ESSAYS ON ROLL-ON/ROLL-OFF POLICY:

THE IMPACT OF NAUTICAL HIGHWAYS IN THE PHILIPPINES

A Dissertation

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by

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Abstract

In 2003, the Roll-on Roll-off (Ro-Ro) policy was implemented in the Philippines to improve the efficiency and cost-effectiveness of the transportation system. This policy changed the country's maritime sector through the integration of sea and road network, which seeks to improve the inter-island economic linkages, increase competition and drive down transportation costs. With the Ro-Ro ferry terminal system, vehicles containing their cargoes can directly roll-on the ship at point of embarkation, and roll-off the ship at point of destination. It eliminates the need for cargo-handling equipment and portside facilities thereby simplifying shipping procedure and lowering transportation costs by about 30 to 40 percent.

In the literature, however, little has been done to track the policy's impact on Philippine economy. Some existing papers remain descriptive and fail to present empirical evidence in associating economic changes to Ro-Ro policy. This dissertation aims to supplement the scarce literature and serve as a useful guide to policymakers as it evaluates the impact of the Ro-Ro policy on two valuable sectors namely, agriculture and education.

The first study evaluates the effect of the Ro-Ro policy on agricultural household income by utilizing a panel fixed-effect model that exploits the differences in geographical distances of agricultural households from the nearest Ro-Ro port. Due to the archipelagic structure of the Philippines, we distinguish between (1) agricultural households that are on the same island as the Ro-Ro port and (2) agricultural households that are *not* on the same island as the Ro-Ro port, assuming differential impact of the policy on these groups. We generally find positive impact of the Ro-Ro policy on agricultural household income; however, our results suggest that the households may be specializing in entrepreneurial

activities based on their comparative advantage. We observe that agricultural households that are closer to the Ro-Ro port and located on the same island as the Ro-Ro port appear to have higher income from non-agricultural sources/activities, while agricultural households that are similarly closer to the ports but are *not* on the same island as the Ro-Ro port appear to have higher income from agricultural sources/activities. The results of this study confirm the importance of an efficient and affordable inter-island transportation system for agricultural households, as it provides them access to trade opportunities as well as the option for specialization. Furthermore, it highlights the importance of proximity of agricultural households to transportation infrastructure such as the Ro-Ro port.

Meanwhile, the second study investigates the effect of the Ro-Ro policy on children's education, by comparing the school attendance of ages 5 to 21 in municipalities near the Ro-Ro ports versus the school attendance of ages 5 to 21 in municipalities near the non-Ro-Ro ports, before and after the policy implementation. Our results indicate that the Ro-Ro policy led to an increase in school attendance of both males and females in all levels of education. We likewise observe a decrease in employment of ages 15 to 21, complementary to the increase in school attendance. We provide several hypotheses to explain these results and discover an increase in household income in municipalities near the Ro-Ro ports. We confirm that both children's school attendance and household income were positively affected by the Ro-Ro port operation. Moreover, we find a strong degree of correlation between children's school attendance and household income. While the Ro-Ro policy was not intended to influence education, we provide empirical evidence showing the increase children's school attendance in municipalities near the Ro-Ro port. In this study, we reveal that household's tendency to invest in children's education when provided with income-improving opportunities.

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For my future husband.

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Chapter 1

Introduction

Transportation plays a key role in the development of a country that is composed of about 7, 500 islands[1]. The Philippines' archipelagic setting requires an efficient transportation system that will link the island economies together, to increase the mobility of the population as well as goods and services within the country. The current transportation system is composed of the road, maritime, air and rail networks; wherein road transportation remains to be the most dominant subsector[2]. While there have been some investments in transportation infrastructure over the years, the conditions of the road networks remain poor and inter-connection between different types of transportation systems is also weak[3].

Economic growth in the Philippines is highly uneven such that most of the development is centered in Luzon[4], specifically in the National Capital Region (NCR), where the country's capital, Manila is located. In effect, there exist a notable gap in the level of income and poverty between urban and rural areas of the country. Policymakers point out that improving the maritime transportation system is critical in promoting countryside development since domestic transfer of trade and services is heavily reliant on shipping method. Basilio et al. (2010) explain that the absence of connectivity among island economies results to poverty and underdevelopment because it limits trade opportunities and social integration. Briones (2013) meanwhile suggest that rural development can achieved through infrastructural investments.

[1] Philippine National Mapping and Resource Information Authority (NAMRIA)
[2] It accounts for 98% of passenger traffic and 58% of cargo traffic based on Asian Development Bank. Philippines Transport Sector Assessment Strategy and Road Map. ADB HQ: Manila, Philippines.
[3] See Asian Development Bank. Philippines Transport Sector Assessment Strategy and Road Map. ADB HQ: Manila, Philippines.
[4] The Philippine islands are categorized into three major geographic divisions namely: Luzon, Visayas and Mindanao (see Appendix 1.1).

In 2003, the Philippine government introduced the Roll-on/-Roll-off (Ro-Ro) policy to enhance the mobility within the country. This policy integrated the sea and road networks to facilitate seamless inter-island travel. The Ro-Ro concept provides a system that permits vehicles to directly "roll-on" the ship at point of embarkation and "roll-off" the ship at point of destination, making inter-island transfer more efficient and cost-effective. Aside from expanding the country's inter-island economic linkages, this policy also effectively lowered the cost of shipping by about 30 to 40 percent[5].

A valuable policy question to ask is whether the Ro-Ro policy was able to promote countryside development, given that the Ro-Ro ports provided an affordable mode of transfer to areas that are faced with problems of underdevelopment and poverty. From a policy standpoint, understanding the effect of improving the country's transportation system is vital, especially if inclusive growth is desired. However, the existing literature fails to address the need for empirical references as previous studies remain descriptive. In this regard, this dissertation seeks to provide an empirical assessment on the impact of the Ro-Ro policy on local economies to supplement the scarce literature. It serves as the first large-scale empirical study on the impact of the Ro-Ro policy that utilizes nationally-representative surveys, consisting of two main studies that specifically look at the effect of the policy on two important sectors namely: (1) agriculture and (2) education.

The first study focuses on agricultural households since this group represents the poorest segment of Philippine population[6]. It aims to provide information on how improvements in the maritime transportation system impact the income-generating activities

[5] See The Asia Foundation's Roll-on Roll-off Transport: Connecting Maritime Southeast Asia, accessed from https://asiafoundation.org/resources/pdfs/4PagerRoRoPHLetter.pdf on 29 May 2016.

[6] Poverty incidence is higher in agricultural households (57 percent) as compared with non-agricultural households (17 percent). See Reyes, C. Tabuga, A. Asis, R. and Datu, B. (2012). Poverty and Agriculture in the Philippines: Trends in Income Poverty and Distribution. PIDS Discussion Paper 2012-09. Makati City: Philippine Institute for Development Studies for a more detailed discussion.

of agricultural households. Likewise, it seeks to investigate the role played by the agricultural household's geographic proximity from the Ro-Ro ports in terms of gaining benefits from the Ro-Ro policy. The second study on the other hand, explores the impact of the Ro-Ro policy on children's education, since education serves as a widely-used policy tool in achieving long-term inclusive growth. It attempts to explain the role of an efficient maritime transportation system in the education outcomes of children by age level and sex. This study distinguishes itself from previous studies about education in the Philippines in the following ways. Firstly, it provides better information on the magnitude of effect of the Ro-Ro policy because it presents findings for each age level, instead of the aggregate effect per cohort level as done in previous studies. Secondly, it offers information on the differential impact of the Ro-Ro policy by sex, which is relevant in light of the government's goal to eliminate gender disparities in education.

The empirical strategies utilized in these two main studies make use of carefully constructed straight line distances that exploit the location of the Ro-Ro ports as the point of reference. The idea behind this strategy is that the geographical proximity from a Ro-Ro port determines the magnitude of impact obtained from the Ro-Ro policy. There exist two related studies that similarly used this technique in analyzing the impact of transportation infrastructure. Banerjee et al. (2012) for instance, estimated the impact of access to a transportation route on GDP growth in China by constructing a distance variable that indicates the distance from a straight line joining historical cities and city ports. This study argues that the distance from this straight line increases the possibility that a transportation route will be built. On the other hand, Atack et al. (2009) analyzed the effect of railroads on urbanization and population growth in the U.S. by employing a distance-based instrument that was constructed based on the straight line calculated between the start and end point of the railway line.

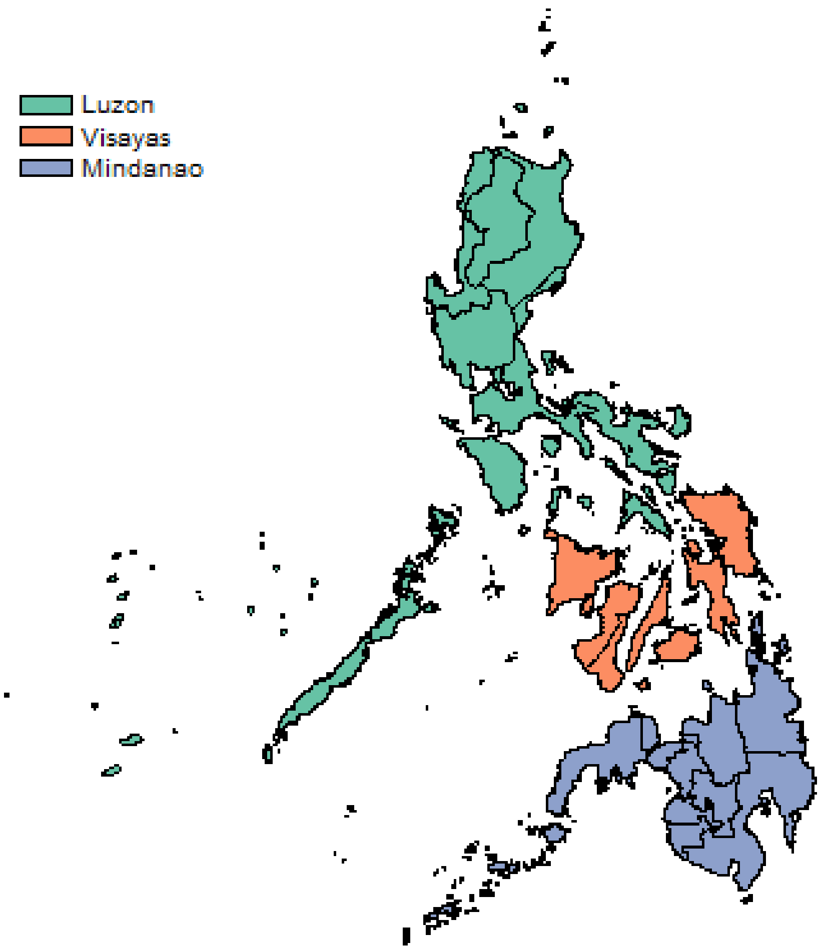
Meanwhile, the results from the first study show positive impact of the Ro-Ro policy on agricultural household income. Based on our estimates, we deduce that agricultural households may be specializing in entrepreneurial activities according to their comparative advantage. More specifically, we observe that agricultural households that are closer to the Ro-Ro port and located on the same island as the Ro-Ro port appear to have higher income from non-agricultural sources/activities, while agricultural households that are similarly closer to the ports but are not on the same island as the Ro-Ro port appear to have higher income from agricultural sources/activities. In addition, the results from the second study similarly show positive impact of the Ro-Ro policy on children's education. Based on our estimates, we provide evidence of increases in school attendance of both males and females in the pre-primary, primary, secondary and tertiary levels of education, in municipalities near the Ro-Ro ports. Furthermore, we find that both children's school attendance and household income were positively affected by the Ro-Ro policy. We also note a strong degree of correlation between the two.

Taken as a whole, this dissertation will serve as a useful guide in promoting better policy responses with regard to improvements in the transportation system in the Philippines. It offers valuable conclusions and policy implications based on empirical evidences presented in the two main studies. The first study highlights the influence of an efficient and cost-effective maritime transportation system in the income-generating activities of agricultural households. This study confirms the importance of agricultural households' access to transportation infrastructure. Moreover, the second study demonstrates how changes in access to welfare-improving opportunities modify the behavior of households towards investing in children's education. It reveals how an efficient transportation system affects children's education outcomes, through changes in household income.

The rest of this dissertation is organized as follows. We provide an analytical framework and background on the Ro-Ro policy in Chapter 2. Then, we present the analysis on the effect of the Ro-Ro policy on agricultural household income in Chapter 3 and offer the analysis on the policy's effect on education in Chapter 4. Finally, we state our conclusions and suggest some policy implications in Chapter 5.

Appendix

Appendix 1.1: Major Island Divisions of the Philippines



Chapter 2

Background

There exists a consensus in the literature that acknowledges the significant role of transportation in the development process of a country. However, a more thorough understanding of this role is necessary since numerous development assistance programs today are centered on building transportation networks to promote economic growth. The World Bank for instance, allots roughly 20 percent of its lending on transportation infrastructure (Crescenzi and Rodriguez-Pose, 2012). Similarly, the Asian Development Bank has been supporting its member countries in building transportation infrastructure over the last four decades, with about 32 percent of its total lending.

The literature offers a handful of references that empirically proves the link between transportation infrastructure and economic development. Initial studies usually refer to the development experience of Europe, Japan and U.S. because rapid economic growth was observed after the construction of each country's railroad system. More recent studies meanwhile, explore the experiences of several other countries, although the analyses remain frequently focused on road and railway transportation. Some examples of these include Donaldson (2010), which explains how the railway network in India facilitated regional trade that resulted to better welfare of people in the area. Ahlfeldt and Feddersen (2010) also observe the increase in economic activities in the areas covered by the newly-build high-speed railway system that connected Cologne and Frankfurt, Germany. Baum-Snow et al. (2012) similarly show the effect of expanded road and railway networks on the decentralization in China. Keller and Shiue (2008) likewise notice price convergence as an effect of the railway operations connecting regions in Germany.

In the Philippines however, such studies are limited. While the archipelagic structure of the country requires a comprehensive analysis on the possible benefits of inter-island connectivity, researchers have not been able to provide the necessary support to policy-makers. Arguably, the lack of solid references could be one of the reasons why the government has not placed high priority on inter-island transportation system. Moreover, the available literature is typically centered on road and railway transportation[7], which may be beneficial, but does not entirely match the need for studies on maritime transportation system given that the Philippine's domestic trade is heavily reliant on shipping method.

2.1. Analytical Framework

This dissertation aims to supplement the scarce literature by demonstrating how transportation infrastructure impacts household income and children's education in the Philippines. We adapt a modified version of Ali and Pernia's (2003) analytical framework to show the mechanism by which a transportation infrastructure is able to affect local economies (Figure 2.1). In the following discussions, we utilize related literature to provide support to the links shown in our framework.

Transportation infrastructure stimulates local economies because it facilitates connectivity to other parts of the country. The immediate impacts of investing in transportation infrastructure can be noticed through reduced travel time and travel cost which in effect, improves the efficiency of travel. Banerjee et al. (2012) explains that an efficient transportation system is necessary for economic growth because it promotes market integration. As noted by this study, increased efficiency of travel reduces price volatility, allowing resources to be allocated based on comparative advantage and improved

[7] This is understandable given that fact that only few countries exhibit the same geographical structure as the Philippines. Other countries with similar archipelagic structure include Fiji, Indonesia, Papua New Guinea and the Bahamas.

connectivity broadens the market size for firms, permitting them to benefit from the gains of trade while maintaining a healthy level of competition.

The literature shows that transportation infrastructure fosters both agricultural productivity and non-agricultural productivity. For instance, Llanto (2012) confirms that rural infrastructure increases agricultural productivity and income in the Philippines because improved access to adjacent growing markets lessens the input and transaction costs for both producers and consumers. He adds that the increased connectivity provides feasible options for production, processing, marketing and distribution of agricultural products, allowing resources to be allocated efficiently. On the other hand, Fan (2004) presents evidence that transportation infrastructure encourages small non-farm businesses such as food processing and marketing enterprises, electronic repair shops, transportation and trade, and restaurant services, providing various employment opportunities in local areas. Fan and Chan-Kang (2004) relatedly mention that rural enterprises usually arise in areas with good access to roads, electricity and telecommunication facilities.

The increase in productivity of both agricultural and non-agricultural sector largely determines the wage income received by the households. For instance, higher crop yields could result to higher wages or higher productivity in non-agricultural sector could expand the demand for local employment. Effectively, higher wage income results to higher household real income. Meanwhile, higher productivity of both agricultural and non-agricultural sector also in effect, indirectly stimulates local economic growth by affecting the supply and prices of basic commodities. In theory, lower prices of basic commodities positively impact household real income while higher prices negatively impact household real income.

On a different note, a review of the literature suggests that higher household income equate to higher capacity of sending children to school. Even in the earlier literature (Chernichovsky, 1985; Jamison and Lockheed, 1987; Galenson, 1995 and Wydick, 1999), the positive association between household income and school attendance in children has already been recognized. The more recent studies of Maligalig et al. (2010) and Albert et al. (2012) likewise observe higher school attendance among children from high-income households. Meanwhile, Orbeta (2003) confirms that household income remains as a primary consideration for children's education in the Philippines. Lastly, we mention that although there are cultural, physical, social and institutional factors affecting the household's decision to send children to school, we focus on the household's financial capacity to support children's education in our analytical framework.

2.2. Background of Ro-Ro Policy

The main goal of this dissertation is to analyze the effect of a government policy that promoted the use of a more efficient maritime transportation system in the Philippines. The Roll-on/Roll-off (Ro-Ro) policy, crafted in 2003, expanded the country's transportation system with minimal infrastructure investment from the government. It made use of existing port infrastructure and encouraged private sector participation, by allowing the conversion of private non-commercial ports into commercial ports under the Ro-Ro Ferry Terminal System (RRTS). The RRTS is a network of Ro-Ro ferry terminals that links the country together by means of Ro-Ro ferry ships. The Ro-Ro concept allows vehicles to directly roll-on the Ro-Ro ferry ship at point of embarkation and roll-off the ship at point of destination, effectively removing the need for portside facilities and equipment and lowering transportation costs by about 30 to 40 percent[8].

Prior to 2003, it was relatively more expensive to send products within the country than from other neighboring Asian countries like Hong Kong, China or Bangkok. Back then, the sole method of shipping products within the country was the loan-on load-off (Lo-Lo) system which requires the use of several portside facilities and equipment that result to higher cost of shipping. Some studies view this method inefficient as well as expensive, particularly for small-scale shippers. Basilio et al. (2010) for instance, note that this system aggravates the inefficiencies in the maritime transportation system by (a) constraining countryside development and (b) hindering efforts to improve the productivity and competitiveness of the export and tourism sectors. Similarly, Basilio et al. (2005) explain that inefficiencies in the maritime transportation system intensify transaction costs, which in effect, result in higher prices of goods and lower competitiveness of market players.

The goal of crafting the Ro-Ro policy is to (1) reduce the transportation costs of sending products within the country; (2) enhance transportation throughout the country, for tourism and commerce; (3) facilitate the agro-fisheries modernization and food security programs; (4) promote private sector participation in the establishment, construction, and operation of RRTS facilities; and (5) establish a new policy to promote the development of RRTS. The Ro-Ro system however, was not intended to replace the Lo-Lo system since large-scale shipping would still require its use. Rather, it was created to serve as an alternative option for small-scale shippers.

