households that are near the newly-operational Ro-Ro ports at construct a model that would be able to capture the variations in their income. We estimate our model as:

$$y_{ict} = \alpha + \delta(d.year * Ro - Ro_t) + \pi(Z_{ict}) + \gamma_c + \gamma_t + \varepsilon_{ict}$$

where i denotes households in municipality c at time t. In the above equation, y is our outcome variable which represents agricultural household income; Z is a matrix of individual household characteristics affecting income; γ_c and γ_t control for municipality and time fixed-effects and ε_{ict} is the idiosyncratic error. In our model, the variable $d.year$ is an indicator variable that accounts for time periods included in our study. Likewise, $Ro - Ro_t$ is an indicator variable that serves as our treatment indicator; this is coded 1 if the agricultural household is near a Ro-Ro port and 0 if it is near a non-Ro-Ro port. Since the operation of Ro-Ro ports started at different time periods, the interaction $d.year * Ro - Ro_t$ captures the impact on income of being close to a Ro-Ro port for each of the year included in our panel. Following this, our coefficient of interest is δ, which captures the impact of being close to a Ro-Ro port over time. Due the archipelagic structure of the Philippines, the effect of distance from the Ro-Ro port is expected to vary if the agricultural household is on the same island as the Ro-Ro port or not. To accommodate for this differential effect, we separately estimate our model for agricultural households that are on the same island as the Ro-Ro port and agricultural households on nearby islands.

2.2. Children's Education

To estimate the impact of Ro-Ro ports on children's education, we construct a two-period fully-interacted DID model that accounts for age level and sex variations in education outcomes in each municipality. We use year 2000 as our pre-treatment period and year 2010 as our post-treatment period. Our model is specified as:

$$y_{asmt} = \delta_a(D_m \cdot T_t \cdot S_s \cdot A_a) + \theta_a(D_m \cdot T_t \cdot A_a) + \beta_1 D_m + \beta_2 T_t + \beta_{3a} A_a + \beta_4 S_s + \phi_{asmt} + \mu_m + e_{asmt}$$

where:

$$\phi_{asmt} = \beta_{5a}(D_m \cdot A_a) + \beta_6(D_m \cdot S_s) + \beta_{7a}(S_s \cdot A_a) + \beta_{8a}(D_m \cdot S_s \cdot A_a) + \beta_9(T_t \cdot S_s) + \beta_{10a}(T_t \cdot A_a) + \beta_{11a}(T_t \cdot S_s \cdot A_a)$$

In the above equation, y_{asmt} denotes the school attendance rate in municipality m at period t for individuals of age a and sex s. As distinguished by our subscripts, we stack our data by age, sex, municipality and period. The variable D_m is coded 1 if the municipality is considered in the treatment group and 0 otherwise; T_t indicates our period which is coded 1 if post-treatment period and 0 if pre-treatment period; A_a denotes age level and S_s represents sex, which is coded 1 if male and 0 otherwise. The parameters $\beta_1, \beta_2, \beta_{3a}$ and β_4 represents average differences among treatment groups (D), periods (T), age levels (A) and sex (S), respectively.

Meanwhile, ϕ_{asmt} captures the heterogeneity in outcome levels. It contains interactions across treatment groups, periods, age levels and sex. On the other hand, μ_m accounts for municipality-level fixed effects, which allows us to control for time-invariant characteristics that are common within municipalities, across time. Lastly, e_{asmt} is the model residual, which we assume to exhibit a white noise process after conditioning on our control variables.

The crucial part of our model is the term $\delta_a S_s + \theta_a$ because it represents our DID estimate of the impact of Ro-Ro ports on school attendance. In our model, δ_a captures the differential impact between males and females. We note that we suppress the interaction term for δ_a; allowing us to directly estimate separate DID coefficients $\gamma_{as} = (\delta_a S_s + \theta_a)$ for males and females in the same equation[10].

