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Contents

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Spatial Integration Analysis of the Regional Urea Fertilizer Markets in the Philippines

Ivory Myka R. Galang[1]

ABSTRACT

Fertilizer, an important production input, accounts for a significant share of the total production cost of some crops. Data on fertilizer's retail price show that the price levels considerably vary across regions. Given the archipelagic nature of the Philippines, one possible cause of such disparity is the poor condition of the domestic transport infrastructure. Huge price differences could also be due to the presence of market power in the fertilizer industry. However, no study has yet analyzed the spatial market integration of the fertilizer market at the subnational level. To help determine whether or not the variability across regional domestic markets could be attributed to inefficiencies due to market segmentation, this study conducted conventional tests of spatial market integration. Those tests were implemented using two different approaches—pairwise and simultaneous. Under the pairwise approach, each region was paired with another region. All possible pairs were included in the analysis. Under the simultaneous approach, cointegration test was applied to previously identified as "anomalous" regions (i.e., regions whose fertilizer prices were greater than the national average) vis-a-vis other regions in their corresponding island groups. Results of both pairwise and

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simultaneous cointegration tests suggested the rejection of the null hypothesis of no cointegration. The absence of segmentation and the sheer number of players lessened the likelihood of localized monopolies as being the source of regional price disparities.

INTRODUCTION

Fertilizer accounts for a significant share of the total production cost for some crops. Based on the Philippine Statistics Authority's CountryStat Philippines data on average fertilizer costs from 2011 to 2015, fertilizer's share in the total production cost was 11 percent for rice, 26 percent for potato, and 27 percent for tomato, respectively (PSA 2015). A change in the price of fertilizer could, in turn, cause substantial change in the total farm production cost of certain commodities.

Domestic retail fertilizer price data (i.e., dealers' price of urea) show regional disparities. A recent study by Briones (2016) suggests that, using the national average prices, the domestic fertilizer market is integrated with the international fertilizer market. This means that price changes in the international market are readily transmitted to the domestic market. Although he noticed regional price discrepancies, Briones (2016) did not fully address the issue on the presence of regional-level market power. If indeed present, there would be segmentation of regional markets.

At present, there are no existing studies that analyze the spatial market integration of the fertilizer market at the subnational level. To help determine whether the high prices of urea observed in some regions are due to the presence of market power, this study conducted conventional tests of spatial market integration, which is a necessary (but not sufficient) condition for market efficiency. A rejection of the hypothesis of market segmentation means that those observed price variations are less likely to be due to the presence of market power. An alternative explanation for the price variations could be the high transportation costs.

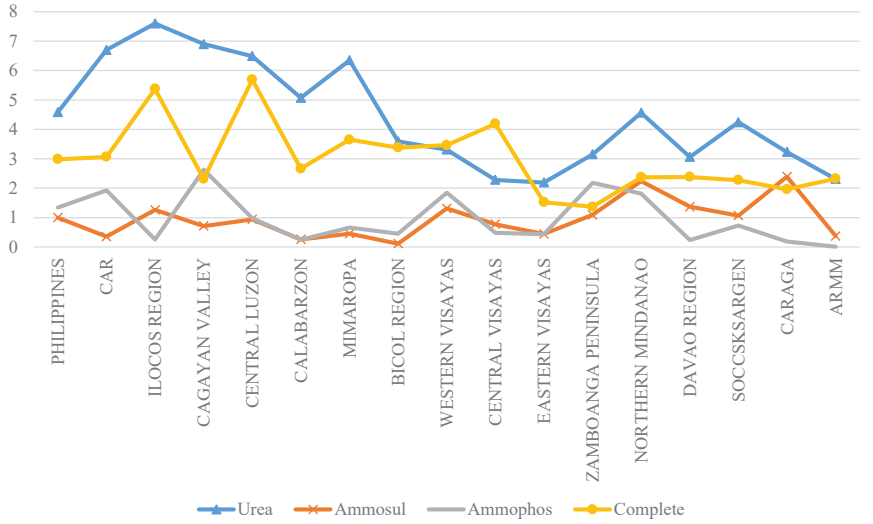
THE FERTILIZER MARKET IN THE PHILIPPINES

The domestic fertilizer market is well integrated with the international fertilizer market. Briones (2016) examined the role of fertilizer in agriculture development and the evolution of the policy regime concerning the fertilizer market. Integration implies that price changes in the international market are readily transmitted to the domestic fertilizer market. However, he observed that there were large price discrepancies (in all fertilizer grades) across some regions. The following sections discuss these issues in detail, but focus only on one fertilizer grade, i.e., urea.