The Ro-Ro policy was fully implemented through three Executive Orders (EO) namely, EO 170, EO 170-A and EO 170-B. The key features of EO 170 include the

[8] See The Asia Foundation's Roll-on Roll-off Transport: Connecting Maritime Southeast Asia, accessed from https://asiafoundation.org/resources/pdfs/4PagerRoRoPHLetter.pdf on 29 May 2016.

following: (1) removal of cargo handling charges, (2) removal of wharfage dues, (3) fees for all rolling cargoes are based on size instead of weight, (4) toll fee consisting of freight, berthing, terminal and passenger fees, (5) simplified documentary requirements, (6) fixed regulatory supervision fees, (5) privatization of public Ro-Ro ports, (6) minimum permit requirements in port construction and operation and (7) financing from the Development Bank of the Philippines (DBP). The EO 170-A was issued to lift the 50-nautical mile limit originally imposed on all Ro-Ro routes. This practically allowed any route within the country to be eligible for Ro-Ro operations. The EO 170-B meanwhile was issued in 2005 to fast-track the expansion of Ro-Ro routes, which permitted the conversion of non-commercial ports into commercial ports under the RRTS. Most of the Ro-Ro ports and terminals that make up the RRTS are public ports that are owned and operated by the Philippine Ports Authority (PPA), Cebu Ports Authority (CPA) and Regional Ports Management Authority (RPMA). The Ro-Ro system is managed and regulated by two government offices namely: the Maritime Industry Authority (MARINA) and the Philippine Ports Authority (PPA).

The RRTS is composed of four major nautical highways namely: (1) Western Nautical Highway, (2) Maharlika Highway/ Pan-Philippine Highway, (3) Central Nautical Highway and (4) Eastern Nautical Highway, which provide connectivity between Manila and the rest of Visayas and Mindanao. The average travel time between Ro-Ro links takes about four hours using the Ro-Ro ferry ships. Figure 2.2 exhibits the map of the four nautical highways.

The Western Nautical Highway was the first nautical highway launched in 2003. It connects Luzon to Visayas and Mindanao, using the port of Batangas as the jump-off point. The other ports that constitute this nautical highway are: port of Calapan, Mindoro Oriental, port of Roxas, Oriental Mindoro, port of Caticlan, Malay, Aklan, port of Iloilo/Dumangas, port of Bacolod (BREDCO), port of Dumaguete, Negros Oriental and port Dapitan, Zamboanga Norte.

The Central Nautical Highway on the other hand, borrows some links from the Eastern Nautical Highway (i.e. port of Bulan, Sorsogon to port of Masbate). It started operating in 2009. The ports included in this link are: port of Pasacao, port of San Pascual (Burias Island, Masbate), port of Claveria (Burias Island, Masbate), port of Aroroy (Masbate), port of Cawayan (Masbate), port of Bogo (Cebu), port of Cebu, port of Tubigon (Bohol), port of Jagna (Bohol), port of Mambajao (Camiguin), port of Benoni (Mahinog, Camiguin) and port of Balingoan (Misamis Oriental).

The Ro-Ro network also made use of the existing Maharlika Highway, also known as the Pan-Philippine Highway. It became part of the RRTS in 2003. The Maharlika Highway is considered the oldest among the nautical highways because it has been built in the 1960s and further expanded in 1997 with the assistance of the Japanese government. This highway was the first major attempt to connect Luzon to Visayas and Mindanao through sea, roads and bridges, in the aim of stimulating agricultural production and promoting regional development. It connects the islands of Matnog in Sorsogon, Allen and Dapdap in Northern Samar, Liloan in Leyte and Lipata in Surigao. Ports included in this nautical highway are: port of Matnog (Sorsogon), port of Allen (Northern Samar), port of Dapdap (Northern Samar), port of Liloan (Leyte) and port of Lipata (Surigao).

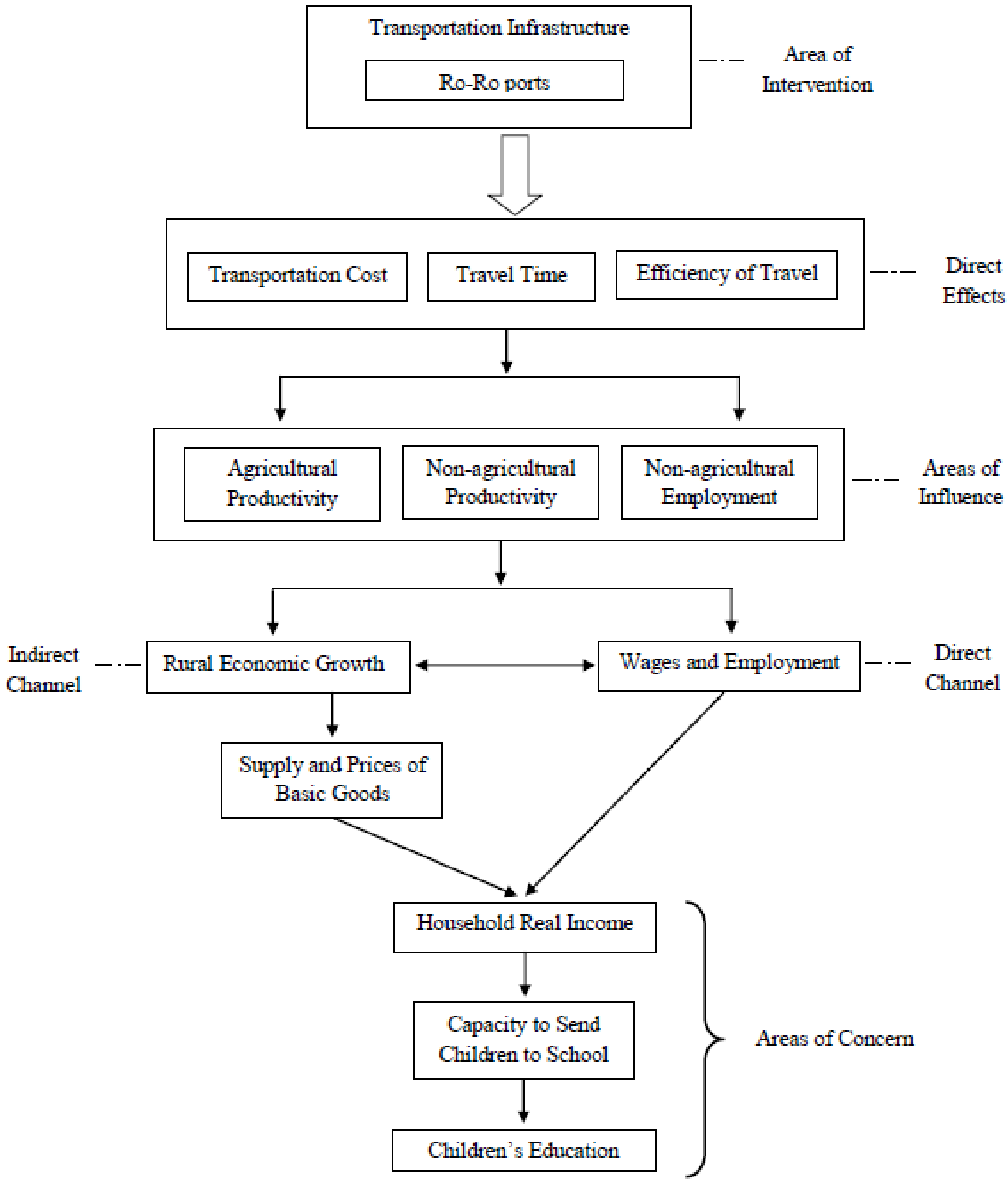
Lastly, the Eastern Nautical Highway was established in 2009 to complete the interconnection between three major islands of the Philippines (i.e. Luzon, Visayas and Mindanao). It also connected the islands that were not included in the Maharlika Highway. The ports included in this link are: port of Bulan (Sorsogon), port of Masbate, port of

Maripipi (Biliran), port of Naval (Biliran), port of San Ricardo (Southern Leyte), port of Lipata (Surigao del Norte), port of Placer (Surigao del Norte) and port of Surigao.

The RRTS was designed to be part of the national highway system. The Department of Public Works and Highways (DPWH) implemented several major road repairs and expansion to support the operation of the RRTS and create a seamless connection between nautical highways and road networks. The South Luzon Expressway (SLEX) for instance, has undergone major road widening to accommodate the influx of vehicles from the Western Nautical Highway. It was also extended to include Sto. Tomas, Batangas. The SLEX-Western Nautical Highway connection serves as the gateway to Metro Manila from the port of Batangas. Similarly, road links that were connected to the Eastern and Central Nautical Highways were also improved to accommodate the increasing number of vehicles and tourists.

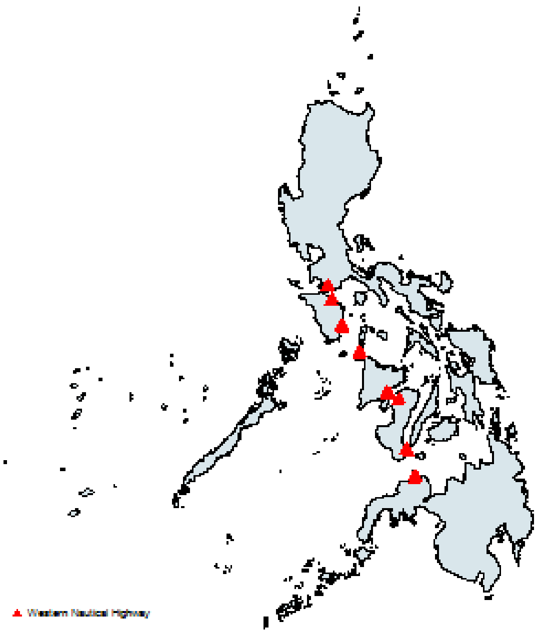
Figures

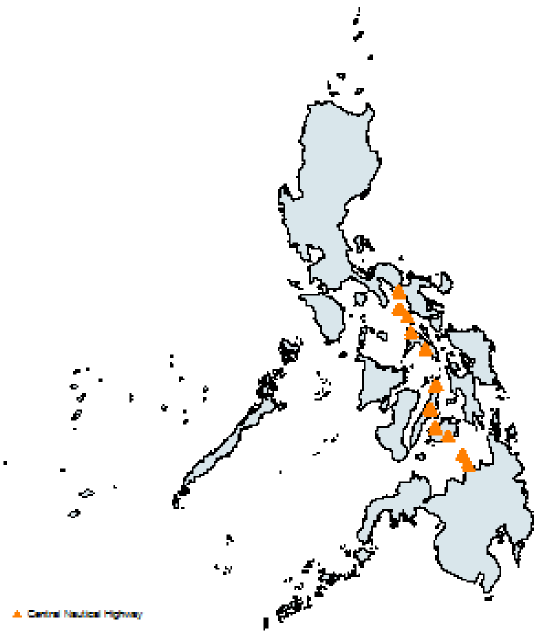
Figure 2.1: Analytical Framework on Infrastructure, Household Income and Education



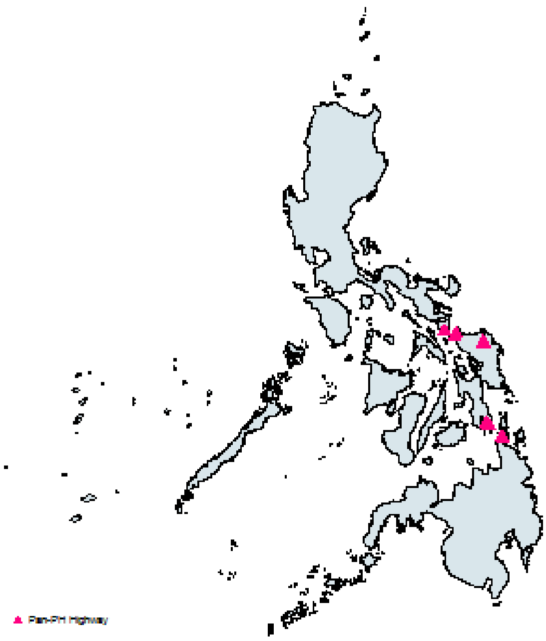
Note: Adapted from Ali and Pernia (2003)

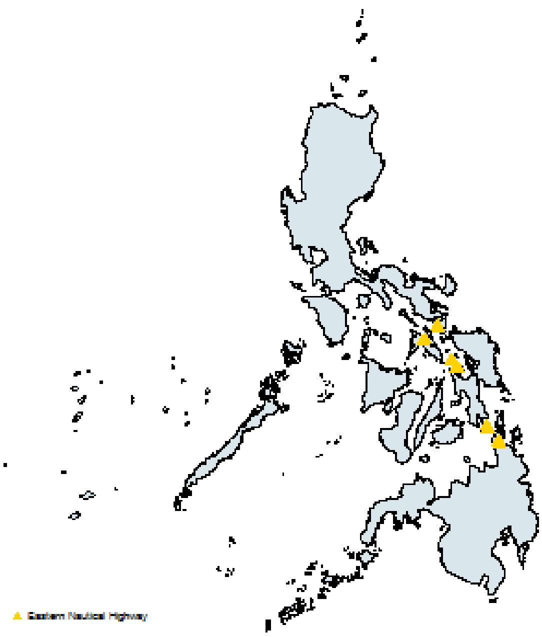
Figure 2.2: Location Maps of the Four Nautical Highways





Western Nautical Highway **Central Nautical Highway**





Pan-Philippine Highway **Eastern Nautical Highway**

Note: list of Ro-Ro ports sourced from Philippine Ports Authority

Chapter 3

Ro-Ro policy and Agricultural Household Income

3.1. Introduction

The agriculture sector remains relevant in Philippine economy despite its slow growth (1.6 percent in 2014) and decline in total gross domestic product share (from 18.9 percent in 1997 to 11.3 percent in 2014[9]) over the years. This sector continues to be the main driver of growth and source of employment in areas where poverty is widespread. It provides livelihood to about 36 percent of the total employed population in rural areas[10], where poverty (39.4 percent) is three folds higher than urban areas and significantly higher than the national poverty average (26.5 percent). Although the causes of rural poverty varies from island to island, the general reasons are attributed to the decline in productivity in farming and fishing activities, lack of access to microfinance and credit services and lack of non-farm income-generating opportunities (International Fund for Agricultural Development).

Even in the earlier literature (Jazairy et al., 1992; Quibria and Srinivasan, 1993; Balisacan, 1993), productivity improvement in agriculture has been cited as vital for the Philippines since majority of the rural poor are dependent on the sector. A recent study Briones (2013) likewise argues that the key factor for achieving inclusive growth in the country is rural development that is anchored on productivity growth in agriculture. Meanwhile, Andersen and Shimokawa (2007) explain that productivity improvement in agriculture is dependent on good rural infrastructure, well-function markets, institutions and

[9] Data from Asian Development Bank Key Indicators for Asia and the Pacific, accessed from http://www.adb.org/publications/key-indicators-asia-and-pacific-2015 on 21 May 2016.
[10] Asian Development Bank's Country Operations Business Plan: Philippines, 2013–2015, accessed from http://www.adb.org/documents/philippines-country-operations-business-plan-2013-2015 on 1 October 2015.

technology. Webster et al. (2003) note that rural infrastructure enhances rural-urban linkages that result to positive economic returns.

Evidently, the transfer of agricultural products and services within the country is heavily-reliant on the efficiency of the transportation system. Given that the Philippines is composed of about 7, 500 islands, agricultural farmers aiming to reach bigger markets are faced with the problem of transporting products to regional centers that serve as hubs for economic activities. However, prior to 2003, the sole method of shipping products, which is the loan-on load-off (Lo-Lo) system, was very costly and inefficient for small-scale agricultural farmers. Since this system requires the use of several equipment and port-side facilities, shipping agricultural products usually entails layers of fees that are burdensome for agricultural farmers. A study notes (Basilio et al., 2010) that difficulties in transporting products to regional centers translates to (1) lower income –due to longer travel time and higher spillage and (2) higher prices of commodities –due to higher transportation costs.

In response to this problem, the government implemented the Ro-Ro policy in 2003 to provide an alternative mode of shipping that would simplify the shipping procedure and reduce transportation cost. This policy was primarily designed to enhance trade within the country. The Ro-Ro ferry terminal system allowed vehicles containing cargoes to directly board the Ro-Ro ferries and disembark at point of destination. This concept effectively reduced the transportation cost by about 30 to 40 percent because it eliminated the need for port-side facilities. The Ro-Ro routes also expanded the market access of agricultural farmers as it practically bridged the Philippine islands together.

The goal of our study is to evaluate the impact of the Ro-Ro policy on agricultural household[11] income. More specifically, we look at the changes in specific components of agricultural household income namely: income from agricultural as well as non-agricultural sources. Additionally, we evaluate the changes in income for specific entrepreneurial activities that largely contribute to agricultural output, namely: (1) crop farming and gardening, (2) livestock and poultry raising and (3) fishing. Due to the archipelagic structure of the country, we distinguish between agricultural households that are located on the same island as the Ro-Ro ports and agricultural households that are *not* on the same island as the Ro-Ro ports, based on perceived differential impact of the Ro-Ro policy.

Our study will provide useful insights on how transportation infrastructure such as the Ro-Ro port, affects income-generating opportunities for agricultural households. Moreover, since our analyses largely focus on the distance of agricultural households from the Ro-Ro ports, our results will demonstrate the role of "access" to Ro-Ro ports, in terms gaining benefits from the Ro-Ro policy.

The rest of this chapter is organized as follows: we provide a background on Philippine agriculture in Section 3.2 and offer a review of literature on the estimation techniques used in previous studies in Section 3.3. We discuss the estimation procedure, data and distance calculation in Section 3.4 and present the results in Section 3.5. Finally, we state our conclusions in Section 3.6.

[11] We define agricultural households as households whose main source of income comes from agriculture-related activities, which include the following: crop production such as palay, corn, vegetable, coconut, sugarcane, tobacco, fiber, coffee, cacao, etc.; livestock and poultry such as cattle raising, chicken raising, duck raising, etc,; agricultural services; fishing (ocean, coastal, inland, etc.), fishpond operation, fishpen operation, fish farm, shrimp farm, oyster farm, etc. and logging operations, hunting, trapping and game propagation. Our definition is based on the Family Income and Expenditure Survey (FIES) manual.

3.2. Background on Philippine Agriculture

Agricultural land occupies about 32 percent of the country's total land area. The agriculture sector is composed of crop farming, fishing, livestock raising, forestry, hunting and fishing industries. It employs about 31 percent of the total employment and contributes about 11.3 percent of the country's total gross domestic product (GDP)[12]. On the other hand, agricultural products comprise about 10 percent of the country's total exports. Export products include coconut oil, fresh bananas, tuna, pineapple and its by-products, which are sent to major export destinations such as US, Netherlands, Japan, China and Germany. Import products meanwhile, include wheat & meslin, soya bean, oil/cake meal, milk & other by-products and rice, which are sourced from US, Australia, Argentina, New Zealand, Vietnam and India[13].