[10] For a complete discussion of the model, see pp. 59-64 of Francisco, K. (2016). Essays on Roll-on/Roll-off Policy: The Impact of Nautical Highways in the Philippines. A PhD Dissertation Submitted to the Faculty of the National Graduate Institute for Policy Studies, Tokyo, Japan.
https://grips.repo.nii.ac.jp/?action=pages_view_main&active_action=repository_view_main_item_detail&item_id=1529&item_no=1&page_id=15&block_id=26

2.3. Treatment Identification

The treatment assignment for each of our DID models follows the same distance-based principle. Since the analysis for agricultural household income is performed at the household-level and the analysis for children's education is performed at the municipality-level, we locate each agricultural household and municipality based on their geographic locations. We similarly locate the geographic locations of our Ro-Ro and non Ro-Ro ports. Using these information, we calculate the geographic distances of each agricultural household and municipality relative to a Ro-Ro and non Ro-Ro port by employing the straight line distance formula specified as: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

After computing for relative distances of all our agricultural households and municipalities from the nearest Ro-Ro port and nearest non Ro-Ro ports, we compare the two values and keep the smallest one. If the distance from the nearest Ro-Ro port $<$ distance from the nearest non Ro-Ro port, then we assign the agricultural household or municipality to the treatment group. Conversely, if the distance from the nearest Ro-Ro port $>$ distance from the nearest non Ro-Ro port, then we assign the agricultural household or municipality to the control group.

3. Data

We primarily utilize nationally-representative surveys sourced from the Philippine Statistics Authority (PSA) to analyze our two topics. For the analysis on agricultural household income, we use the data from the Family Income and Expenditure Survey (FIES), which contains information about family-level income as well as characteristics of each household and household head. Since the Ro-Ro port operation started from 2003 until 2009, we use survey data for years 2003, 2006 and 2009. We deflate all income variables using region and year-specific consumer price index for all commodities, also sourced from the PSA.

Meanwhile, we use the Census of Population and Housing (CPH) survey for the analysis on children's education. The purpose of the CPH survey is to provide an inventory of size and population of the Philippines. It has information on demographic, social, economic and cultural characteristics of the population. We construct a municipality-level pseudo panel for years 2000 and 2010 using the CPH data, where we calculate the proportion of school attendance of 5 to 21 years old in each municipality.

Our list of non-Ro-Ro and Ro-Ro ports are based on the Philippine Ports Inventory published by the PSA and the Ro-Ro handbook requested from the Philippine Ports Authority (PPA). These publications provide us the location of the ports based on administrative division. Additionally, we use the Philippine Standard Geographic Code (PSGC), which gives us the codes for the corresponding administrative division. Furthermore, we exploit the Data Kit of Official Philippine Statistics

(DATOS) for the x and y coordinates of each geographic location, which we use as a basis for calculating the distances. The summary statistics for the data used in our analyses are presented in Tables 1 and 2.

Table 1. Summary Statistics of Data for Agricultural Household Income

	Mean	Std. Dev.	Min	Max
Total Family Income	6.1938	0.5751	4.1111	9.9106
Total Income from Agri	5.9069	0.5913	3.5220	9.4046
Total Income from Non-Agri	4.5075	0.9867	0.4334	8.9871
Conrol variables:				
Household labor force	3.8464	1.2486	0	10
Years of education of household head	6.2306	3.3089	0	15
Sex of household head	0.9229	0.2668	0	1
Age of household head	47	13	17	98
Household electricity	0.5454	0.4980	0	1
Household with car	0.0242	0.1536	0	1
Household with motor	0.0507	0.2194	0	1

Table 2. Municipality-level School Attendance Rate

	Pre-treatment (2000)		Post-treatment (2010)	
	Treatment	Control	Treatment	Control
Mean	0.6559	0.6731	0.7075	0.7035
Std. error	(0.2520)	(0.2450)	(0.2734)	(0.2732)
N	15470	36829	15470	36829

4. Results

The goal of this study is to provide an empirical assessment of the impact of the Ro-Ro policy on the local economies. To do this, we perform two separate analyses at the household and municipality-level, by examining changes in agricultural household income and children's education, respectively. The results of our estimations are presented in the following sections.

4.1. Agricultural Household Income

Our analysis on agricultural household income is important because these households comprise the poorest segment of the Philippine population. Agricultural households usually live in rural areas, where poverty is considerably higher (39.4 percent) than the national average (26.5 percent)[11]. The causes of rural poverty are mainly attributed to the decline in productivity in agriculture, lack of access to finance and lack of non-farm income-generating options[12]. In this section we explore how a more efficient transport system affects the income of agricultural households.