Urea is the most-used grade among the four grades of fertilizer. Figure 1 shows that urea is the most-used fertilizer grade for cereal crops (i.e., rice and corn) in terms of bags per hectare in almost all regions in the Philippines. On the average, from 2003 to 2014, the following regions were the top urea users: (1) Ilocos Region; (2) Cagayan Valley; (3) Cordillera Autonomous Region (CAR); and (4) Central Luzon. Similarly, when assessed based on their respective shares in area harvested for cereals, Ilocos, Cagayan Valley, and Central Luzon remain the top urea users (See Figure 2).

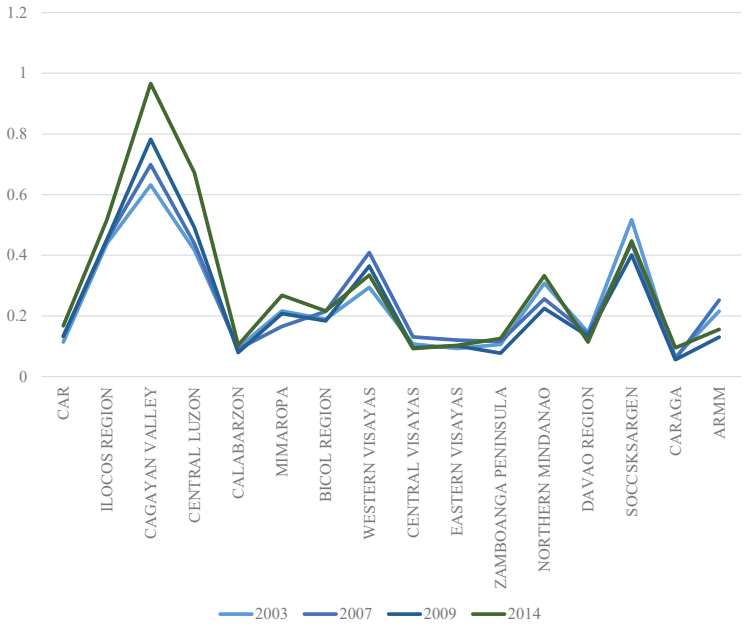
Urea is priced higher in a few regions. A simple comparison of average annual retail prices of urea from 1990 to 2016 would show large variation across regions. Most regions lie below the national average price, but those that appear to be 5 percent higher than the national average price (as indicated by a black bar in Figure 3) were suspected to be "anomalous"—that is, their price differences were excessively high. The initial analysis that compared their standard deviations over time with the

Figure 1. Fertilizer use for cereals by grade and region: Philippines, 2014 (bags of 50kg)



CAR - Cordillera Administrative Region; CALABARZON - Cavite, Laguna, Batangas, Rizal, and Quezon; MIMAROPA - Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan; SOCCSKSARGEN - South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos; ARMM - Autonomous Region in Muslim Mindanao
Source of basic date: Philippine Statistics Authority (2017a)

Figure 2. Urea use weighted by their shares in total area harvested for cereals (in %)