The major subsectors of agriculture are: (1) crop farming (50 percent), (2) livestock and poultry raising (25 percent) and (3) fishing (18 percent)[14]. Crop farming is the most common agricultural activity in the country, where major outputs produced are rice, corn, coconuts, sugarcane, bananas, pineapples, and mangoes. Rice is the primary staple crop of the country, while corn serves as a substitute for rice and functions as an important component in livestock and poultry feed. Meanwhile, the crop industry is challenged by its high susceptibility to weather disturbances[15] and inadequate infrastructural investments that further aggravate the problems in the marketing system of crop products.

On the other hand, the livestock and poultry industry contributes about 14 percent and 11 percent of the total agricultural output, respectively. The types of livestock raised in

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[12] Data from Asian Development Bank key Indicators for Asia and the Pacific, accessed from http://www.adb.org/publications/key-indicators-asia-and-pacific-2015 on 21 May 2016.
[13] Sourced from Philippine Statistic Authority CountrySTAT Philippines, Philippine Agriculture in Figures, 2012 accessed from http://countrystat.psa.gov.ph/?cont=3&yr=2012 on 15 May 2016.
[14] Based on share in Gross Value Added in Agriculture. Sourced from CountrySTAT Philippines, Philippine Statistics Authority, accessed from http://countrystat.psa.gov.ph/?cont=3 on 21 May 2016.
[15] Given that the Philippines is visited by an average of 19 typhoons annually, crop yields are highly variable throughout dry and rainy seasons.

the country are carabao, cattle, goat and swine. The livestock industry is dominated by backyard growers. Meanwhile, the types of poultry raised in the country include chickens and ducks. In contrast, the poultry industry is dominated by commercial growers. The marketing system for livestock and poultry products is mostly managed by the private sector, where medium and large-scale operators usually organize a direct marketing arrangement with the processing firms (Librero and Tidon, 1996).

Fishing likewise remains as a productive industry in the Philippines. It contributes about 18 percent share of total gross value added in Agriculture, Fishery and Forestry output. This industry also provides export earnings, dietary needs, notable income and employment to rural households. The total fish supply of the country comes from four sources namely: aquaculture, commercial fisheries, municipal fisheries and imports[16]. The marketing system of the fish industry is relatively shorter than any other agricultural product, but it involves a number of players including brokers, wholesales, wholesalers-retailers and retailers (Food and Agriculture Organization of the United Nations).

3.3. Literature Review

The literature offers a rich selection of studies that estimate the impact of transportation infrastructure on economic development. The earliest study was done by Owen (1987) who finds significant correlation between per capita gross national product (GNP) and passenger and freight transport volumes. His work was later followed by a number of studies that look at the effect of transportation infrastructure investment on aggregate income (Aschauer, 1989;

[16] Based on the Bureau of Agricultural Statistics definitions, *Aquaculture* –pertains to fishery operation that entails raising fish or other marine species in marine, brackish and fresh water environment as in the case of fishponds, fish pens, fish cages, and also mussel, oyster, seaweed farms and hatcheries, *commercial fishing* –involves catching of fish using fishing boats of capacity not more than three people and *inland municipal fishing* –is the catching of fish, crustaceans, mollusks as well as other aquatic animals and plants in inland water like lakes, rivers, dams, marshes, etc. with the use of fishing gears and fishing boats.

Easterly and Rebelo, 1993; and Fernald 1999), agricultural productivity (Antle 1983; Binswanger et al. 1993; and Craig et al. 1997), transportation cost (Minten and Kyle, 1999) and trade (Limao and Venables, 2001).

Majority of the previous studies utilizes the production function-type model in analyzing the effect of transportation infrastructure on the economy. This type of model accounts for the effect of production inputs such as capital, labor and infrastructure investment on a certain output of interest. Previous analyses were also carried out at different administrative levels including state (Eberts, 1986; Costa et al., 1987; Munnell, 1992; Moomaw and Williams, 1991; Garcia-Mila and McGuire, 1992), national (Lynde and Richmond, 1992), metropolitan area (Duffy-Deno and Eberts, 1991), county (Ozbay et al., 2003; Ozbay et al., 2007) and province (Waters, 2004).

Alternatively, Haughwort (2000) uses a spatial general equilibrium model which treats infrastructure as a non-traded localized public good. He observes that infrastructure brings productivity and consumption benefits to households and firms. Eaton and Kortum (2002) also employ a general equilibrium model in estimating the effect of transportation infrastructure on regional growth. Jiang et al. (2015) on the other hand, utilize a reduced form Solow growth model in estimating the effect of transportation on regional economic development in China.

The difference-in-differences method is likewise gaining popularity in the literature. Several studies such as Michaels (2008), Donaldson (2010), Keller and Shiue (2008) and Atack et al. (2009), find that transportation infrastructure results to greater price convergence. On a different note, another important development in the literature highlights the importance of proximity to transportation networks in estimating the impact of transportation infrastructure. For instance, Banerjee et al. (2012) note that access to a transportation network results to positive effects on per capita GDP and per capita GDP growth in China. Likewise, Atack et al. (2009) observe higher urbanization in areas near the railway line in the U.S.

3.4. Estimation and Data

3.4.1. Estimation

We analyze the impact of the Ro-Ro policy on agricultural household income in the same vein as Banerjee et al. (2012) and Atack et al. (2009). In our specification, we utilize the distance of agricultural households from the transportation infrastructure, which we identify as the Ro-Ro port. Essentially, we employ a relatively simpler panel fixed-effect model and use the distance of agricultural households from the nearest Ro-Ro port as an explanatory variable. This strategy allows us to make inferences about the changes in agricultural household income across time, while controlling for unobserved heterogeneity.

Due to the archipelagic structure of the Philippines, we separate our data into two groups: (1) agricultural households that are on the same island as the Ro-Ro port and (2) agricultural households that are *not* on the same island as the Ro-Ro port, based on perceived differential impact of the Ro-Ro policy. We consider the model for household $i = 1, \dots, N$ at time period $= 1, \dots, t$ as:

$$y_{it} = \beta_0 + x_{it}'\beta_1 + \beta_2\, d_{it} + \beta_3\, s_{it} + \beta_4\, d_{it} * s_{it} + c_i + e_t + u_{it} \qquad (3.1)$$

In Equation 3.1, y_{it} is the household income for household i at time t. The term x_{it}' represents the transpose of the *K*-dimensional vector of control variables which we specify in Table 3.1. The variable d_{it} represents the distance of each household from the nearest Ro-Ro port at each time t. We note that the operation of the Ro-Ro ports was carried out at different time periods during our study. Hence this variable is expected to vary across our study period. The variable s_{it} is a dummy variable equal to unity if the household is on the same island as the Ro-Ro port and 0 otherwise. The term $d_{it} * s_{it}$ represents the interaction between *distance from the nearest Ro-Ro port* and dummy variable for being on the same island as the Ro-Ro port, which captures household heterogeneity in income levels based on distance from Ro-Ro port and island location. The parameters $\beta_1, \beta_2, \beta_3, \beta_4$ capture average differences among households based on the set of controls, distance from the nearest Ro-Ro port, island location and interaction term, respectively.

By specifying our panel fixed-effect model as above, we are able to control for time-invariant characteristics common across households and across time, through the household-specific and time-specific fixed effects, c_i and e_t, respectively. Lastly, u_{it} represents the model residual, which we assume to follow a white noise process upon conditioning on the controls specified above.

To better interpret our coefficients, we can rearrange Equation 3.1 as follows. Suppose the agricultural household is located on the same island as the Ro-Ro port ($s_{it} = 1$):

$$y_{it} = (\beta_0 + \beta_3) + x_{it}'\beta_1 + (\beta_2 + \beta_4)d_{it} + c_i + e_t + u_{it} \qquad (3.2)$$

Then (3.2) implies that the change in income with respect to the change in distance relative to the nearest Ro-Ro port is given by $\frac{\partial y_{it}}{\partial d_{it}} = \beta_2 + \beta_4$.

Alternatively, suppose the agricultural household is *not* on the same island as the Ro-Ro port ($s_{it} = 0$):

$$y_{it} = \beta_0 + x_{it}'\beta_1 + \beta_2 d_{it} + c_i + e_t + u_{it} \qquad (3.3)$$

Then (3.3) implies that the change in income with respect to the change in distance relative to the nearest Ro-Ro port is given by $\frac{\partial y_{it}}{\partial d_{it}} = \beta_2$.

The strength of our model is that it allows us to show the differential impact of the Ro-Ro policy based on the household's distance from the Ro-Ro port, for each of the groups of agricultural households. This strategy is best illustrated in Figure 3.1.

3.4.2. Data

We primarily use the Family Income and Expenditure Survey (FIES) sourced from the National Statistics Office (NSO) in our analyses. The FIES is a nationally representative survey done every three years since 1985, which contains information on family-level consumption, income, expenditure as well as household characteristics. Since the Ro-Ro policy was implemented in 2003, we utilize FIES survey 2003, 2006 and 2009 to capture the changes in household income through time. As mentioned earlier, we will limit our samples to agricultural households in the three-period panel. We deflate income data with region-specific and year-specific consumer price index (CPI) for all commodities, sourced from the National Statistics Office (NSO). We show the income variables and the set of control variables used in our analyses in Table 3.1.

3.4.3. Distance Data and Calculation

The data used in calculating the distances used in our analyses are mainly sourced from the National Statistics Office (NSO) Data Kit of Official Philippine Statistics (DATOS). The DATOS provides the easting and northing values of each geographic location; where we define easting –as the eastward-measured distance (x-coordinate) and northing –as the northward-measured distance (y-coordinate). By providing the coordinates, the DATOS enables us to plot any location in a geographical map. We merge the DATOS with the FIES dataset using the Philippine Standard Geographic Code (PSGC) as identifier.

The PSGC is composed of a 9-digit code that corresponds to a specific administrative division[17] in the Philippines. This data is sourced from National Statistical Coordination Board (NSCB). We match the PSGC with the location data of agricultural households in the FIES dataset, and then assign their respective easting and northing values. Meanwhile, we use the list provided by the Philippine Ports Authority (PPA) to identify the location of the Ro-Ro ports at the municipality-level. Similarly, we merge the ports data and the NSO DATOS using the PSGC codes. We likewise identify the location of each Ro-Ro port and assign their respective easting and northing values. Since nautical highways operated at different time periods, the set of Ro-Ro ports in operation will also vary throughout our study period.

We employ the straight-line distance formula in calculating the geographic distance between each agricultural household and each Ro-Ro port. Given two locations (i.e., household and Ro-Ro port), each with easting and northing values, we calculate the distance using $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. This formula allows us to calculate the relative distance of each agricultural household to all of the Ro-Ro ports. We harmonize our two merged data sets (i.e., FIES-DATOS and ports-DATOS) using the municipality locations.

Finally, to identify the nearest Ro-Ro port relative to each of the agricultural household, we compare all agricultural household-to-port distances and retain the smallest value. Since we have a different set of Ro-Ro ports in operation for each FIES period, we similarly end up with varying computed distances (i.e. *distance from the nearest Ro-Ro port*). This actually allows us to include the distance variable in our panel fixed-effect model. We note that we would not be able to do this if we used the non-Ro-Ro ports as a reference since these ports already existed prior to 2003. By utilizing distance from non-Ro-Ro ports, our

[17] Appendix 3.1 provides a diagram of the Philippine administrative divisions for better understanding.

computations would result to non-varying distances that will eventually be removed by the fixed-effect controls.

3.4.4. Exogeneity of Distance Variable

Before we present our analyses, we first establish that the location of Ro-Ro ports can be regarded as exogenous to agricultural households. We note that starting 2003, several private non-commercial ports were converted into Ro-Ro ports, where we highlight that the choice of the ports to be converted was solely the decision of the Philippine government. Agricultural households on the other hand, were at the receiving end with no power to influence this decision. One should caution however, that while the location of Ro-Ro ports is exogenous at the household-level, agricultural households could always relocate to places near the Ro-Ro ports. The panel structure of our data eliminates this possibility as household identifiers remain consistent for all three periods.

Likewise, we mention that the location of Ro-Ro ports may not be exogenous at the municipality-level. Generally, the location of all ports in the country was influenced by local factors such as road availability, economic activity and population density. We recall that the Ro-Ro ports were only converted as such, after the Ro-Ro policy was implemented. Prior to 2003, it operated as a normal port, which probably was built for functions that would serve private operators. Furthermore, as we have shown in Figure 2.2 of the previous chapter, the Ro-Ro ports seem to be strategically located at jump-off points that would connect major islands of the country. Thus, we can only treat our distance variable as exogenous at the household-level and not at the municipality-level; although differences in municipality characteristics can be controlled by adding municipality-level fixed-effect.

3.5. Results

The Ro-Ro policy is expected to impact agricultural households because it significantly reduced the cost of shipping agricultural products within the country. This policy was specifically designed to facilitate the agro-fisheries modernization and food security programs of the government, which were intended to improve the performance of the agriculture sector[18]. Given the archipelagic structure of the country, we hypothesize that the effect of the Ro-Ro port operation may be different depending on the distance of agricultural household from the Ro-Ro port. Logically, we expect that agricultural households that are closer to the Ro-Ro port would benefit more from the policy because they are exposed to more income-generating opportunities and lower travel cost.

In the following sections, we present our analyses on the effect of the Ro-Ro policy on agricultural household income. Firstly, we mention some important caveats to interpreting our results. The control variables used in our analyses are highly affected by the availability of variables in the utilized survey data. Thus, while we try to control for possible factors that could affect agricultural household income; we welcome the possibility that we were not able to capture everything due to data constraint. In addition, our estimates should be interpreted as the effect of being close to a Ro-Ro port, since we used distance from the Ro-Ro port as proxy for the overall impact of the Ro-Ro policy. One should caution that the effect we measure may not purely be the effect of the Ro-Ro port alone, but a cumulative effect of economic forces that were stimulated by the Ro-Ro port operation.

[18] Based on Executive Order 170.

3.5.1. Effect on Total Family Income of Agricultural and Non-agricultural Households

Although the focus of our study is on agricultural households, it is equally important to show that agricultural households benefited more from the Ro-Ro policy than non-agricultural households. As presented in Table 3.2, agricultural households in general (both in same island and *not* in same island as the Ro-Ro port), have higher total family income if they are closer to the Ro-Ro port. Non-agricultural households on the other hand, appear to be unaffected by the Ro-Ro port operation if they are located on the same island as the Ro-Ro port, while they seem to have higher total family income if they are *not* on the same island as the Ro-Ro port.

3.5.2. Characteristics of Agricultural and Non-agricultural Households

To complement our previous results, we characterize both agricultural and non-agricultural households to show possible differences between the two. Based on Table 3.3, we observe that on average, agricultural households are earning lower total family income than non-agricultural households. This may be expected since we notice that the heads of agricultural households are relatively younger and less educated than the heads of non-agricultural households. As compared with the heads of non-agricultural households, heads of agricultural households may be limited based in terms of work opportunities because of lower educational attainment. Heads of non-agricultural households on the contrary, would be able to optimally choose work opportunities based on their higher educational attainment.

From Table 3.2, we previously noticed that agricultural households benefited more from the Ro-Ro policy than non-agricultural households since both agricultural households on the same island as the Ro-Ro port and *not* on the same island as the Ro-Ro port were significantly affected. We hypothesize that the operation of the Ro-Ro port may have induced some changes that provided more income-generating opportunities for agricultural households, allowing them to choose more efficiently. We note that since heads of agricultural households are less educated, we expect that work opportunities available to them are limited, compared with those available for heads of non-agricultural households. Thus, we expect that any changes in the local economy such as the Ro-Ro port operation could easily influence their work options. Reasonably, we do not expect to observe the same for non-agricultural households, given that they are highly educated. We expect that heads of non-agricultural households are able to optimally choose work opportunities that would provide them enough income, even without the presence of a Ro-Ro port. Meanwhile, we observed that non-agricultural households seem to have higher total family income if they are closer to a Ro-Ro port but *not* on the same island as the Ro-Ro port. In this case, we hypothesize that the Ro-Ro port operation in a nearby island may have provided extra sources of income; hence the observed change in total income. However, we mention that will not elaborate on the effects of the Ro-Ro policy on non-agricultural households in this study[19], as we will focus mainly on agricultural households.

In addition to the previously mentioned characteristics, we also notice that agricultural households have relatively larger family size and younger family members (as evidenced by lower household labor force) than non-agricultural households. In terms of family support, these characteristics may not be helpful since fewer members would be able to work to sustain family needs. Evidently, the ratio between household labor force and family size is higher for non-agricultural households.

Lastly, we point out that agricultural households exhibit similar characteristics regardless of their distance from the Ro-Ro port. We likewise observe the same for non-

[19] An in-depth analysis on the effect of the Ro-Ro policy on non-agricultural households will be done in a separate study.

agricultural households. Furthermore, the differences in characteristics between agricultural and non-agricultural households are consistently observed at the beginning and at the end of our study period (i.e. 2003 and 2009, respectively). We also find these differences significant based on a series of t-tests performed.

3.5.3. Results for Agricultural Households

As mentioned earlier, the focus of this study on agricultural households given that they represent the poorest segment of Philippine population. In the following discussions, we perform an in-depth analysis on the effect of the Ro-Ro policy on agricultural households by looking at specific components of their income.

3.5.3.1. Effect on Income from Agricultural and Non-agricultural Sources

The income of agricultural households is classified into two categories: *income from agricultural sources/activities* and *income from non-agricultural sources/activities.* As shown in Table 3.4, agricultural households located on the same island as the Ro-Ro port tend to have higher income from non-agricultural sources/activities if they are closer to the Ro-Ro port. More specifically, if an agricultural household is 1 percent closer in distance to the nearest Ro-Ro port relative to its original location, total income from non-agricultural sources/activities is higher by .07 percent, on average.

Earlier we showed that agricultural households are generally less educated than non-agricultural households, thus suggesting that their opportunities are relatively limited. However, in Table 3.4, we notice that income from non-agricultural sources/activities tend to be higher if the agricultural household is closer to the Ro-Ro port. In this sense, we view the existence of the Ro-Ro port as a possible driver for non-agriculture income-generating opportunities. As Fan (2004) and Fan and Chan-Kang (2004) find, small non-farm businesses are encouraged by the availability of infrastructure and road access. A possible explanation is that agricultural households may be shifting to non-agriculture-related activities in response to the Ro-Ro port operation. We note that the concept of the Ro-Ro policy allows the vehicles to be transported via the Ro-Ro ferry ships. In effect, this system stimulates the influx of vehicles and passengers in the areas near the Ro-Ro ports. The increase in vehicle and passenger traffic could increase the demand for vehicle-related services, food and accommodation, which could be beneficial for agricultural household located near the Ro-Ro ports. Alternatively, the operation of the Ro-Ro ports may have improved the access of agricultural households to final goods, providing them the option to purchase agricultural products and allocate their time for other income-generating activities. As Adamopoulos (2011) explains, improved transportation allows regions to specialize because it reduces the cost of shipping final goods, thereby enhancing trade.