The results of our estimation are shown in Table 3. In the first column, we notice that our estimates seem to suggest that agricultural households living near the Ro-Ro ports gained higher income in 2006 and 2009. As we can see from the table, the increase in income is higher in 2009 than in 2006. This observation may be explained by the increase in Ro-Ro connections towards 2009, where the full-scale operation of the Ro-Ro system may have had a bigger impact. Nevertheless, we observe the short-run effect of the Ro-Ro policy on agricultural household income.

In the next two columns, we disaggregate total family income into: (a) total income from agriculture and (b) total income from non-agriculture-related sources to understand which of these sources caused the increase. Based on our estimates, we observe that both incomes from agriculture and non-agriculture sources were stimulated by the Ro-Ro port operation. However, we notice that the increase in income from non-agriculture sources appear to be higher. Our findings are consistent with that of Escobal (2001) and Malmberg et al (1997) which reveal that the access of rural households to transport infrastructure contributes to the profitability of both farm and non-farm sectors, thereby providing opportunities to the local population. What is interesting with our results is that it suggests that the operation of Ro-Ro ports allowed for non-agriculture-related opportunities for agricultural households. A study (Fan and Rao, 2002) explains the importance of non-farm opportunities as it helped the poor survived during the post-green revolution in many Asian countries. As mentioned earlier, one of the causes of rural poverty is the lack of non-farm opportunities. Thus, having additional income-generating opportunities will allow agricultural households to devote their time on more productive activities or diversify their sources of income.

[11] World Bank. 2014. Country Partnership Strategy for the Republic of the Philippines, FY 2015–2018. Washington, D.C.
[12] See International Fund for Agricultural Development. Investing in Rural People in the Philippines. Accessed from https://www.ifad.org/documents/10180/3407a4bc-4505-4c7a-bcc4-edb5f0bc3819 on 28 February 3017.

Table 3. Estimates for Agricultural Household Income

	Total Family Income	Total Income from Agri	Total Income from Non Agri
2003 x Ro-Ro	0.0700	0.0529	0.1736
	(0.0564)	(0.0605)	(0.1156)
2006 x Ro-Ro	0.0786 **	0.0726	0.1371
	(0.0396)	(0.0460)	(0.0955)
2009 x Ro-Ro	0.1543 ***	0.1076 **	0.3611 ***
	(0.0442)	(0.0488)	(0.0982)
Controls variables:			
Household labor force	0.0622 ***	0.0508 ***	0.1180 ***
	(0.0099)	(0.0106)	(0.0225)
Years of education of household head	-0.0034	-0.0076	0.0211
	(0.0075)	(0.0083)	(0.0154)
Sex of household head	0.0622	0.0755	-0.1313
	(0.0747)	(0.1134)	(0.2000)
Age of household head	0.0031	0.0011	0.0173 **
	(0.0023)	(0.0025)	(0.0078)
Household electricity	0.0581 **	0.0667 *	0.0240
	(0.0290)	(0.0340)	(0.0685)
Household with car	0.1653	0.2079 *	-0.1480
	(0.1130)	(0.1198)	(0.1343)
Household with motor	0.2389 ***	0.2386 ***	0.1989
	(0.0684)	(0.0781)	(0.1457)
Other controls:			
Muncipality fixed-effect	Yes	Yes	Yes
Time fixed-effect	Yes	Yes	Yes
N	2982	2982	2982
Adjusted R-squared	0.089	0.052	0.070