On the contrary, Table 3.5 shows that agricultural households that are *not* on the same island as the Ro-Ro port tend to have higher income from agricultural sources/activities if they are closer to the Ro-Ro port. Our result indicates that if an agricultural household is 1 percent closer in distance to the nearest Ro-Ro port relative to its original location, total income from agricultural sources/activities is higher by about .19 percent, on average. We find this result interesting since it reveals that the agricultural household's distance from the Ro-Ro port is important, regardless if it is located on the same island as the Ro-Ro port or not. In relation to this finding, we show in Figure 3.2 that there are numerous adjacent non-Ro-Ro ports that can be utilized by agricultural households from nearby islands to access the Ro-Ro ports; thereby confirming the possibility of Ro-Ro ports benefiting other nearby islands.

Meanwhile, we hypothesize that the operation of the Ro-Ro ports may have enhanced trade, allowing agricultural households to access cheaper inputs that lower operation cost and improve productivity. Moreover, since we have previously observed that agricultural households on the same island as the Ro-Ro ports tend to concentrate on non-agricultural activities, agricultural households from nearby islands may have increased production to compensate for the changes in supply of agricultural products. Moreover, the improved access to numerous markets via the Ro-Ro ferry ships may have increased the incentive to improve production.

3.5.3.2. Effect on Income from Specific Entrepreneurial Activities

Given the relative importance of the agriculture sector in Philippine economy, we similarly provide empirical analyses on the effect of the Ro-Ro policy on specific entrepreneurial activities that largely contribute to agricultural output which are: (1) crop farming, (2) livestock and poultry raising and (3) fishing. In the following discussions, we evaluate the changes in gross income and net income from these specific entrepreneurial activities.

3.5.3.2.a. Crop Farming and Gardening

As shown in Tables 3.6 and 3.7, agricultural household that are *not* on the same island as the Ro-Ro port tend to have higher gross income and net income from crop farming and gardening if they are closer to the Ro-Ro port. Our estimates indicate that if an agricultural household is 1 percent closer in distance to the nearest Ro-Ro port relative to its original location, gross and net income from crop farming and gardening is higher by .33 and .35 percent on average, respectively. We find this result consistent with our finding in the previous section wherein income from agricultural sources/activities of agricultural households in nearby islands is stimulated by the Ro-Ro port operation. Similarly, we hypothesize that the Ro-Ro port operation may have improved trade, allowing access to cheaper inputs for crop farming and gardening. Cheaper inputs could result to lower operational costs as well as improved productivity.

Alternatively, we draw attention to the fact that crop farmers are heavily reliant on road and inter-island transportation wherein a large segment of crop products serve as exports to other countries. A previous study mentions (Librero and Tidon, 1996) that prior to the Ro-Ro port operation, the flow of agricultural products such as rice, corn, coconut, bananas and mangoes has been impeded by issues of inadequate transportation facilities, high costs of transportation and poor farm-to-market roads. Hence, we hypothesize that the Ro-Ro port operation may have provided a cheaper alternative to transport agricultural products, possibly encouraging higher production. Moreover, the rolling cargo system may have enabled agricultural households to transport larger quantities of output and market highly perishable products on a regular basis.

3.5.3.2.b. Livestock and Poultry Raising

Meanwhile, we find insufficient evidence to conclude that the Ro-Ro port operation was able to affect agricultural household's gross and net income from livestock and poultry raising activities (Tables 3.8 and 3.9). Our findings may be reflective of the nature of marketing system for this industry, given that agricultural households are usually not involved in the transport of livestock and poultry products to the markets. Hence, changes in the efficiency of transportation system may not directly affect agricultural household income. We note that in the livestock and poultry industry, the burden of moving animal products from the farms to the markets is carried out by either the middle men or the commercial producers, depending on the type of operation. For backyard operations, agricultural households would usually sell their products to middle men or municipal livestock auction markets. For medium and large-scale operations, on the other hand, commercial growers would either have their own processing plants or would be in direct marketing arrangement with larger firms.

3.5.3.2.c. Fishing

The marketing channel for fish products is relatively shorter compared to other agricultural products in the Philippines. However, the location of agricultural households is crucial in this industry. Due to the highly perishable nature of fish products, distance from a nearby market is very important. Prior to the operation of the Ro-Ro ports, agricultural households would sell their products to either fish traders or fish retailers at the local markets, depending on their location.

Fish traders serve as the middle men in the fish industry, where they operate as near to the markets as possible (Food and Agriculture Organization, 2001). For agricultural households, being farther away from the local market imposes higher transportation cost. In this case, selling fish products to fish traders is a reasonable option. On the contrary, being located near a local market provides the option to sell products directly to fish retailers. This gains agricultural households higher profit as the need for middle men is eliminated.

With the Ro-Ro port operation, the landscape for marketing fish products in the country has changed. Fish traders took advantage of the rolling cargo system and opted to purchase fish products near the Ro-Ro ports, in order to minimize transaction costs (Basilio, 2008). Essentially, the Ro-Ro ports became the focal point for local fish trade, thus benefitting agricultural households in nearby areas. While our result in Table 3.10 does not show any significant effect on gross income, our result in Table 3.11 reveals that agricultural households on the same island as the Ro-Ro port have higher net income for fishing activities if they are closer to the Ro-Ro port. Based on our estimate, if an agricultural household is 1 percent closer in distance to the nearest Ro-Ro port relative to its original location, net income from fishing is higher by about .07 percent, on average. We hypothesize that the Ro-Ro port operation induced higher demand for fish products in areas near the Ro-Ro port since it simplifies the process and effectively reduces the cost for fish traders.

Meanwhile, Table 3.11 also reveals that income from fishing activities of agricultural households *not* on the same island as the Ro-Ro port is negatively affected by the Ro-Ro port operation. Our result shows that if an agricultural household is 1 percent closer in distance to the nearest Ro-Ro port relative to its original location, net income from fishing activities is lower by 1.16 percent on average. As mentioned earlier, agricultural households are very similar in terms of characteristics. Hence, we perceive that the difference in effect of the Ro-Ro port operation for agricultural households involved in fishing activities that are on the same island as the Ro-Ro port versus those on nearby islands, is largely determined by their distance from the Ro-Ro port. Based on our estimates, we hypothesize that the Ro-Ro port operation induced a competitive environment for agricultural households involved in fishing activities, as both agricultural households on the same island as the Ro-Ro ports and nearby islands would aim to market their products to fish traders operating near the Ro-Ro ports. However, we expect that agricultural households *not* on the same island as the Ro-Ro port would incur higher transportation cost, thereby resulting to lower net income. Alternatively, agricultural households who could not afford to transport their products to the nearest Ro-Ro port location would have to dispose their supply at the nearest local market where prices may not be as competitive.

3.5.3.3. Effect on Total Wages and Salaries from Agriculture and Non-agriculture

Finally, we verify the effect of the Ro-Ro port operation on total wages and salaries received from agriculture and non-agriculture sources to confirm if agricultural households are indeed shifting to non-agriculture-related activities in response to the Ro-Ro port operation. As shown in Table 3.12, total wages and salaries received from agricultural sources were unaffected by the Ro-Ro port operation, thus providing basis to conclude that the effect of the Ro-Ro policy is largely through the reduction of transportation costs involved in moving agricultural products and enhancing trade.

Meanwhile, we provide support that the Ro-Ro port operation indeed stimulated non-agriculture-related activities as total wages and salaries received from non-agriculture sources appear to be higher if the agricultural household is closer to the Ro-Ro port. Specifically, if an agricultural household is 1 percent closer in distance to the nearest Ro-Ro port relative to its original location, total wages and salaries received from non-agriculture sources is higher by 0.11 and 0.86 percent for agricultural households on the same island as the port and agricultural households *not* on the same island as the port, respectively. Our findings are consistent with our previous hypothesis that agricultural households may be shifting in non-agriculture related activities in response to the Ro-Ro port operation. Likewise, our results support our previous conclusion that the Ro-Ro port operation is beneficial to agricultural households, regardless if they are on the same island as the Ro-Ro port or not.

3.6. Conclusion

The implementation of the Ro-Ro policy provided an alternative mode of transportation for agricultural products at a relatively lower cost. Based on the analyses performed in this study, we conclude the positive impact of the Ro-Ro policy on agricultural household income.

Firstly, we compared the changes in total family income of agricultural and non-agricultural households and found that agricultural households benefited more from the Ro-Ro policy. Based on comparison of household characteristics, we observed that agricultural households are characterized by larger family size, younger members and less educated household head. We initially hypothesized that the Ro-Ro port operation provided agricultural households new income-generating opportunities, given that agricultural households are relatively limited in terms of work opportunities because of lower educational attainment. We confirmed this in our analysis on the effect of the Ro-Ro policy on income from agricultural and non-agricultural sources, where we revealed that agricultural households on the same island as the Ro-Ro port shifting to non-agriculture-related activities in response to the Ro-Ro port operation. We likewise noticed that total wages and salaries from non-agriculture sources increased with smaller distance from the Ro-Ro port. Meanwhile, we found that agricultural households on nearby islands are specializing on agricultural activities. Our estimates confirmed that the Ro-Ro port operation is beneficial for crop farming and gardening as well as fishing activities, but did not significantly affect livestock and poultry raising activities. Based on these results we conclude that the Ro-Ro policy provided agricultural households income-generating opportunities that allowed them to specialize based on comparative advantage. Furthermore, we highlight that the Ro-Ro policy is beneficial for agricultural households, regardless if they are located on the same island as the Ro-Ro port or not.

Figures

Figure 3.1: Illustration of the Regression Model

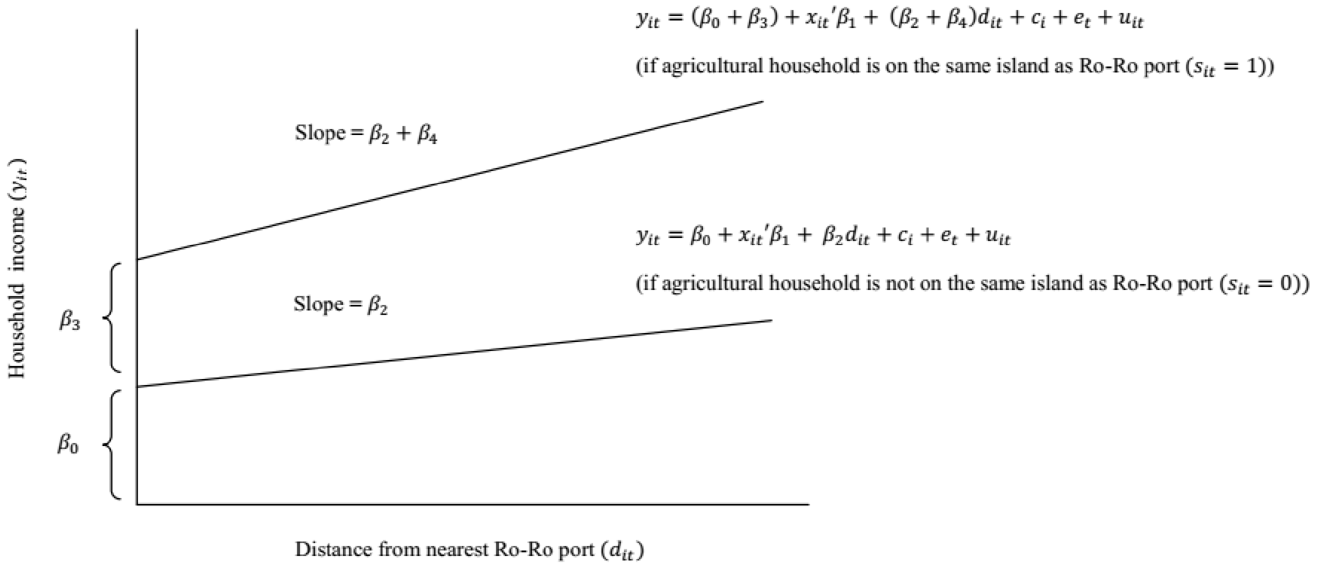
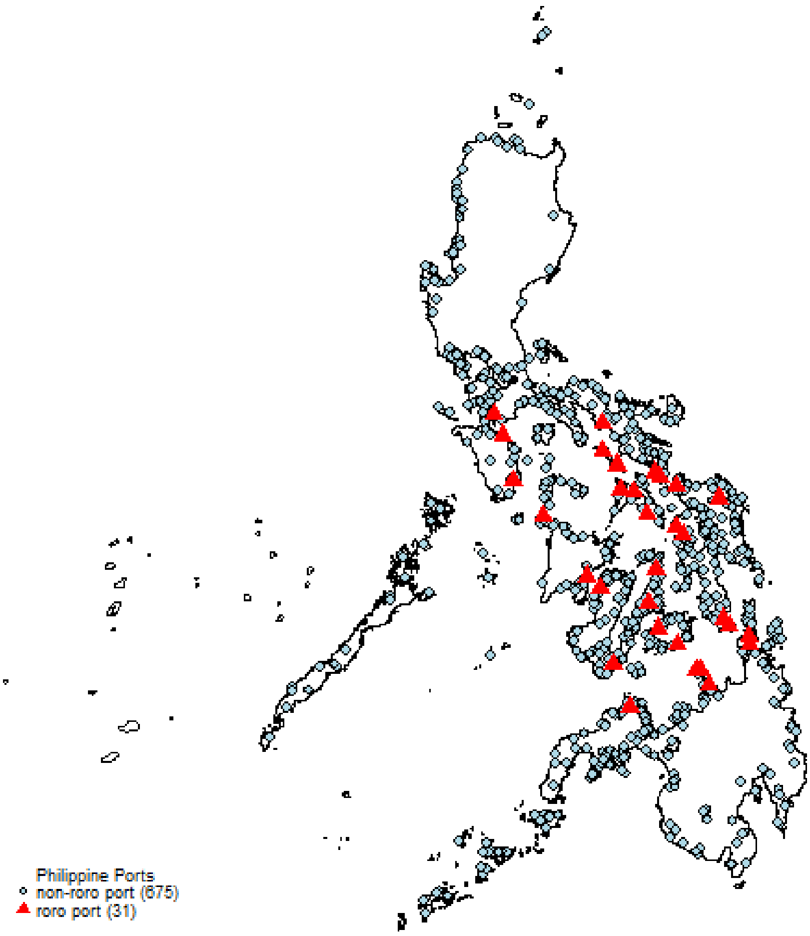


Figure 3.2: Location Map of Ro-Ro and non-Ro-Ro ports in the Philippines



Sources: Philippine Ports Authority and National Statistical Coordination Board's Port Inventory

Tables

Table 3.1: Summary Statistics

Variable	Obs	Mean	SD	Min.	Max
Income variables					
log of Total Family Income of Non-Agricultural Households	13636	6.910259	0.788311	3.624921	10.142020
log of Total Family Income of Agricultural Households	5915	6.193840	0.575099	4.111084	9.910635
log of Total income from Nonagricultural sources/activities	5915	4.507524	0.986729	0.433387	8.987099
log of Total income from Agricultural sources/activities	5915	5.906929	0.591345	3.522010	9.404611
log of Gross income from Crop farming	4074	5.593582	1.121896	-0.709739	9.607928
log of Gross income from Livestock & poultry raising	1509	3.890194	1.284394	-1.743271	8.839201
log of Gross income from Fishing	1060	5.596169	1.185877	0.136135	9.398504
log of Net income from Crop farming	4074	5.312008	1.041931	-0.709739	8.892297
log of Net income from Livestock & poultry raising	1507	3.553118	1.233400	-2.428814	8.425621
log of Net income from Fishing	1059	5.342065	1.072754	0.136135	7.451850
log of Total wages and salaries from Non-agriculture	1519	4.245739	1.125147	-1.925593	8.026685
log of Total wages and salaries from Agriculture	3389	4.801875	1.074871	0.343775	8.906115
Control variables					
log of Distance from nearest Ro-Ro port (in meters)	5915	11.518620	1.580642	0	13.573280
Same island as the Ro-Ro port	5915	0.750634	0.432683	0	1
Household labor force	2982	3.846412	1.248637	0	10
With car (1 -with car)	5915	0.024176	0.153608	0	1
With motorcycle (1 -with motorcycle)	5915	0.050719	0.219441	0	1
With acess to electricity (1 -with access)	5915	0.545393	0.497977	0	1
Sex of household head (1 -male)	5915	0.922908	0.266760	0	1
Age of household head	5915	47.479970	12.964880	17	98
Years of education of household head	5915	6.230600	3.308904	0	15

Table 3.2: Estimates for log of Total Family Income

	Agricultural Household	Non-agricultural Household
Log of distance of HH from nearest Ro-Ro port	-0.209343 **	-0.033943 **
	(0.090491)	(0.014668)
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.179476 **	0.029855 *
	(0.091062)	(0.015524)
HH labor force (members above 15 y.o. but less than 60)	0.059166 ***	0.076035 ***
	(0.009992)	(0.005616)
With car	0.222654 ***	0.168956 ***
	(0.080144)	(0.030391)
With motorcycle	0.214667 ***	0.104048 ***
	(0.061287)	(0.019155)
With acess to electricity	0.049596 *	0.144320 ***
	(0.027291)	(0.029348)
Sex of Household Head	0.105184	0.010655
	(0.075442)	(0.029847)
Age of Household Head	0.003371	0.001671
	(0.002581)	(0.001703)
Years of education of Household Head	-0.000355	0.004552
	(0.006920)	(0.004044)
Controlled for Year Fixed-effect	YES	YES
Effect of being closer to a Ro-Ro port		
Same island as the Ro-Ro port	-0.029868 ***	-0.004087
	(0.010198)	(0.005249)
Not same island as the Ro-Ro port	-0.209343 **	-0.0339425 **
	(0.090491)	(0.014668)
N	3892	9930
R^2 :		
within	0.083	0.0928
between	0.0039	0.2536
overall	0.0017	0.2363

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.3: Characteristics of Agricultural and Non-agricultural Households

Characteristics		2003 Agricultural Households	2003 Non-agricultural Households	2009 Agricultural Households	2009 Non-agricultural Households
log of Total Family Income	Mean	6.11846	6.96759	6.22212	6.93585
	Std. error	(0.5739)	(0.8177)	(0.5858)	(0.7942)
	N	3067	7409	2318	6876
Years of education of household head	Mean	6.10042	9.51815	6.23943	9.65780
	Std. error	(3.2994)	(3.8259)	(3.4641)	(3.7372)
	N	3067	7409	2318	6876
Age of household head	Mean	44.73851	47.00499	48.79422	51.03723
	Std. error	(13.5108)	(14.6164)	(13.0101)	(14.0709)
	N	3067	7409	2318	6876
Family size	Mean	5.04565	4.74322	5.03947	4.65009
	Std. error	(2.1721)	(2.1397)	(2.1894)	(2.1506)
	N	3067	7409	2318	6876
Household labor force[1]	Mean	3.82645	4.05305	3.77606	3.93143
	Std. error	(1.3031)	(1.4948)	(1.2204)	(1.3883)
	N	1429	3563	1161	3223
Household labor ratio[2]	Mean	0.69874	0.75874	0.67372	0.73142
	Std. error	(0.2209)	(0.2128)	(0.2120)	(0.2064)
	N	1429	3563	1161	3223

Notes: [1]Household members 15 years old and over

[2]Computed as household labor force divided by family size

Table 3.4: Estimates for log of Total Income from Non-agricultural Sources/Activities

Log of distance of HH from nearest Ro-Ro port	-0.263973	
	(0.221448)	
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.191621	
	(0.222453)	
HH labor force (members above 15 y.o. but less than 60)	0.106646	***
	(0.022470)	
With car	-0.056328	
	(0.145430)	
With motorcycle	0.134804	
	(0.131336)	
With acess to electricity	0.011163	
	(0.066439)	
Sex of Household Head	0.038321	
	(0.189253)	
Age of Household Head	0.016227	**
	(0.007306)	
Years of education of Household Head	0.016914	
	(0.014545)	
Controlled for Year Fixed-effect	YES	
Effect of being closer to a Ro-Ro port		
Same island as the Ro-Ro port	-0.072352	***
	(0.020883)	
Not same island as the Ro-Ro port	-0.263973	
	(0.221448)	
N	3891	
R^2 :		
within	0.0578	
between	0.0396	
overall	0.0348	

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.5: Estimates for log of Total Income from Agricultural Sources/Activities

Log of distance of HH from nearest Ro-Ro port	-0.199040 **
	(0.084028)
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.178996 **
	(0.084694)
HH labor force (members above 15 y.o. but less than 60)	0.048616 ***
	(0.010787)
With car	0.268230 ***
	0.085638
With motorcycle	0.221301 ***
	0.068425
With acess to electricity	0.057021 *
	0.030425
Sex of Household Head	0.098479
	0.093909
Age of Household Head	0.001750
	0.002775
Years of education of Household Head	-0.003052
	0.007437
Controlled for Year Fixed-effect	YES
Effect of being closer to a Ro-Ro port	
Same island as the Ro-Ro port	-0.020045 *
	(0.010690)
Not same island as the Ro-Ro port	-0.199040 **
	(0.084028)
N	3892
R^2 :	
within	0.0522
between	0.0001
overall	0.0003

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.6: Estimates for log of Gross Income from Crop Farming

Log of distance of HH from nearest Ro-Ro port	-0.326110 ***
	(0.115253)
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.330894 ***
	(0.118121)
HH labor force (members above 15 y.o. but less than 60)	0.023650
	(0.020921)
With car	0.500447 **
	(0.249287)
With motorcycle	0.127780
	(0.093379)
With acess to electricity	0.075273
	(0.074763)
Sex of Household Head	0.151378
	(0.185207)
Age of Household Head	-0.007256
	(0.005229)
Years of education of Household Head	0.007177
	(0.012483)
Controlled for Year Fixed-effect	YES
Effect of being closer to a Ro-Ro port	
Same island as the Ro-Ro port	0.004784
	(0.025901)
Not same island as the Ro-Ro port	-0.326110 ***
	(0.115253)
N	2751
R^2 :	
within	0.0193
between	0.0002
overall	0.0000

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.7: Estimates for log of Net Income from Crop Farming

Log of distance of HH from nearest Ro-Ro port	-0.353142 ***
	(0.114373)
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.354187 ***
	(0.116987)
HH labor force (members above 15 y.o. but less than 60)	0.016258
	(0.020995)
With car	0.586268 **
	(0.245227)
With motorcycle	0.166394 *
	(0.097380)
With acess to electricity	0.072464
	(0.073814)
Sex of Household Head	0.227093
	(0.188356)
Age of Household Head	-0.009837 *
	(0.005232)
Years of education of Household Head	-0.000934
	(0.012403)
Controlled for Year Fixed-effect	YES
Effect of being closer to a Ro-Ro port	
Same island as the Ro-Ro port	0.0010457
	(0.024147)
Not same island as the Ro-Ro port	-0.3531415 ***
	(0.114373)
N	2751
R^2 :	
within	0.0238
between	0.0005
overall	0.0019

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.8: Estimates for log of Gross Income from Livestock and Poultry Raising

Log of distance of HH from nearest Ro-Ro port	-0.057614
	(0.444146)
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.166657
	(0.454531)
HH labor force (members above 15 y.o. but less than 60)	0.038854
	(0.079960)
With car	-0.448627
	(0.619697)
With motorcycle	0.389137
	(0.352077)
With acess to electricity	-0.179002
	(0.206674)
Sex of Household Head	2.154125 *
	(1.195253)
Age of Household Head	-0.008456
	(0.049971)
Years of education of Household Head	0.053940
	(0.066592)
Controlled for Year Fixed-effect	YES
Effect of being closer to a Ro-Ro port	
Same island as the Ro-Ro port	0.109044
	(0.068123)
Not same island as the Ro-Ro port	-0.057614
	(0.444146)
N	1000
R^2 :	
within	0.0618
between	0.0210
overall	0.0266

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.9: Estimates for log of Net Income from Livestock and Poultry Raising

Log of distance of HH from nearest Ro-Ro port	-0.388922	
	(0.461992)	
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.518462	
	(0.473900)	
HH labor force (members above 15 y.o. but less than 60)	0.074224	
	(0.070897)	
With car	-1.716907	
	(1.419973)	
With motorcycle	0.225218	
	(0.305209)	
With acess to electricity	-0.298643	
	(0.212553)	
Sex of Household Head	2.660433	***
	(1.015662)	
Age of Household Head	-0.034871	
	(0.045002)	
Years of education of Household Head	0.058338	
	(0.061078)	
Controlled for Year Fixed-effect	YES	
Effect of being closer to a Ro-Ro port		
Same island as the Ro-Ro port	0.129540	
	(0.092390)	
Not same island as the Ro-Ro port	-0.388922	
	(0.461992)	
N	998	
R^2 :		
within	0.0893	
between	0.0128	
overall	0.0143	

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.10: Estimates for log of Gross Income from Fishing

Log of distance of HH from nearest Ro-Ro port	0.810047	
	(0.688495)	
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	-0.865530	
	(0.688385)	
HH labor force (members above 15 y.o. but less than 60)	0.041580	
	(0.043325)	
With car	0.256711	**
	(0.122248)	
With motorcycle	0.167782	
	(0.449282)	
With acess to electricity	0.061349	
	(0.150820)	
Sex of Household Head	0.336010	
	(0.367564)	
Age of Household Head	0.018756	
	(0.021842)	
Years of education of Household Head	0.006476	
	(0.034940)	
Controlled for Year Fixed-effect	YES	
Effect of being closer to a Ro-Ro port		
Same island as the Ro-Ro port	-0.0554824	*
	(0.032679)	
Not same island as the Ro-Ro port	0.8100471	
	(0.688495)	
N	714	
R^2 :		
within	0.0628	
between	0.0338	
overall	0.0469	

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Table 3.11: Estimates for log of Net Income from Fishing

Log of distance of HH from nearest Ro-Ro port	1.163275	**
	(0.497590)	
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	-1.231826	**
	(0.498314)	
HH labor force (members above 15 y.o. but less than 60)	0.021694	
	(0.038783)	
With car	0.190698	*
	(0.104942)	
With motorcycle	0.420897	
	(0.469630)	
With acess to electricity	0.048722	
	(0.119561)	
Sex of Household Head	0.166082	
	(0.311432)	
Age of Household Head	0.032283	*
	(0.018724)	
Years of education of Household Head	-0.000732	
	(0.031045)	
Controlled for Year Fixed-effect	YES	
Effect of being closer to a Ro-Ro port		
Same island as the Ro-Ro port	-0.068551	***
	(0.019427)	
Not same island as the Ro-Ro port	1.163275	**
	(0.497590)	
N	714	
R^2 :		
within	0.0641	
between	0.0425	
overall	0.0568	

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

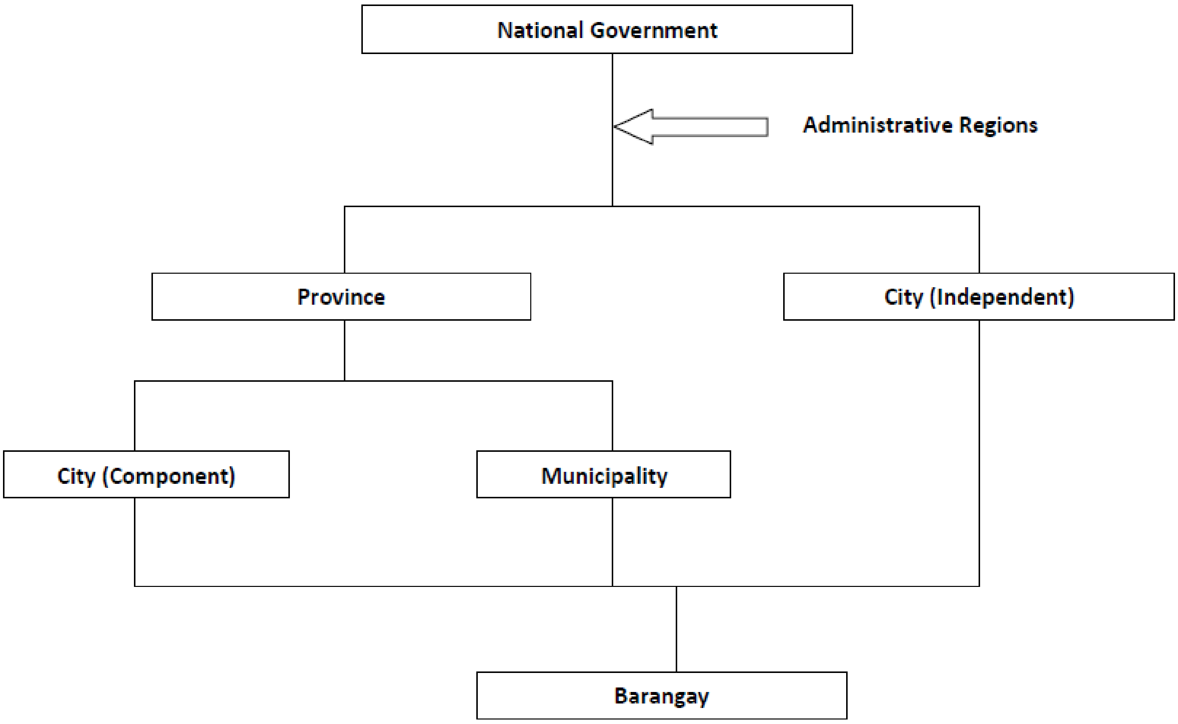
Table 3.12: Estimates for log of Total Wages and Salaries

	Agricultural Sources		Non-agricultural Sources	
Log of distance of HH from nearest Ro-Ro port	-0.209057		-0.862960	**
	(0.333928)		(0.397121)	
Interaction of log of distance of HH from Ro-Ro port & dummy variable for same island as the Ro-Ro port	0.230774		0.752335	*
	(0.337626)		(0.395194)	
HH labor force (members above 15 y.o. but less than 60)	0.096441	**	0.081921	
	(0.038006)		(0.062522)	
With car	-0.076370		0.372125	**
	(0.615570)		(0.187089)	
With motorcycle	0.189145		0.712405	***
	(0.160122)		(0.250348)	
With acess to electricity	0.007806		-0.117845	
	(0.097621)		(0.197081)	
Sex of Household Head	0.100100		2.121325	***
	(0.242964)		(0.367344)	
Age of Household Head	0.015522		-0.040426	
	(0.011262)		(0.031569)	
Years of education of Household Head	-0.013576		0.005975	
	(0.031142)		(0.046593)	
Controlled for Year Fixed-effect	YES		YES	
Effect of being closer to a Ro-Ro port				
Same island as the Ro-Ro port	0.021717		-0.110625	***
	(0.037452)		0.042531	
Not same island as the Ro-Ro port	-0.209057		-0.862960	**
	(0.333928)		0.397121	
N	2315		1185	
R^2 :				
within	0.0248		0.0664	
between	0.0005		0.0012	
overall	0.0015		0.0014	

Notes: *, **, *** indicate significance at the 10-, 5- and 1-percent alpha levels, respectively. Standard errors reported in parentheses are heteroskedasticity-robust. Marginal effects are computed using Delta-method.

Appendix

Appendix 3.1: Administrative Divisions of the Philippines



Source: United Nations (2004). Republic of the Philippines Public Administration Country Profile

Chapter 4

Ro-Ro policy and Education

4.1. Introduction

The Philippines places high priority on education because it is treated as an important policy tool for achieving inclusive growth in the country[20]. Given the persisting uneven development and high income inequality between urban and rural areas, the government strives to ensure that all citizens (especially in rural areas where poverty is widespread) are able to complete basic education[21] so that they may be able to find suitable employment opportunities.

Education is known to increase the quality and capability of a country's work force. From a policy standpoint, having an educated work force is ideal to support countryside development, which is much needed in the Philippines. Studies including Mankiw et al. (1992) Kosfeld and Lauridsen (2004), Soukiazis and Antunes (2011), Arbia et. al (2010), Abel and Gabe (2011) observe that output is higher from working-age population with higher level of education. Bronzini and Piselli (2009) likewise note that higher level of education equates with higher labor productivity. Furthermore, numerous studies (Kosfeld and Lauridsen, 2004; Behrman and Birdsall, 1983; Moll, 1992; Mingat, 1998; Zhong, 2011; Bedi and Edwards, 2002; Bloom et. al, 2006; Hanushek and Woessmann, 2008; Schoellman, 2012; Hanushek, 2013; Seshadri, 2014) show higher income as well as GDP growth with higher level of education.

[20] See for instance The Philippine Development Plan 2011-2016 which states that inclusive growth in the country can be achieved by providing high quality basic education, competitive technical vocational skills training as well as a responsive tertiary level.
[21] Basic education is comprised of the primary and secondary level of formal education.

The education sector of the country has done well in the past three decades. However, its performance has stagnated in recent years, causing it to lag behind other Southeast Asian countries. The major issues faced by the sector are those relating to (1) access and (2) equity. Access to primary and secondary level has been fluctuating over the years. Low enrollment rates are particularly observed in males. One unique characteristic of Philippine education is the relatively high school attendance and educational attainment of females (Johanson, 1999; Orbeta, 2003), which studies attribute to the perceived higher returns to education for females, especially in the secondary and tertiary level (Gerochi, 2002) and the higher availability of employment opportunities for school-age males (Orbeta, 2003). Meanwhile, completion rates[22] are particularly low in highly disadvantaged rural areas and urban slums. Most of the school dropouts are from the poor segment of the population. High disparities in enrollment rates are likewise observed across localities. Orbeta (2003) explains that disparities are more pronounced in rural areas compared to urban areas because it is largely affected by household income.

Although the government has implemented numerous reforms to expand access to basic education especially in highly disadvantaged areas, it is equally beneficial to how study other factors impact education. In this study, we analyze the mechanism by which improvements in the transportation system affects children's education. Specifically, we examine the changes in children's school attendance rate to investigate how the operation of Ro-Ro ports, as a result of the implementation of the Ro-Ro policy, changed the behavior of the households towards investing in their children's education.

[22] Completion rate refers to the percentage of students enrolled in a certain level of education that has completed the level based on the required number of years of study.

The aim of this study is to supplement the limited literature on evaluating the impact of transportation infrastructure on education[23]. It will offer valuable insights to policymakers which will be helpful in formulating targeted government programs. Our study deviates itself from previous literature in two ways. Firstly, it will show the differential impact of the Ro-Ro policy on each age level, as opposed to the aggregated impact on cohort levels done in previous studies. Secondly, it will provide better information by showing the specific impact of the Ro-Ro policy on each sex variation, which is useful in light of the government's goal of eliminating of gender disparities in education.

The remainder of this chapter is organized as follows: we offer a brief background of the education sector in the Philippines in Section 4.2 and explain our data sources and estimation strategy in Section 4.3. We provide a discussion of our results in Section 4.4 and finally, we present our conclusion in Section 4.5.

4.2. Education System in the Philippines

The Philippine education system largely resembles that of the United States. It is composed of formal and non-formal education, wherein the basic medium for instruction is English and Filipino. Formal education has three levels: primary, secondary and tertiary, with two main providers: public schools and private schools. Public schools are funded by the government while private schools are independent schools funded by students' tuition. Both types of schools follow a general curriculum.

In the formal education, children would start schooling at the age of 3 up to the age of 5 for pre-primary level. However, prior to 2012, this is not compulsory. The Philippine Constitution mandates that "basic education" (i.e. primary and secondary level) should be

[23] Limited examples include Hughes (1969) and Levy (1996).

free and compulsory. In response to this mandate, the government funds majority of the primary and secondary level schools (i.e. public schools). The primary level of education involves six years of schooling, starting at the age of 6 until the age of 12. The secondary level on the other hand, involves another four years of schooling, starting at the age of 13 until the age of 16. Meanwhile, the tertiary level is composed of the undergraduate, master and doctorate level where most of the providers are private schools. The undergraduate level takes about 4 years of education from the age of 17 until the age of 21 while the master level takes another 2 years of education. Additionally, the doctorate level takes about 3 to 5 years depending on the field of specialization. In terms of responsibility, the Department of Education (DepEd) supervises the primary and secondary level. It is likewise in charge of overseeing the non-formal education. The tertiary level on the other hand, is managed by the Commission on Higher Education (CHED).

In contrast, the non-formal education is aimed to provide education for out-of-school youth and illiterate adults who were not able to avail formal education. This type of education is consists of programs that incorporates basic literacy with livelihood skills training for non-literate and semi-literate adults. Trainings are usually conducted outside school premises. Furthermore, there exist a post-secondary technical-vocational education that provides skills orientation and training and development for out-of-school youth and unemployed community adults. This program is managed by the Technical Education and Skills Development Authority (TESDA).

4.3. Data and Estimation

4.3.1. Data

To evaluate the impact of the Ro-Ro policy on children's education, we construct a municipality-level pseudo panel by combining the following datasets: Census of Population and Housing (CPH) survey from the National Statistics Office; Statement of Income and Expenditure (SIE) from the Department of Finance's Bureau of Local Government Finance; list of Ro-Ro ports from the Philippine Ports Authority; and Philippine Ports Inventory from the Philippine National Statistics and Coordination Board. In contrast to the previous chapter, we conduct our analyses at the municipality level since the CPH survey is not composed of the same household samples (i.e. not a household panel). This limits us to track the policy-related changes at the household-level. As an alternative, we use municipality-level data as municipalities are easily identifiable and would not change through time.

We primarily use the Census of Population and Housing (CPH) survey from which we computed the school attendance rate of 5 to 21[24] years old and additionally, the employment rate of 15 to 21[25] years old for each municipality. The CPH is a nationally representative survey designed to take inventory on the size and distribution of the population in the Philippines. It provides information on the demographic, social, economic and cultural characteristics of the population. We make use of data on sex, date of birth, school attendance and usual occupation to calculate for population count, proportion of school attendance and employment. We disaggregate our computations based on age level, sex and municipality[26]. In addition, we utilize the CPH Form 5 to track the changes in municipality-level school access during our study period. The CPH Form 5 is an extension of the CPH survey which provides barangay-level information on establishments and service facilities available to each

[24] We note that the survey question on school attendance is only asked for individuals aged 5 years and above, while the survey question on employment is only asked for individuals aged 15 and above.
[25] In the Philippines, the minimum working age allowed by the law is 15 years old. Individuals of the age 15 to 18 years old are allowed to work as long as the environment is considered as non-hazardous.
[26] See Appendix 2 for an illustration regarding the administrative divisions of the Philippines.

barangay. We summarize barangay information and calculate for the proportion of barangays in each municipality with access to primary, secondary and tertiary level schools.