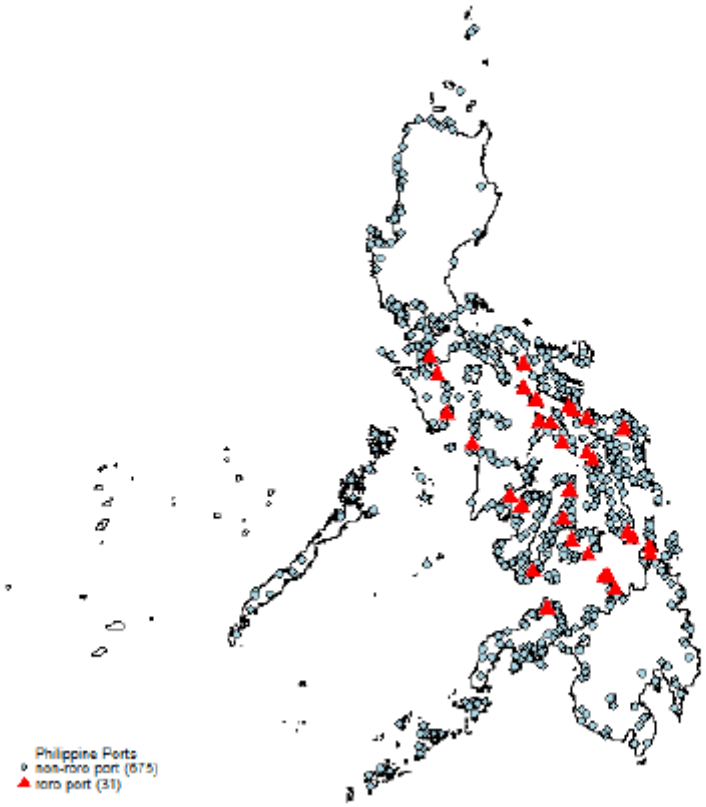
Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors are reported in parentheses; these are heteroskedasticity-robust clustered by municipalities.

To analyze our data further, we distinguish between (a) agricultural households that are on the same island as the Ro-Ro port and (b) agricultural households that are on different islands. Rationally, we expect that agricultural households that are near the Ro-Ro ports would benefit from the policy due to induced economic activities as well as reduced transport cost. Although at the same time, we also expect that the impact of distance from the Ro-Ro port may be different depending on the household's relative island location.

Our estimates are shown in Table 4. Based on our results, agricultural households, in general, benefitted from the Ro-Ro port operation, regardless if they are on the same island as the Ro-Ro port or not. In fact, our estimates reveal that the increase in income of agricultural households in nearby islands is even higher and we consistently observe this effect from 2003 until 2009. This result is indicative of the fact that the impact of Ro-Ro port operation is stronger within smaller distance from the Ro-Ro port. Interestingly, we observe that this effect is not restricted by the island location of agricultural households. To complement this finding, we show in Figure 1 that there are many Ro-Ro

and non-RoRo ports in the Philippines that are not too far from each other. Consequently, agricultural households in nearby islands would still be able to access the Ro-Ro system through the use of non-Ro-Ro ports. We hypothesize that the presence of a Ro-Ro port in a nearby island may have stimulated the demand for agricultural products or promoted agricultural productivity. Benziger (1996) provides evidence that improved access to infrastructure and urban markets also increases the use of fertilizer per unit of land and machinery per work, which eventually leads to higher land and labor productivity. Khandker et al. (1994) also observe increases in the use of agricultural inputs and extension services that helped improved agricultural production.

Figure 1. Map of Ports in the Philippines



Sources: PSA's Philippine Ports Inventory & Philippine Ports Authority

(Note: Only operational ports are included)

In addition to this result, we similarly disaggregate total family income into (a) total income from agriculture and (b) non-agriculture-related sources for our two groups of agricultural households. Based on our estimates, we observe that agricultural households on nearby islands seem to gain from

agriculture-related activities and we immediately observe this effect in 2003 and 2006. On the other hand, agricultural households on the same island as the Ro-Ro port appear to gain from both agriculture and non-agriculture-related activities; however, we observe this impact later in 2009. We particularly notice that the benefit for non-agriculture-related activities seem to be higher for this group. The study of Fan and Chan-Kang (2004) explain that the availability of infrastructure and road access tends to encourage small non-farm businesses. In summary, we conclude that the Ro-Ro port operation largely affected the income of agricultural households near the Ro-Ro ports by influencing the profitability of both agriculture and non-agriculture related activities.