Meanwhile, we employ the Statement of Income and Expenditure (SIE) to calculate the tax revenue per capita in each municipality. We use this to serve as proxy for household income. The SIE provides financial information on all local government units in the Philippines. We utilize the total employed population in each municipality in calculating the per capita values, which allows us to compute more precise estimates of household income. Finally, we combine the list of Ro-Ro ports from the Philippine Ports Authority and Philippine Ports Inventory from the Philippine National Statistics and Coordination Board to identify the location of all ports in the country.

4.3.2. Estimation

We analyze the effect of the Ro-Ro policy on children's education by employing a difference-in-differences (DD) strategy that has been extensively used to study government policies since the work of Ashenfelter and Card (1985). Following the basic set-up of the DD strategy, we assign each municipality to either the treatment ($D = 1$) or control ($D = 0$) group based on their geographic distance from a Ro-Ro and non-Ro-Ro port. Our treatment group consists of municipalities located near Ro-Ro ports while our control group consists of municipalities located near non-Ro-Ro ports. Since the operation of the Ro-Ro ports were carried out at different time periods in 2003 (Western Nautical Highway and Maharlika Highway/ Pan-Philippine Highway), 2008 (Central Nautical Highway) and 2009 (Eastern Nautical Highway), we assign $t = 2000$ as our pre-treatment period ($T = 0$) and $t = 2010$ as our post-treatment period ($T = 1$).

Consider a simple case where we observe only one age group of the same sex in each municipality for each period. The simple DD estimator for the effect of the Ro-Ro policy on school attendance may be estimated from the following equation:

$$y_{mt} = \beta_0 + \beta_1 D_m + \beta_2 T_t + \delta(D_m \cdot T_t) + e_{mt} \quad (4.1)$$

In Equation 4.1, y_{mt} is our outcome of interest for municipality m and e_{mt} is the model residual, which we assume to have zero mean and be uncorrelated with the control variables. The coefficients β_1 and β_2 capture average differences in school attendance rates between municipalities near the Ro-Ro and non-Ro-Ro ports, and between time periods, respectively. Meanwhile, the coefficient δ is the DD estimator, which shows the impact of the Ro-Ro policy on school attendance, provided that our assumption about e_{mt} holds true.

In the real world, school attendance may likely vary across age and sex. This variation may arise from differences in costs and opportunities faced by individuals at different ages. For instance, the school attendance of 5 year–old children may be lower compared to the school attendance of other age levels because pre-primary education was not compulsory during our study period; hence the possibility that financially constrained households may delay sending their children to school until the age of 6. In addition, the school attendance of females may also be higher than the school attendance of males due to perceived higher returns to schooling for females that was noted in previous studies (Johanson, 1999; Gerochi, 2002; Orbeta, 2003). Failing to control for these variations in our estimation could lead to omitted variables bias. A simple solution would be to estimate Equation 4.1 for each age-sex combination in the sample. This strategy however, is less efficient than modeling age- and sex-specific school attendance using the combined samples across subgroups.

As an alternative, we use an expanded version of Equation 4.1, which takes into account the systematic differences in outcomes across age levels and sex. More specifically, we analyze possible changes in school attendance caused by the policy change, by estimating the following fully-interacted equation:

$$y_{asmt} = \delta_a(D_m \cdot T_t \cdot S_s \cdot A_a) + \theta_a(D_m \cdot T_t \cdot A_a) + \beta_1 D_m + \beta_2 T_t + \beta_{3a} A_a + \beta_4 S_s + \phi_{asmt} + \mu_m + e_{asmt} \qquad (4.2)$$

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 Equation 4.2, y_{asmt} is the school attendance rate in municipality m at period t for individuals of age a and sex s. As may be evident from our choice of subscripts, observations in our data are stacked over age, sex, municipality, and period. By specifying our DD equation as above, we are able to control for time-invariant characteristics common across school-age population within a municipality across our study period, through the municipality-specific fixed effects μ_m. Note that we would not be able to do this if we run separate DD specifications for each age-sex combination. In addition, by pooling our samples together, we are able to leverage on the increased sample size, which improves the efficiency of our estimates.

The parameters $\beta_1, \beta_2, \beta_{3a}$ and β_4 capture average differences across treatment groups, periods, age levels and sex, respectively. The variable A_a represents indicator variables for single-year age levels, while S_s is a dummy variable equal to unity if male, and zero if otherwise. The term ϕ_{asmt}, which contains interaction across treatment groups, periods, age levels and sex, captures heterogeneity in outcome levels. Finally, e_{asmt} is the model residual, which we assume to follow a white noise process upon conditioning on the controls specified above.

Our interest lies on the term $\delta_a S_s + \theta_a$, which represents the DD estimate of the impact of the Ro-Ro policy on our outcome of interest. In our representation, δ_a captures the differential impact between males and females. Note that in our estimation, we suppress the interaction term for δ_a, thus we are able to directly estimate separate DD coefficients $\gamma_{as} = (\delta_a S_s + \theta_a)$ for males and females in the same equation.

As an illustration, we provide the following example. Suppose we look at the school attendance for 5 year-old males in a municipality m. Following our subscripts in Equation 4.2, our outcome of interest at period t is thus given by $y_{a=5;\, s=male;\, m;\, t}$. Taking the conditional expectation of y_{asmt}, we can show that γ_{as} is the DD estimator for the specified age-sex combination. First, note that:

$$E(y_{asmt}|a = 5, s = male, D_m = 1, T_t = 1) = \delta_a + \theta_a + \beta_1 + \beta_2 + \beta_{3a} + \beta_4 + \beta_{5a} + \beta_6 + \beta_{7a} + \beta_{8a} + \beta_9 + \beta_{10a} + \beta_{11a} \tag{4.3}$$

$$E(y_{asmt}|a = 5, s = male, D_m = 1, T_t = 0) = \beta_1 + \beta_{3a} + \beta_4 + \beta_{5a} + \beta_6 + \beta_{7a} + \beta_{8a} \tag{4.4}$$

$$E(y_{asmt}|a = 5, s = male, D_m = 0, T_t = 1) = \beta_2 + \beta_{3a} + \beta_4 + \beta_{7a} + \beta_9 + \beta_{10a} + \beta_{11a} \tag{4.5}$$

$$E(y_{asmt}|a = 5, s = male, D_m = 0, T_t = 0) = \beta_{3a} + \beta_4 + \beta_{7a} \tag{4.6}$$

where Equation 4.3 is the expected school attendance of 5 year-old males in municipalities in the treatment group $(D = 1)$ for year 2010 $(T = 1)$; Equation 4.4 is the expected school attendance of 5 year-old males in municipalities in the treatment group $(D = 1)$ for year 2000 $(T = 0)$; Equation 4.5 is the expected school attendance of 5 year-old males in municipalities in the control group $(D = 0)$ for year 2010 $(T = 1)$ and Equation 4.6 is the expected school attendance of 5 year-old males in municipalities in the control group $(D = 0)$ for year 2000 $(T = 0)$.

What we intend to do in the DD strategy is to compare the change in school attendance of children in municipalities in the treatment group against the change in school attendance of children in municipalities in the control group, as this captures the effect of the Ro-Ro policy. More formally, the simple DD estimator may be specified as:

$$\{E(y_{asmt}|5, male, D = 1, T = 1) - E(y_{asmt}|5, male, D = 1, T = 0)\} -$$
$$\{E(y_{asmt}|5, male, D = 0, T = 1) - E(y_{asmt}|5, male, D = 0, T = 0)\}$$

(4.7)

In Equation 4.7, the part $\{E(y_{asmt}|5, male, D = 1, T = 1) - E(y_{asmt}|5, male, D = 1, T = 0)\}$ shows the change in school attendance of 5 year-old males in municipalities in the treatment group while the part $\{E(y_{asmt}|5, male, D = 0, T = 1) - E(y_{asmt}|5, male, D = 0, T = 0)\}$ shows the change in school attendance of 5 year-old males in municipalities in the control group. Substituting Equations 4.3 to 4.6 in the simple DD set-up above, Equation 4.7 simplifies into our DD estimator:

$$E(\hat{\gamma}_{as}) = (\delta_a + \theta_a + \beta_2 + \beta_9 + \beta_{10a} + \beta_{11a}) - (\beta_2 + \beta_9 + \beta_{10a} + \beta_{11a})$$

(4.8)

$$E(\hat{\gamma}_{as}) = \delta_a + \theta_a$$

It is important to note that when $E(\hat{\gamma})$ is positive, the average change in school attendance of 5 year-old males across our study period, in municipalities in the treatment group, is larger than those in municipalities in the control group, implying that the Ro-Ro policy has a positive effect on school attendance. In contrast, a negative $E(\hat{\gamma})$ indicates that the Ro-Ro policy hinders higher school attendance. Essentially, the DD strategy enables us to use the control group as a natural basis for comparison; wherein the double-differencing allows us to eliminate time-invariant confounding factors that could affect the outcomes, leaving only the effect of the Ro-Ro policy.

4.3.3. Treatment Identification

We assign each municipality to either the treatment $(D = 1)$ or control group $(D = 0)$ based on their geographical proximity from a Ro-Ro or non-Ro-Ro port. Firstly, we locate each municipality using the Philippine Standard Geographic Code (PSGC) which provides the location code. Next, we combine the list of Ro-Ro ports from the Philippine Ports Authority with the Philippine Ports Inventory from the Philippine National Statistics and Coordination Board and similarly use the PSGC to identify their locations. Using geographic data from National Statistics Office (NSO) Data Kit of Official Philippine Statistics (DATOS), we assign the eastward (x-coordinate) and northward-measured distance (y-coordinate) to each of these locations. We then determine the relative distances of the designated points by using a straight-line distance formula wherein, given two locations (for ex. a municipality and a Ro-Ro port), each with easting (x) and northing (y) coordinates, we calculate the distance as $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. We compute for the *distance from the nearest Ro-Ro port* and the *distance from the nearest non-Ro-Ro port* for each of the municipality and compare the two values. If the *distance from the nearest Ro-Ro port* < *distance from the nearest non-Ro-Ro port*, the municipality will be assigned in the *treatment* $(D = 1)$ group. On the other hand, if the *distance from the nearest Ro-Ro port* > *distance from the nearest non-Ro-Ro port*, the municipality will be assigned in the *control* ($D = 0$) group.

4.3.3.1. Characteristics of Treatment and Control Samples

Table 4.1 shows the characteristics of sample municipalities included in our treatment and control group. Firstly, we notice that mean school attendance rate is higher in municipalities in the control group than in the treatment group in year 2000. However, we no longer observe this difference in mean school attendance rate in year 2010. On the other hand, the mean employment rate for school-age individuals appears to be similar between the treatment and control group in year 2000, while it appears to be significantly lower in municipalities in the treatment group in year 2010.

Meanwhile, we observe that municipalities in the treatment group have significantly higher access to primary level schools. In contrast, municipalities in the control group have significantly higher access to secondary and tertiary level schools. Moreover, tax revenue per capita appears to be higher in municipalities in the control group as compared with municipalities in the treatment group. We note these differences in access to primary, secondary and tertiary level schools as well as tax revenue per capita between the treatment and control group are consistently observed for both years 2000 and 2010[27].

In the following discussions, we will analyze the impact of the Ro-Ro policy on children's school attendance and employment. Likewise, we will utilize the mentioned characteristics in unveiling the factors that could have affected the changes in children's school attendance and employment.

[27] We note that comparisons were based on a series of T-tests performed.

4.4. Results

The DD strategy allows us to evaluate the impact of the Ro-Ro policy on children's education by using the school attendance of children of same sex and age, in municipalities near the non-Ro-Ro ports as a natural basis for comparison. An important requirement of our estimation strategy is the parallel-trend assumption, which states that in the absence of the policy change, the outcome of the treatment and control group should follow the same trend.

Although the parallel trend assumption is difficult to verify, previous studies utilized pre-treatment data to show movements in outcome (Ashenfelter and Card, 1985; Autor, 2003) However, we are unable to employ this strategy since we are constrained by the lack of data for pre-treatment years. Alternatively, we provide plots of the distribution of children's school attendance and employment rates, before and after policy implementation to observe possible movements in our data. We expect that when school attendance increases, employment for the same age level will also decrease since these two activities could not be performed at the same time (i.e. children are either in school or working).

Figures 4.1 and 4.2 show similarities between the distribution of school attendance rates of males and females aged 5 to 21, for the treatment and control group. In 2000, the distributions of school attendance for both treatment and control group appear to be on the same level, which we consistently observe for males and females. However, in 2010, we notice that the level of school attendance seems to be higher for the treatment group. The general trend for both groups meanwhile, appears to be increasing. In addition, the distributions of employment rates of males and females aged 15 to 21 are shown in Figure 4.3. We observe that the distributions appear to moving in the same direction. Specifically, we notice that the distribution of employment rates seem to be lower in 2010 than in 2000. We consistently observe this for both males and females.

Additionally, we perform further inspections to ensure that individual-level and municipality-level characteristics remain unchanged even with the implementation of the Ro-Ro policy. We utilize the following characteristics: (1) *age* for the individual-level characteristic and (2) *proportion of males and females* for the municipality-level characteristics. Consistent with our expectations, we show that children's age and the proportion of males and females in municipalities were unaffected by the implementation of the Ro-Ro policy (Tables 4.2 and 4.3, respectively).

4.4.1. School Attendance

In the previous section, we showed that the distribution of school attendance rates for the treatment and control group is moving in the same increasing direction. We find this to be consistent with the national data from the Department of Education (DepEd), which reveals rising enrollment in primary and secondary level between school year 2000-2001 and school year 2010-2011[28]; where majority of enrollments are for public schools[29].

In this section, we analyze the impact of the Ro-Ro policy on children's education by using our DD estimates shown in Table 4.4. Based on our results, we confirm an increase in school attendance in municipalities near the Ro-Ro ports. We observe this effect in both males and females, particularly in ages 6 to 20 for males, and ages 5 to 7, 10 and 13 to 21 for females. Meanwhile, a closer evaluation of the changes in school attendance rates of males reveals that the effect of the Ro-Ro policy is relatively high in ages 6 and 7 (about 4 percent), 15 and 16 (about 3 percent) and 19 (about 3 percent). We show this by plotting the beta coefficients from our DD estimation in Figure 4.4. Moreover, we calculate the equivalent

[28] Figures are shown in Appendix 4.1.
[29] Only about 7-8 percent in the primary level and 19- 23 percent in the secondary level accounts for enrollment in private schools.

number of increase in male students using our beta estimates and male population in school[30] per age level (Table 4.5). Based on our calculations, there were an additional 3,923 male students in the pre-primary level, 35,395 in the primary level, 23,163 in the secondary level and 20,736 in the tertiary level. Overall, this is equivalent to a total of 83,217 additional male students in municipalities near the Ro-Ro ports.

Correspondingly, we analyze the impact of the Ro-Ro policy on the school attendance of females. Table 4.4 shows that there was a significant increase in school attendance of females in the pre-primary level (about 2 percent). Likewise, Figure 4.4 exhibits a relatively high effect in ages 6 (about 6 percent), 15 and 16 (about 2 to 3 percent) and 17 (about 3 percent). Meanwhile, the total increase in female students in municipalities near the Ro-Ro ports is equivalent to 74,637 (Table 4.5). This translates to an additional 4,548 females in the pre-primary level, 27,436 in the primary level, 19,913 in the secondary level and 22, 741 in the tertiary level. We observe that this increase in female students in the primary and secondary level is lower compared to the increase in male students in the same levels. However, we highlight that the increase in female students in the pre-primary as well as tertiary level, remains higher than the increase male students.

In summary, our results show an increase in school attendance in both males and females in municipalities near the Ro-Ro ports. We take this as an effect of the implementation of the Ro-Ro policy. An important finding in this section is that we observe a significant increase in school attendance of females in the pre-primary level, which we did not observe in males. We note that in the duration of our study period, pre-primary level was non-compulsory in the Philippines, and yet we notice that more females are enrolled in this level. Hence, we attribute our finding to the perceived higher returns to schooling for females

[30] Based on figures from the Census of Population and Housing (CPH) survey.

in the Philippines (Sakellariou, 2004; Quisumbing et. al., 2004). Since schooling is known to increase the labor participation rate in females, households tend to enroll female children earlier in school.

On the other hand, we also notice that the increase in school attendance of males in the primary and secondary level is higher compared to the increase in school attendance of females. We view this positively since in terms of gender, schools in the Philippines are highly dominated by females especially in secondary and tertiary level. A previous study (Orbeta, 2003) explains that this observation can be attributed to the lack of employment opportunities for females, compared to males, among school-age population. Hence, the higher school attendance of males in the primary and secondary level should be taken positively since it is suggestive that the Ro-Ro policy was able to influence school-age males to attend school instead of engaging in employment opportunities available to them.

4.4.2. Employment

In conjunction with our analysis on children's school attendance, we likewise evaluate the changes in employment of 15 to 21 years old. Practically, our goal is to check whether our findings on employment will be consistent with our findings on school attendance. Firstly, we mention that we recognize a compromising relationship between school attendance and employment such that individuals attending school would have lesser chance of working due to time constraint.

Our DD estimates in Table 4.6 reveal a decrease in employment in municipalities near the Ro-Ro ports. We notice that these changes are more noticeable in males than in females, as significant decreases are observed in males from age 15 to 21 while in females, the effect is only observed from ages 17 to 21. We attribute this to the fact that more males are working as compared with females. Meanwhile, Figure 4.5 exhibits the plot of coefficients from the DD estimation, wherein we notice that the effect in males is about 3 to 4 percent throughout ages 15 to 21. In females on the other hand, the highest effect is only observe in ages 19 and 21 (about 3 percent). We note that these are also the age levels where we noticed significant increases in school attendance. Overall, we find that these results complement our previous results on school attendance. Particularly, we notice that the increase in school attendance is accompanied by a decrease in employment in municipalities near the Ro-Ro ports.

4.4.3. Possible Mechanisms

Since we have established the effect of the Ro-Ro policy on education through increased school attendance in municipalities near the Ro-Ro ports, our next step is to uncover some underlying mechanisms to explain our results. In the following section, we offer several hypotheses to explain the increase in school attendance and attempt to verify each, using empirical evidence and literature review.

4.4.3.1. Improved School Access[31]

Using data from the Annual Poverty Indicator Survey (APIS) 2007 and 2008, David et. al (2012) points out that the primary reason for not attending school in rural areas in the Philippines is difficulty in school access, relating to schools being too far, no schools within the village, or no regular transportation to school. Since some of the Ro-Ro ports are located in less developed areas, we hypothesize that the increase in school attendance in

[31] We define "access" here as physical access to schools.

municipalities near the Ro-Ro ports could possibly be explained by some improvements in school access.