Table 4. Estimates for Disaggregated Agricultural Household Income

	Total Family Income		**Total Income from Agri**		**Total Income from Non Agri**	
	Same island	**Not same island**	**Same island**	**Not same island**	**Same island**	**Not same island**
2003 x Ro-Ro	0.0344	0.4483 ***	0.0169	0.3989 ***	0.1638	0.4796
	(0.0626)	(0.1078)	(0.0680)	(0.1289)	(0.1279)	(0.4202)
2006 x Ro-Ro	0.0637	0.2937 ***	0.0590	0.3236 **	0.1333	0.1831
	(0.0411)	(0.0869)	(0.0476)	(0.1581)	(0.1023)	(0.4520)
2009 x Ro-Ro	0.1490 ***	0.3579 **	0.1019 **	0.3320	0.3466 ***	0.5497
	(0.0451)	(0.1764)	(0.0505)	(0.2204)	(0.1048)	(0.4855)
Controls variables:						
Household labor force	0.0604 ***	0.0592 ***	0.0491 ***	0.0484 **	0.1123 ***	0.1297 ***
	(0.0116)	(0.0191)	(0.0126)	(0.0192)	(0.0277)	(0.0384)
Years of education of household head	-0.0050	-0.0042	-0.0112	-0.0047	0.0247	0.0136
	(0.0084)	(0.0158)	(0.0097)	(0.0173)	(0.0181)	(0.0273)
Sex of household head	0.0516	0.1823	0.1117	0.0898	-0.2263	0.0515
	(0.0939)	(0.1139)	(0.1267)	(0.2037)	(0.1675)	(0.5063)
Age of household head	0.0035	0.0036	-0.0003 ***	0.0052	0.0237	0.0037
	(0.0024)	(0.0056)	(0.0030)	(0.0045)	(0.0072)	(0.0211)
Household electricity	0.0589 *	0.0375	0.0643	0.0555	0.0520	-0.0819
	(0.0326)	(0.0647)	(0.0393)	(0.0689)	(0.0827)	(0.1272)
Household with car	0.3329 **	0.0270	0.3304	0.1063	0.2215	-0.4233 ***
	(0.1626)	(0.1259)	(0.2145)	(0.1199)	(0.2498)	(0.0855)
Household with motor	0.1930 ***	0.3577 *	0.1947 ***	0.3324	0.1792	0.3087
	(0.0615)	(0.1862)	(0.0677)	(0.2190)	(0.1523)	(0.3425)
Other controls:						
Muncipality fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes
N	2208	774	2208	774	2208	774
Adjusted R-squared	0.094	0.102	0.050	0.066	0.080	0.056

*Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors are reported in parentheses; these are heteroskedasticity-robust clustered by municipalities.*

4.2. Children's Education

In this section, we examine the impact of Ro-Ro port operation at the municipality level by looking at changes in children's school attendance. Education has always been treated as a development tool in the Philippines. As mandated by the Philippine Constitution, the government strives to provide free

basic education so that its population will be able to find suitable employment and contribute to economic growth. The tangency between Ro-Ro ports and children's education therefore, is important because most of the Ro-Ro ports are located in the Visayas as well as Mindanao areas (see Appendix 1), where poverty and underdevelopment issues are widespread.

The results are shown in Table 4. Our estimates reveal that there were significant increases in school attendance of both males and females in municipalities near the Ro-Ro ports. We consistently observe this increase for males from age 6 to 20; while for females from age 5 to 7 and age 13 to 21. Our finding on increased school attendance of males is encouraging because it tells us that males are attending school instead of working to help their families. This problem is highly persistent in impoverished areas such as rural communities and urban slums where school-age males would usually quit schooling to help their parents earn money. On the contrary, work opportunities for school-age females are highly scarce. Several studies (Johanson, 1999, Orbeta, 2003) note that the school attendance and educational attainment of females in the Philippines are historically higher than that of males because of the lack of work opportunities for them. As we can observe from our results, school attendance increased for females of age 5 and 21. This is because they are enrolled in school earlier and usually proceed to higher levels of education. Our finding is reflective of the fact that education is perceived to have higher returns for females in the Philippines (Sakellariou, 2004; Quisumbing et. al., 2004).

Table 4. DID Coefficients for School Attendance

	Male	Female
Pre-primary level		
Age 5	0.01610	0.02016 **
	(0.00991)	(0.00977)
Primary level		
Age 6	0.03682 ***	0.05557 ***
	(0.00957)	(0.00988)
Age 7	0.03910 ***	0.02170 ***
	(0.00715)	(0.00650)
Age 8	0.01809 ***	0.00910
	(0.00591)	(0.00571)
Age 9	0.01147 **	0.00866
	(0.00503)	(0.00544)
Age 10	0.01285 **	0.01271 **
	(0.00529)	(0.00521)
Age 11	0.01192 **	0.00757
	(0.00519)	(0.00535)
Age 12	0.01727 ***	0.00654
	(0.00543)	(0.00518)
Secondary level		
Age 13	0.01865 ***	0.01790 ***
	(0.00644)	(0.00558)
Age 14	0.02185 ***	0.02040 ***
	(0.00655)	(0.00582)
Age 15	0.03063 ***	0.02886 ***
	(0.00687)	(0.00693)
Age 16	0.02929 ***	0.02497 ***
	(0.00765)	(0.00785)
Tertiary level		
Age 17	0.01663 **	0.03286 ***
	(0.00839)	(0.00863)
Age 18	0.02036 **	0.02104 **
	(0.00839)	(0.00905)
Age 19	0.02854 ***	0.01820 **
	(0.00891)	(0.00901)
Age 20	0.02233 ***	0.02712 ***
	(0.00854)	(0.00872)
Age 21	0.01452	0.02207 **
	(0.00903)	(0.00925)
N:		
observations	104,598	
groups	1,539	
R-squared:		
within	0.8491	
between	0.0016	
overall	0.7965	

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. The model controls for provincial and municipality-level fixed effects. Heteroskedasticity-robust standard errors are reported in parentheses.

To further make sense of our estimates, we compute for the equivalent increases in school attendance of males and females (Table 5). Based on our computations, we observe that more female students

(about 4,548) are enrolled at the pre-primary level in municipalities near the Ro-Ro ports. We highlight that we observe a higher number of males attending primary and secondary level (about 35,395 and 23, 162, respectively). Evidently, females still dominate the tertiary level with a 22,741 increase in school attendance. Overall, we attribute about 83, 2017 and 74, 637 increases in school attendance of males and females, respectively, to the Ro-Ro port operation. Our finding is similar with Levy (1996) who finds increases in enrollment rate of children in rural areas, as one of the effect of road improvements in Morocco.

What our results show is that the Ro-Ro policy was able to generate a relatively long-term impact on local economies. It particularly exhibits that the opportunities gained by households from the Ro-Ro port operation were reallocated to their children in the form of human capital investment. Education is known to increase the quality of the work force. Hence, a better educated future work force will benefit local economies in the long-run.

Table 5. Equivalent Increases in School Attendance

Age	Total Population (in school)		Beta estimates		Equivalent number of individuals		
	Male	Female	Male	Female	Male	Female	Total
Pre-primary level*							
5	243,731	225,557	0.01610	0.02016	3,923	4,548	8,471
				Subtotals	3,923	4,548	8,471
Primary level							
6	241,516	226,035	0.03682	0.05557	8,892	12,560	21,452
7	239,119	222,901	0.03910	0.02170	9,350	4,836	14,187
8	224,904	212,718	0.01809	0.00910	4,067	1,936	6,003
9	251,031	233,958	0.01147	0.00866	2,880	2,026	4,905
10	251,208	230,433	0.01285	0.01271	3,227	2,928	6,155
11	230,498	219,521	0.01192	0.00757	2,747	1,662	4,409
12	245,050	227,684	0.01727	0.00654	4,231	1,488	5,720
				Subtotals	35,395	27,436	62,831
Seondary level							
13	227,768	217,218	0.01865	0.01790	4,248	3,888	8,136
14	237,953	222,833	0.02185	0.02040	5,200	4,545	9,745
15	231,182	216,106	0.03063	0.02886	7,080	6,238	13,318
16	226,494	209,953	0.02929	0.02497	6,635	5,242	11,877
				Subtotals	23,163	19,913	43,076
Tertiary level							
17	221,126	204,314	0.01663	0.03286	3,678	6,713	10,391
18	212,907	197,510	0.02036	0.02104	4,334	4,156	8,490
19	205,122	190,479	0.02854	0.01820	5,854	3,466	9,320
20	191,839	177,356	0.02233	0.02712	4,285	4,809	9,094
21	177,994	162,945	0.01452	0.02207	2,585	3,597	6,181
				Subtotals	20,736	22,741	43,477
Total significant increase					**83,217**	**74,637**	**157,855**

Note: * Not compulsory prior to 2012

On a final note, it is possible that the increase in children's school attendance in municipalities near the Ro-Ro ports may have been driven by income factors. Several studies reveal that income is the main consideration for children's education in the Philippines because higher family income equate to higher capacity of sending children to school (Albert et al., 2012; Maligalig et al., 2010; Orbeta, 2003). A related result from the 2008 Functional Literacy, Education and Mass Media Survey (FLEMMS) likewise shows that the high cost of education (24%) and employment/looking for work (22%) are the two of the most-cited reasons for not attending school among 6 to 24 years old. Accordingly, we verify for household income changes in municipalities near the Ro-Ro ports by employing a DID estimation on the log of tax revenue per capita sourced from the Statement of Income and Expenditure (SIE) of the Department of Finance (DOF). Based on Table 6, there was an increase in household income by about 7 percent in municipalities near the Ro-Ro ports. This finding indicates the increase in financial capacity of households to send children to school; thus providing support to our previous results on increased school attendance.