We attempt to verify this hypothesis using data from the Census of Population and Housing (CPH) Form 5 to compute for variables that will serve as proxy for school access. In each municipality, we compute for: (1) proportion of barangays with primary level school, (2) proportion of barangays with secondary level school and (3) proportion of barangays with tertiary level school and use each of these variables as the outcome in our DD model. Our results are shown in Table 4.7. Basically, we observe a general improvement in access to primary, secondary and tertiary level schools in 2010, as indicated by a highly significant *"year"* variable. However, we notice that these improvements were not significantly felt in municipalities near the Ro-Ro ports especially for primary and tertiary level schools. Meanwhile, we point out that while we observe a significant change in access to secondary level schools in municipalities near the Ro-Ro ports (as indicated by the significant DD estimator), the increase in proportion of barangays with secondary level school is significantly lower by about 1 percent compared to the increase in proportion of barangays with secondary level school in municipalities near the non-Ro-Ro ports. Hence, we find no reason to associate the increase in school attendance in municipalities near the Ro-Ro ports to improvements in school access.

4.4.3.2. Education Policies

Aside from improved school access, there are also education policies that are specifically aimed to improve school enrollment among school-age population. Our next step is to review education policies[32] that were implemented within our study period that could have encouraged the increase school attendance. We highlight the following:

- "Early Registration Day" Program –the conduct of annual early registration period that usually starts at the last week of January, to ensure that all children of ages 5 and 6 would be enrolled in pre-primary and primary education by the month of June, in the coming school year.
- "Government Assistance to Students and Teachers in Private Education Act" – implemented in 2008 through Republic Act No. 6728, which expands students' access to education by providing financial assistance to deserving elementary graduates who prefers to continue studying in private schools.
- "No Collection Policy" –issued in 2009 through Department Order No. 48, which forbids the collection of certain school fees and recommends a schedule for necessary fees to allow parents to financially prepare for them.
- Mother Tongue-Based Multilingual Education (MTB MLE) –institutionalized in 2009 through Department Order No. 74, which allows the use of a child's native language as the medium of instruction in all other subject areas except for Filipino and English subjects, which is believed to boost children's confidence and potential to learn.

Although the abovementioned policies could have affected school attendance, we emphasize the fact that these were implemented on a national scale, which means that it affected all schools, in both our treatment (municipalities near the Ro-Ro ports) and control group (municipalities near the non-Ro-Ro ports). Thus, any effect of these policies should have brought similar changes to our group of households.

[32] Based on "Education for All 2015 National Review Report: Philippines", a document prepared for the United Nations Educational, Scientific and Cultural Organization (UNESCO) for World Education Forum 2015. Retrieved from http://unesdoc.unesco.org/images/0023/002303/230331e.pdf

4.4.3.3. Increased Household Income

Provided that we have dismissed the validity of our previous hypotheses, we move on to consider the increase in household income in explaining the increase in school attendance in municipalities near the Ro-Ro ports. Income remains to be a primary consideration for school attendance in the Philippines (Orbeta, 2003). We expect that when income rises, the household's ability to send their children to school also increases. We find two papers (Albert et al., 2012 and Maligalig et al., 2010) that specifically observe this behavior in the Philippines. To further support our argument, we present several studies (Chernichovsky, 1985; Jamison and Lockheed, 1987; Galenson, 1995; Wydick, 1999) that show positive association between income and school attendance. We likewise mention some additional studies that recognize young members of the family participating in the labor, foregoing education, once household income falls below a certain threshold (King and Lillard, 1987; Binder and Scrogin, 1999). Consistently, the 2008 Functional Literacy, Education and Mass Media Survey (FLEMMS) also reports a total of 12.3 million (about 32 percent of the total population for this age) Filipinos of age 6 to 24 that were not in school, citing the high cost of education (24%) and employment/looking for work (22%), as two of the most common reasons for not attending school.

In this step, we analyze the changes in household income by using the log of tax revenue per capita as a proxy variable, and similarly employ the DD strategy. We utilize the municipality-level tax revenue from the Statement of Income and Expenditure since the CPH survey does not have information on income. We compute for per capita values using the total employed population in each municipality and insulate our data from price fluctuations using deflated values. Based on our estimates (Table 4.8), the log of tax revenue per capita in municipalities near the Ro-Ro ports significantly increased by about 7 percent. This result confirms our hypothesis on increased household income. Earlier, we argued that the household's ability to send their children to school rises with household income. Based on our findings, we highlight that both household income and school attendance were positively affected by the Ro-Ro policy. We also verify a strong correlation between the log of tax revenue per capita and school attendance in Table 4.9. A gleaming indication of this relationship is that we notice in our previous result the Ro-Ro policy was able to influence the increase in school attendance in the pre-primary level which was non-compulsory during our study period[33]. Our previous finding thus, suggests some improvement in household's financial capability in sending children to school.

4.4.4. Other Factors and Confounders

In addition to our previous hypotheses, we also include some other factors that can influence school attendance and may confound our estimates. In this section, we review the effects of the Pantawid Pamilyang Pilipino Program (4Ps) as well as domestic and foreign migration on changes in school attendance.

4.4.4.1. Pantawid Pamilyang Pilipino Program (4Ps)

A government policy that can influence school attendance and confound our estimates is the Pantawid Pamilyang Pilipino Program (4Ps). 4Ps is the conditional cash transfer program in the Philippines that aims to provide healthcare and education subsidies to the poorest households. This program was implemented in 2008 and entitles qualified households to a 500-PhP (10.77 USD[34]) subsidy per month for healthcare and nutrition, and a 300-PhP (6.46

[33] Pre-primary level education became compulsory in the Philippines in 2012.
[34] At 1 USD = 46.4 PhP exchange rate

USD) per child[35] per month subsidy for education, provided that several program conditions are met. One particular condition that we expect to drive school attendance up is the condition that requires 6 to 14 year-old members of the family to be enrolled in primary or secondary level and to attend at least 85 percent of the total school days in a year. Since the implementation of the 4Ps program occurred within our study period, and there exist a possibility that the municipalities near the Ro-Ro ports and the municipalities under this program are the same, we consider the likelihood that our estimates may have captured the effect of the 4Ps program along with the effect of the Ro-Ro policy. If this is the case, then our beta estimates on school attendance may have been overestimated for ages 6 to 14, however, estimates for ages 15 to 21 will remain clean.

We equate our findings with the study of Chaudhury et. al (2013) who carried out an impact evaluation of the government's 4Ps program by combining Randomized Control Trials (RCT) –to compare the effect of the program in randomly assigned program areas and non-program areas and Regression Discontinuity (RD) approach –to compare the effect on the outcomes of 4Ps-recipient poor households versus non-4Ps recipient poor households just above the poverty line. This study commenced in 2008, while the impact evaluation survey was done in 2011. The effectiveness of the 4Ps program was analyzed through three main outcomes namely: (1) monthly per capita household consumption, (2) school participation of 6-14 year olds, and (3) health facility visits of 0-5 year olds. The analysis on school participation, which is most relevant to our paper, finds a 4.5 percent increase in school attendance among children of age 6 to 11 in 4Ps-recipient poor households, compared to children of the same ages in non-4Ps recipient poor households. Meanwhile, the study finds no significant impact on school attendance among children of age 12 to 17, citing the fact that

[35] With a maximum of three (3) children.

the program was not designed to improve the school participation of children above 14 years old, as suggested by the age limit for education grants.

We perform a back-of-the-envelope calculation to estimate this 4.5 percent increase in school attendance of children aged 6 to 11from 4Ps-recipient poor households and compare it with our results. Based on the 2011 Annual Poverty Indicators Survey (APIS), 15 percent of the total population of children aged 6 to 11 are recipients of the 4Ps program. Assuming a 4.5 percent increase in the school attendance of this 15 percent will result to .68 percent total population increase in school attendance due to the 4Ps program. This indicates that .68 percent of our estimated increase in school attendance in males and females is actually the effect of the 4Ps program and not the Ro-Ro policy[36]. However, this effect is still small relative to our mean estimates that are equal to 2.2 and 1.9 percent increase in school attendance of males and females, respectively, for ages 6 to 11 (Table 4.4). We therefore treat this .68 percent as the possible bias in our estimates for ages 6 to 11, while maintaining that our estimates for ages 15 to 21 are clean.

4.4.4.2. Domestic Migration

In the CPH survey, domestic migration is recorded when a person's city/municipality of residence in the current year is different from his residence 5 years ago. This movement is usually driven by the lack of employment or education opportunities in rural areas. Domestic migration is expected to impact school attendance in two ways: (1) it may cause an increase in school attendance in areas that attract domestic migrants and at the same time, (2) cause a decrease in school attendance in the areas they left behind. To ensure that our estimates are insulated from these effects, we account for in-and-out-of municipality migration in our

[36] This is based on the assumption that the effect of the 4Ps program for both males and females is equal.

model (Table 4.10). We show that are estimates in (b) that controls for domestic migration is actually consistent with our estimates in our base model (a). We likewise verify that the implementation of the Ro-Ro policy did not have significant impact on domestic migration (Table 4.11).

4.4.4.3. Foreign Migration

The Philippines has been a major exporter of labor to all parts of the world since the 1970s. Factors that encourage foreign migration include non-inclusive economic development, low wages and high unemployment rates. In 2010, there were about 9.4 million[37] Filipinos working overseas; this is about 10 percent of the total population of the country. We consider foreign migration in this study because Overseas Filipino Workers (OFW) are known to send remittances to their families in the Philippines[38]. Remittances in a way, increases household income and alters household expenditures (Orbeta, 2008). Several studies also (Tullao et al., 2007; Tabuga, 2007; Yang, 2008; Ang et al. 2009) show that remittance-receiving households tend to invest more in education as compared with non-remittance-receiving households. We control for foreign migration in our model by accounting for the proportion of OFWs in each municipality. Our results in Table 4.10 however, show that even after controlling for the population of OFWs, our estimates for school attendance are robust and quite similar with our estimates in our base model. Further, we show that foreign migration was likewise not affected by the Ro-Ro policy (Table 4.11).

[37] Based on Stock Estimates of Overseas Filipinos as of December 2010, sourced from Commission on Filipinos Overseas.
[38] For instance, the total recorded remittances in 2010 amounted to 18.7 billion US dollars (Bangko Sentral ng Pilipinas).

4.5. Conclusion

The main goal of implementing the Ro-Ro policy is to improve inter-island economic linkages and drive down transportation costs. However, in this study we provide empirical evidence that the Ro-Ro policy also affected children's education, as shown by the increased school attendance of males and females in municipalities near the Ro-Ro ports. Using our estimates, we presented that this increase in school attendance is observed in the pre-primary, primary, secondary and tertiary level of education. The highest increase in school attendance of males in the primary level was observed in ages 6 and 7 (about 4 percent), while in the secondary and tertiary level, the highest increase was observed in ages 15 and 16 (about 3 percent) and age 19 (about 3 percent), respectively. Overall, we computed a total of 83,217 additional male students. Meanwhile, in females, we noticed a significant increase in school attendance in the pre-primary level (about 2 percent), which we do not observe in males. The highest increase in school attendance was also observed in age 6 (about 6 percent) in the primary level, age 15 and 16 (about 2 to 3 percent) in the secondary level and age 17 (about 3 percent) in the tertiary level. The total increase in female students equate to 74,637.

Additionally, we performed an analysis on employment of ages 15 to 21 to check the consistency of our findings on school attendance. We noticed that employment decreased as school attendance increased, in municipalities near the Ro-Ro ports. We provided several hypotheses to explain the increase in school attendance and found the increase in household income as the most valid hypothesis. We highlight that both household income and school attendance were positively affected by the Ro-Ro policy and there exist a high correlation between these two variables. We also noticed an increase in school attendance of females in the pre-primary level despite it being non-compulsory, which further supported our hypothesis.

Meanwhile, we performed a back-of-the-envelope calculation to show that the estimates we have come up were not confounded by the effect of the 4Ps (conditional cash transfer) program. Based on our calculation, only .68 percent increase in school attendance of the total population of children ages 6 to 11 can be attributed to the 4Ps program, for which we considered small compared with our estimates of 2.2 and 1.9 percent increase in school attendance of males and females, respectively. We concluded that regardless of the effect of the education grants from the 4Ps program, we still found increases in school attendance, as an effect of the implementation of the Ro-Ro policy. Our findings likewise appeared consistent after controlling for the effects of domestic and foreign migration. Ultimately, we confirm the positive impact of the Ro-Ro policy on children's education.