Table 6. Estimate for log of Tax Revenue per capita

Treatment	-0.1992341 ***
	(0.0603927)
Year	0.2880480 ***
	(0.0199620)
DID estimator	0.0692498 **
	(0.0346459)
N:	
observations	2,870
groups	1,435
R-squared:	
within	0.2015
between	0.0041
overall	0.0195

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Heteroskedasticity-robust standard errors, clustered by province and municipality, are reported in parentheses.

5. Conclusion

In this study we have demonstrated that improving the transport system within a country provides short-run and long-run effects. With our results we have shown that the government's effort in improving the mobility of goods and services as well as the population within the economy, have resulted to welfare-improving opportunities especially to households living near the Ro-Ro ports. In

the short-run, we immediately noticed the increase in income of agricultural households. Using our estimates, we have exhibited how the Ro-Ro port operation stimulated both agriculture and non-agriculture related activities. We highlight that non-agriculture opportunities flourished on the island where the Ro-Ro port is located. Meanwhile, agricultural productivity on nearby islands was also enhanced. On another note, we saw that the benefits gained by households from Ro-Ro port operation were transferred to children in the form of human capital investment. We expect this to have long-term effects on local economies as it enhances the capacity of their future work force. In addition, our finding on increased school attendance of males is motivating because this group has the highest record of school drop-out. Our result therefore, indicates that children are kept in school and not forced to work to help their families. In general, our study highlights the central role the transport system in an archipelagic country like the Philippines. It strengthens the argument that rural growth can be enhanced by providing urban-rural linkages through an efficient and affordable transport network. We note however, that while we found some positive effects of the Ro-Ro port operation, the impact of the Ro-Ro policy on all sectors may not necessarily be uniformly positive. Hence, for future research, we suggest looking into several other sectors to completely unveil the economic impacts of the Ro-Ro policy.

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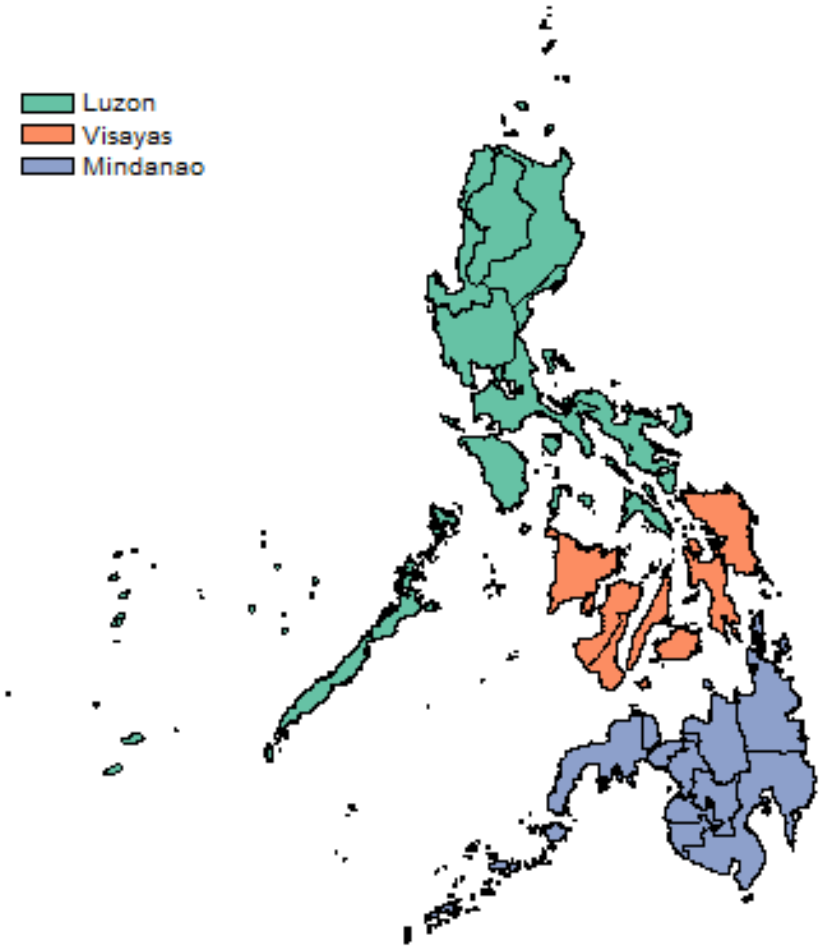
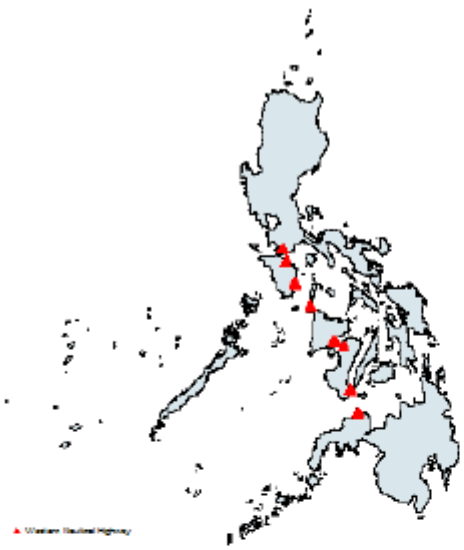
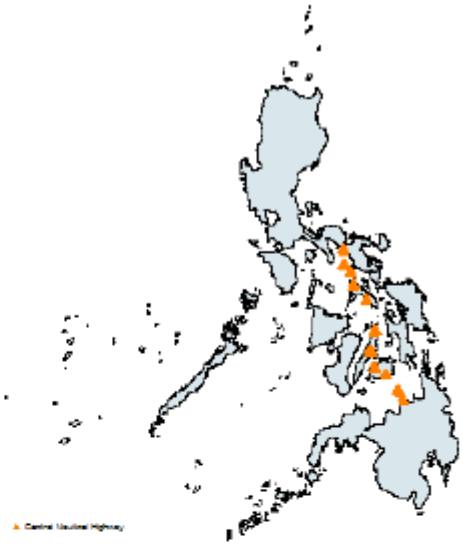
Appendix 1. Major Island Groups of the Philippines



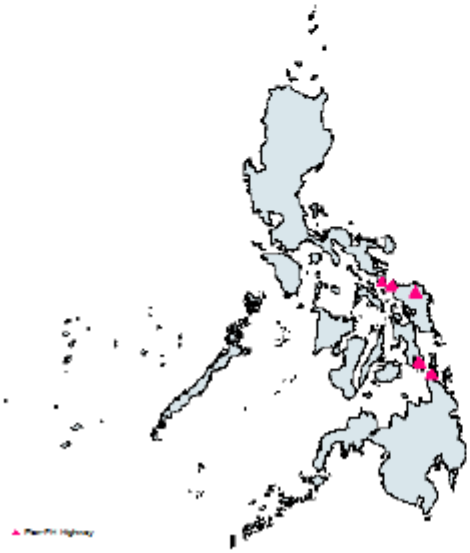
Appendix 2. Philippine Nautical Highways



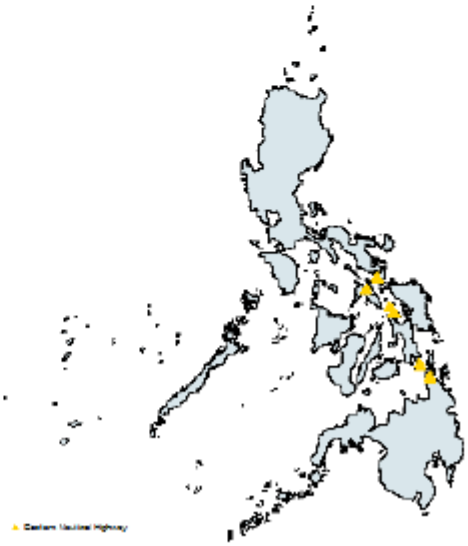
Western Nautical Highway



Central Nautical Highway



Pan-Philippine Highway



Eastern Nautical Highway