Figures

Figure 4.1: Distribution of School Attendance Rates, Males 5 to 21 years old

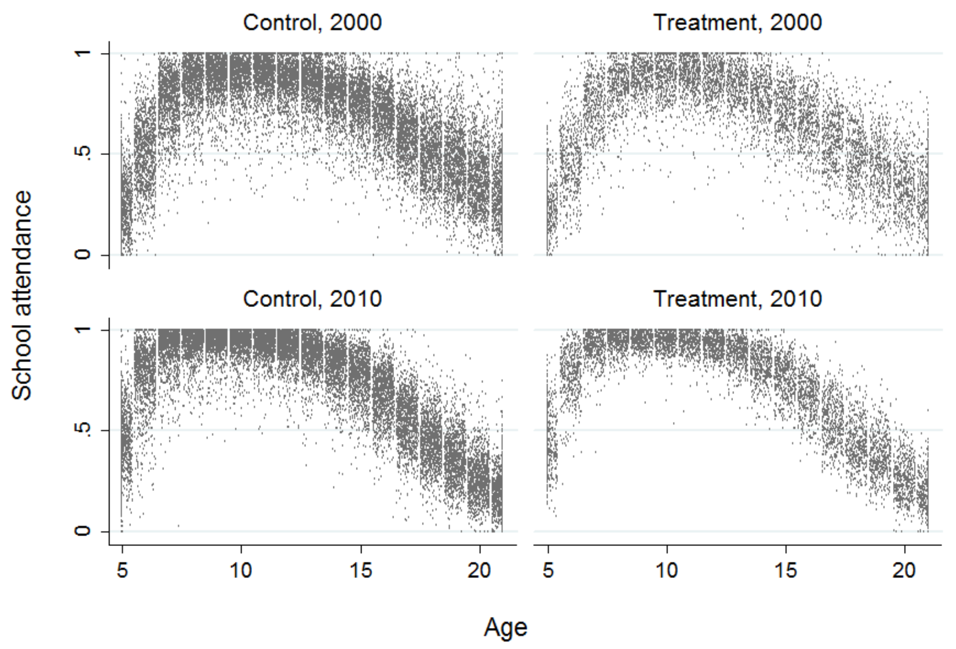


Figure 4.2: Distribution of School Attendance Rates, Females 5 to 21 years old

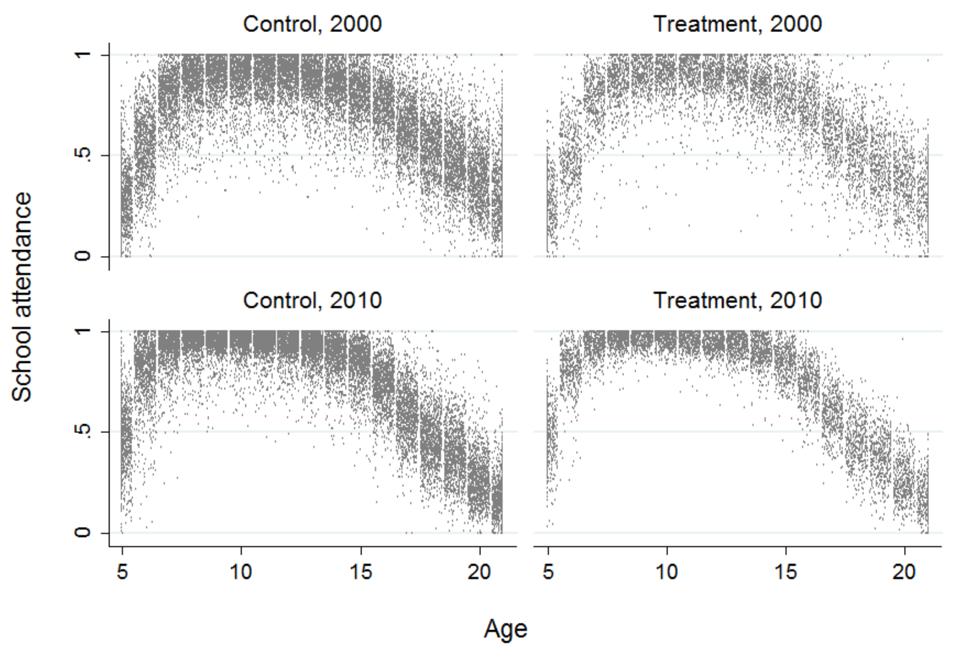


Figure 4.3: Distribution of Employment Rates, 15 to 21 years old

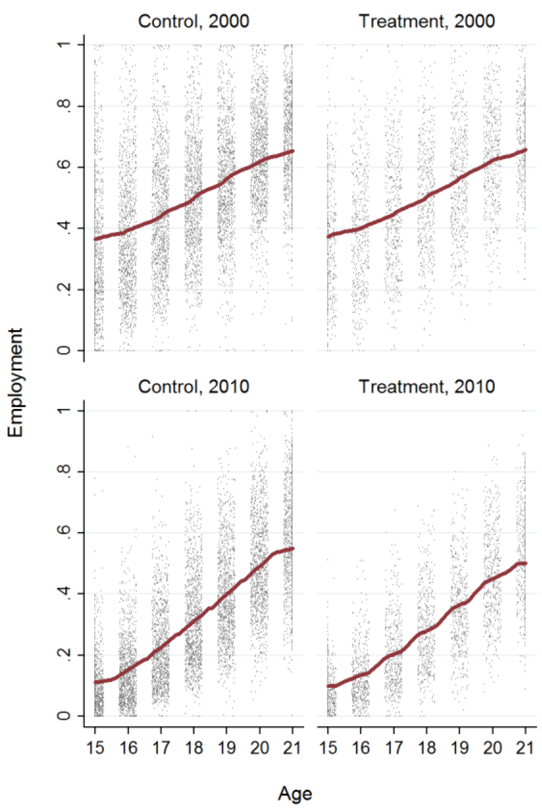


Figure 4.4: Plots of Beta Estimates for School Attendance

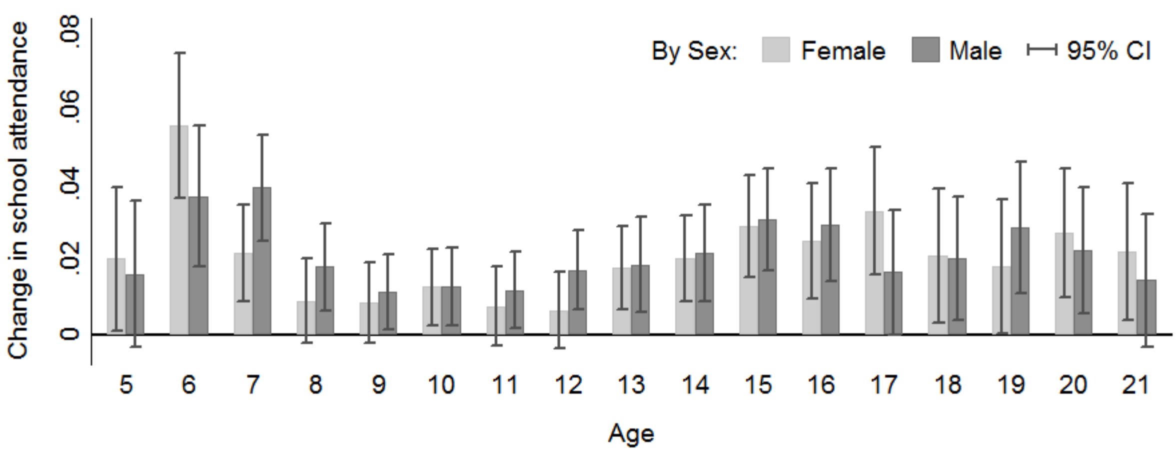
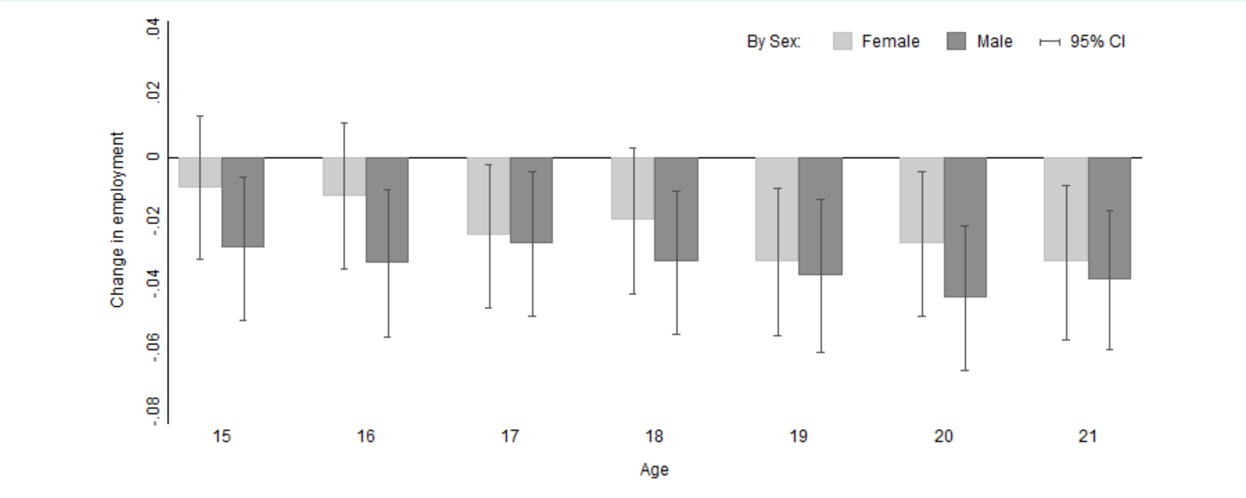


Figure 4.5: Plots of Beta Estimates for Employment



Tables

Table 4.1: Characteristics of Treatment and Control Samples

Characteristics		Year 2000 (pre-treatment)		Year 2010 (post-treatment)	
		Treatment Group	Control Group	Treatment Group	Control Group
School attendance rate	Mean	0.65585	0.67305	0.70750	0.70347
	Std. error	(0.2520)	(0.2450)	(0.2734)	(0.2732)
	N	15470	36829	15470	36829
Employment rate for school-age individuals	Mean	0.37048	0.36985	0.21084	0.23780
	Std. error	(0.2245)	(0.2433)	(0.1813)	(0.2001)
	N	10920	25996	6370	15165
Proportion of barangays with primary level school	Mean	0.78449	0.76431	0.81228	0.79540
	Std. error	(0.1719)	(0.2068)	(0.1644)	(0.2074)
	N	15470	36829	15470	36829
Proportion of barangays with secondary level school	Mean	0.17951	0.19806	0.22243	0.25594
	Std. error	(0.1017)	(0.1352)	(0.1255)	(0.1604)
	N	15470	36829	15470	36829
Proportion of barangays with tertiary level school	Mean	0.03014	0.03838	0.03959	0.05024
	Std. error	(0.0448)	(0.0647)	(0.0568)	(0.0778)
	N	15470	36829	15470	36829
Municipality tax revenue per capita	Mean	29,174	75,010	44,354	91,130
	Std. error	(48614)	(971364)	(71044)	(666872)
	N	15470	36829	15470	36829

Table 4.2: Individual-level Characteristic

	Age
Treatment	0.0001086
	(0.0003541)
Year	-3.14e-15
	(9.71e-12)
DD estimator	5.69e-15
	(9.71e-12)
N:	
observations	104,598
groups	1,539
R-squared:	
within	0.0000
between	0.0001
overall	0.0000

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.

Table 4.3: Municipality-level Characteristics

	Proportion of Males	Proportion of Females
Treatment	0.0015548 ***	-0.0015548 ***
	(0.0004805)	(0.0004805)
Year	0.0022289 ***	-0.0022289 ***
	(0.0002054)	(0.0002054)
DD estimator	0.0004402	-0.0004402
	(0.0003126)	(0.0003126)
The model controls for:		
Municipality population	Yes	Yes
N:		
observations	3,076	3,076
groups	1,539	1,539
R-squared:		
within	0.1158	0.1158
between	0.0656	0.0656
overall	0.0705	0.0705

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.

Table 4.4: Difference-in-Differences Estimates 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.

Table 4.5: Equivalent Increase 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

Table 4.6: Difference-in-Differences Estimates for Employment

	Male	Female
Secondary level		
Age 15	-0.02848 **	-0.00942
	(0.01149)	(0.01143)
Age 16	-0.03332 ***	-0.01208
	(0.01176)	(0.01169)
Tertiary level		
Age 17	-0.02712 **	-0.02462 **
	(0.01157)	(0.01150)
Age 18	-0.03302 ***	-0.01990 *
	(0.01149)	(0.01180)
Age 19	-0.03714 ***	-0.03265 ***
	(0.01224)	(0.01185)
Age 20	-0.04414 ***	-0.02717 **
	(0.01166)	(0.01151)
Age 21	-0.03845 ***	-0.03289 ***
	(0.01119)	(0.01238)
N:		
observations	43,070	
groups	1,539	
R-squared:		
within	0.6146	
between	0.0062	
overall	0.5134	

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.

Table 4.7: Estimates for School Access

	Prop. of barangays with primary level schools	Prop. of barangays with secondary level schools	Prop. of barangays with tertiary level schools
Treatment	0.0199913 *	-0.0186045 ***	-0.0082535 ***
	(0.0102221)	0.0062991	0.0028781
Year	0.0308493 ***	0.0578841 ***	0.0118613 ***
	(0.0039240)	0.0030997	0.0017099
DD estimator	-0.0030527	-0.0149591 ***	-0.0024040
	(0.0063194)	0.0051019	0.0026032
N:			
observations	3,076	3,076	3,076
groups	1,538	1,538	1,538
R-squared:			
within	0.0565	0.2337	0.0437
between	0.0020	0.0083	0.0050
overall	0.0076	0.0429	0.0113

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.

Table 4.8: Estimates for log of Tax Revenue Per Capita

Treatment	-0.1992341 ***
	(0.0603927)
Year	0.2880480 ***
	(0.0199620)
DD 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.

Table 4.9: Estimates for School Attendance and log of Tax Revenue Per Capita

log of tax revenue per capita	0.0177588 ***
	(0.0017692)
The model controls for:	
Year	Yes
Sex	Yes
Age	Yes
Number of observations	91,788
R-squared	0.8100
Root MSE	0.1106

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.

Table 4.10: Comparison of Difference-in-Differences Estimates for School Attendance

	(a) Base Model		(b) Controlling for domestic migration		(c) Controlling for foreign migration	
	Male	Female	Male	Female	Male	Female
Pre-primary level						
Age 5	0.01610	0.02016 **	0.01608	0.02013 **	0.01590	0.01997 **
	(0.00991)	(0.00977)	(0.00991)	(0.00976)	(0.00991)	(0.00974)
Primary level						
Age 6	0.03682 ***	0.05557 ***	0.03679 ***	0.05554 ***	0.03662 ***	0.05537 ***
	(0.00957)	(0.00988)	(0.00956)	(0.00988)	(0.00955)	(0.00986)
Age 7	0.03910 ***	0.02170 ***	0.03909 ***	0.02167 ***	0.03891 ***	0.02150 ***
	(0.00715)	(0.00650)	(0.00715)	(0.00650)	(0.00719)	(0.00654)
Age 8	0.01809 ***	0.00910	0.01806 ***	0.00907	0.01789 ***	0.00891
	(0.00591)	(0.00571)	(0.00591)	(0.00571)	(0.00597)	(0.00573)
Age 9	0.01147 **	0.00866	0.01146 **	0.00863	0.01128 **	0.00846
	(0.00503)	(0.00544)	(0.00502)	(0.00544)	(0.00507)	(0.00550)
Age 10	0.01285 **	0.01271 **	0.01283 **	0.01268 **	0.01265 **	0.01251 **
	(0.00529)	(0.00521)	(0.00529)	(0.00520)	(0.00533)	(0.00525)
Age 11	0.01192 **	0.00757	0.01189 **	0.00755	0.01172 **	0.00738
	(0.00519)	(0.00535)	(0.00519)	(0.00535)	(0.00523)	(0.00537)
Age 12	0.01727 ***	0.00654	0.01724 ***	0.00651	0.01707 ***	0.00634
	(0.00543)	(0.00518)	(0.00543)	(0.00518)	(0.00544)	(0.00522)
Secondary level						
Age 13	0.01865 ***	0.01790 ***	0.01862 ***	0.01787 ***	0.01846 ***	0.01771 ***
	(0.00644)	(0.00558)	(0.00644)	(0.00558)	(0.00644)	(0.00561)
Age 14	0.02185 ***	0.02040 ***	0.02183 ***	0.02037 ***	0.02166 ***	0.02020 ***
	(0.00655)	(0.00582)	(0.00655)	(0.00582)	(0.00654)	(0.00580)
Age 15	0.03063 ***	0.02886 ***	0.03060 ***	0.02884 ***	0.03043 ***	0.02867 ***
	(0.00687)	(0.00693)	(0.00686)	(0.00693)	(0.00685)	(0.00694)
Age 16	0.02929 ***	0.02497 ***	0.02927 ***	0.02494 ***	0.02910 ***	0.02477 ***
	(0.00765)	(0.00785)	(0.00765)	(0.00785)	(0.00761)	(0.00784)
Tertiary level						
Age 17	0.01663 **	0.03286 ***	0.01662 **	0.03283 ***	0.01644 **	0.03266 ***
	(0.00839)	(0.00863)	(0.00839)	(0.00863)	(0.00836)	(0.00863)
Age 18	0.02036 **	0.02104 **	0.02034 **	0.02101 **	0.02016 **	0.02085 **
	(0.00839)	(0.00905)	(0.00839)	(0.00905)	(0.00835)	(0.00899)
Age 19	0.02854 ***	0.01820 **	0.02853 ***	0.01817 **	0.02835 ***	0.01800 **
	(0.00891)	(0.00901)	(0.00891)	(0.00901)	(0.00886)	(0.00896)
Age 20	0.02233 ***	0.02712 ***	0.02232 ***	0.02709 ***	0.02214 ***	0.02692 ***
	(0.00854)	(0.00872)	(0.00854)	(0.00872)	(0.00850)	(0.00870)
Age 21	0.01452	0.02207 **	0.01451	0.02205 **	0.01433	0.02187 **
	(0.00903)	(0.00925)	(0.00903)	(0.00924)	(0.00898)	(0.00922)
N:						
observations	104,598		104,598		104,598	
groups	1,539		1,539		1,539	
R-squared:						
within	0.8491		0.8491		0.8495	
between	0.0016		0.0021		0.0803	
overall	0.7965		0.7963		0.8048	

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.

Table 4.11: Estimates for Migration

	Domestic migration	**Foreign migration**
Treatment	-0.0012408	-0.0085117 ***
	(0.0015848)	(0.0010371)
Year	-0.0104027 ***	0.0007827
	(0.0009602)	(0.0004644)
DD estimator	-0.0004703	0.0001759
	(0.0011651)	(0.0007532)
N:		
observations	511,226	511,226
groups	1,539	1,539
R-squared:		
within	0.1178	0.0030
between	0.0005	0.0382
overall	0.0303	0.0351

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.

Appendix

Appendix 4.1: School Enrollment (by Education Level and School Type)

School Year	Primary level			Secondary level		
	Total	Public	Private	Total	Public	Private
2000-01	12,760,243	11,837,582	922,661	5,401,867	4,156,185	1,245,682
2001-02	12,878,600	11,945,161	933,439	5,801,008	4,519,815	1,281,193
2002-03	12,980,743	12,056,162	924,581	6,044,192	4,824,789	1,219,403
2003-04	12,986,360	12,065,686	920,674	6,272,099	5,027,847	1,244,252
2004-05	13,015,487	12,089,365	926,122	6,414,620	5,100,061	1,314,559
2005-06	13,006,647	11,990,686	1,015,961	6,298,612	5,013,577	1,285,035
2006-07	13,145,210	12,096,656	1,048,554	6,363,002	5,072,210	1,290,792
2007-08	13,411,286	12,318,505	1,092,781	6,506,176	5,173,330	1,332,846
2008-09	13,686,643	12,574,506	1,112,137	6,763,858	5,421,562	1,342,296
2009-10	13,914,549	12,780,327	1,134,222	6,755,954	5,415,498	1,340,456
2010-11*	14,015,598	13,002,994	1,012,604	6,813,651	5,527,399	1,286,252

Sources: Department of Education; Philippine Statistics Authority

Note: * data based on 78% submissionl rate of school profiles

Chapter 5

Conclusions and Policy Implications

An efficient transportation system plays a crucial role in the economic development of an archipelagic country like the Philippines. Given the unbalanced growth between urban and rural areas of the country, the findings of this dissertation have shown how the operation of the Ro-Ro ports stimulated local economies by positively affecting agricultural household income and children's education.

In Chapter 3, we focused on the impact of the Ro-Ro policy on agricultural households given that this group makes up the poorest segment of Philippine population. Characterizing the agricultural households, we found that they are composed of less educated and younger household head, larger family size and younger family members. We noted that since heads of agricultural households are less educated, work opportunities might be limited for them. Hence, we expected that changes in the local economy caused by the Ro-Ro port operation could have easily influenced their work options. Consistently, we found that agricultural households located on the same island as the Ro-Ro port have higher income from non-agricultural sources if they are closer to the Ro-Ro port. This finding indicated that the Ro-Ro port operation stimulated non-agriculture related activities near the port, providing new sources of income for agricultural households. On the other hand, we observed that agricultural households on nearby islands have higher income from agricultural sources if they are closer to the Ro-Ro port. We interpreted this as a possible result of the changes in supply of agricultural products, provided that agricultural households on the same island as the Ro-Ro port shifted to non-agricultural activities, and the possible improvement in access to cheaper inputs due to the Ro-Ro port operation.

Given the findings from Chapter 3, we conclude that the Ro-Ro policy is largely beneficial to agricultural households, as it stimulated both incomes from agricultural and non-agricultural sources. Likewise, our results emphasized that the effect of Ro-Ro operation is largely dependent on the agricultural household's geographic distance from the Ro-Ro port. This study practically demonstrated the importance of an affordable and accessible transportation infrastructure to agricultural households. Moreover, it showed that transportation infrastructure such as the Ro-Ro port, improves the access of agricultural households to income-generating opportunities, allowing them to specialize based on their comparative advantage.

In Chapter 4, we showed that the benefits of the Ro-Ro port operation are not limited to agricultural households. In this study, we generally confirmed the positive impact of the Ro-Ro policy on children's education in municipalities near the Ro-Ro ports. Given our results, we showed the increase in school attendance of both males and females in the pre-primary, primary, secondary and tertiary level of education. We likewise found a decrease in employment of aged 15 to 21, complementary to increase in school attendance. Meanwhile, we characterized the municipalities near the Ro-Ro ports as having higher access to primary level schools, lower access to secondary level and tertiary level schools as well as lower tax revenue per capita, as compared with municipalities near the non-Ro-Ro ports. Our further analyses showed that there was an increase in tax revenue per capita in municipalities near the non-Ro-Ro port, which we used as proxy for household income, and interpreted as the possible driver for the increase in children's school attendance. We found that both children's school attendance and household income were positively affected by the Ro-Ro port operation. We also proved high degree of correlation between the two.

Given the findings from Chapter 4, we conclude that transportation infrastructure such as the Ro-Ro port, could lead to unintended effects such as what we have observed in children's education. What can be inferred from this study is that the operation of the Ro-Ro port stimulated the income of households in municipalities near the Ro-Ro port, increasing their capacity to send their children to school. In relevance to policy-making, this study showed that direct intervention is not the only approach to encourage school attendance in targeted areas. Essentially, we demonstrated that expanding the access of households to welfare-improving opportunities by means of a better transportation system for instance, could be an alternative strategy to increase household's capability to send children to school.

In a much broader perspective, the Philippines' experience on the Ro-Ro policy exhibited that improving a country's transportation system does not necessarily require building new infrastructure. As an alternative, the government could instead introduce some modifications in the use of pre-existing infrastructure and encourage private sector participation to support the necessary improvements. This strategy is especially relevant for developing economies with constrained resources. Meanwhile, archipelagic countries such as Indonesia, Fiji, Papua New Guinea and the Bahamas that have already adapted the concept of Ro-Ro shipping, could utilize this dissertation as a useful reference in assessing the impact of the Ro-Ro system in their economies. Furthermore, the whole of this dissertation have shown how the Philippines benefited from the Ro-Ro system, which we hope to encourage more ASEAN members to consider the proposed ASEAN nautical transportation network[39]. This proposal aims to improve international trade, investment as well as tourism among ASEAN countries. Currently, the Ro-Ro operation between General Santos City, Philippines and

[39] This concept was proposed in 2009 by Former Philippine President Arroyo during the ASEAN Leaders Summit in February 2009 and at the 6th Summit of the Brunei-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA). See https://asiafoundation.org/resources/pdfs/4PagerRoRoPHLetter.pdf accessed on 28 May 2016.

Bitung, Indonesia is being pilot-tested by the Japan International Cooperation Agency (JICA). Likewise, The REID Foundation is studying the viability of Ro-Ro connectivity between Davao City, Philippine and Manado, Indonesia[40].

As a final note, we mention that this dissertation may not have fully uncovered the impact of the Ro-Ro policy on Philippine economy, as analyses in the two main studies are limited to agricultural households and children's education. For future research, we recommend looking into other sectors to unveil other positive as well as negative impact of the Ro-Ro policy.

[40] See http://www.minda.gov.ph/index.php/bimp-eaga/development-pillars/126-connectivity-pillar-update-2015, accessed on 29 May 2016.

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