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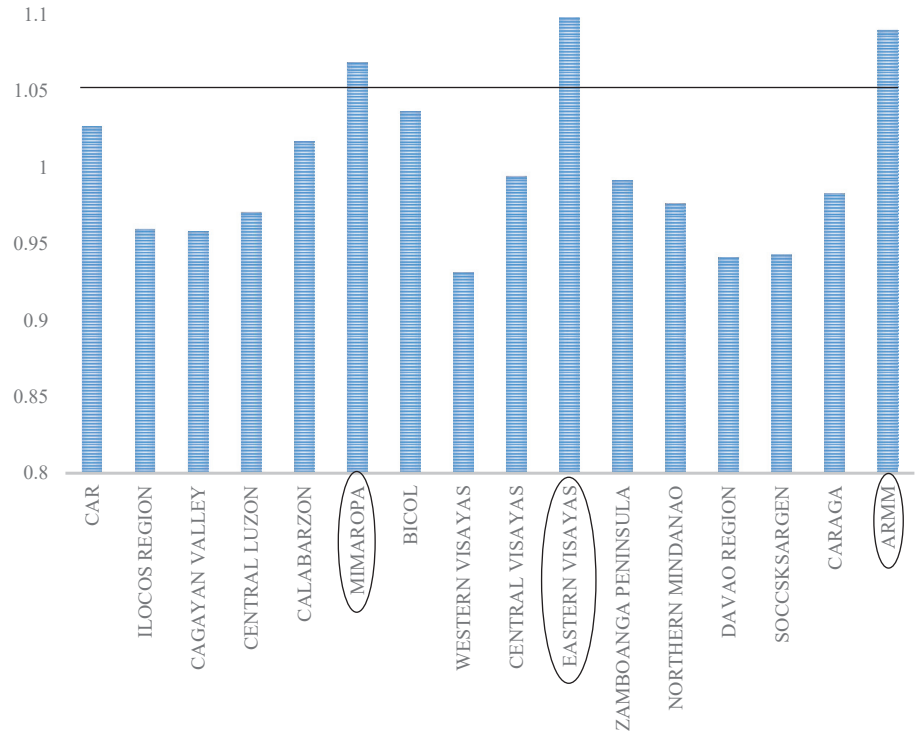
Source of basic date: Philippine Statistics Authority (2017b)

Figure 3. Ratio of regional price to national average price from 1990 to 2016



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Source of basic date: Philippine Statistics Authority (2017c)

national average indeed showed that their values were higher. Based on this initial examination of prices, the following regions were identified as "anomalous": MIMAROPA (Occidental Mindoro, Oriental Mindoro, Marinduque, Romblon and Palawan), Eastern Visayas, and Autonomous Region in Muslim Mindanao (ARMM).

To confirm such "anomaly", t-test was conducted. Upon testing the mean of national average against the mean of each region, the null hypothesis of no significant difference between regions is rejected only for the allegedly anomalous regions at 90-percent level of confidence. The alternative hypothesis is that each of those regions has significantly higher prices than the national average.

What could possibly be driving up prices in the "anomalous" regions? The literature on market efficiency points to two broad categories of market inefficiency causes. First, market inefficiency may be due to the high magnitude of transaction cost of trade. As early as 1970, a study by Fama (1970) noted that transaction costs and availability of information determine market efficiency. In fact, high transaction costs may hinder both information trading and arbitrage trading (Liu 2010).

For a specific market, i.e., equity market, Pagano (1989) found that Pareto-superior equilibrium (which indicates efficiency) exists along with lower transaction cost, higher number of players transacting, lower price volatility, and larger supply of assets. Ghosh and Revilla (2007), likewise, noted that due to high transactions costs, security markets become less liquid and less efficient.

High transaction costs could be driven by (1) poor contract enforcement; (2) inadequate police protection; (3) corruption; (4) excessively high taxes; and (5) inadequate transport

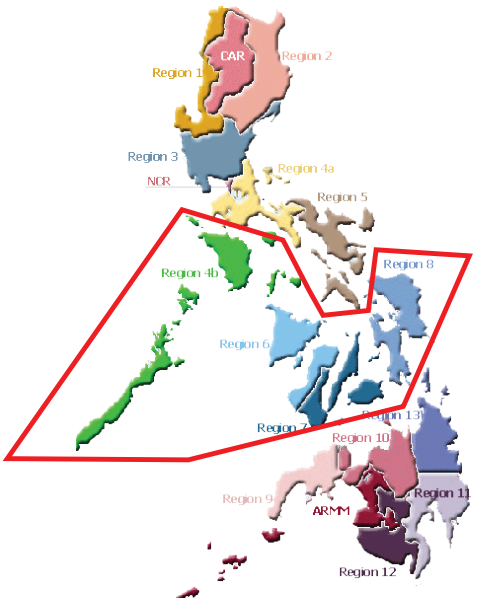
and communications infrastructure (Fackler and Goodwin 2001). In the Philippine setting, excessively high taxes in the fertilizer market could be ruled out as a driver of high transaction cost since fertilizers are exempted from value-added tax and tariffs (for producer-importers) (Briones 2016). Briones (2016) suspected that large price variations in the fertilizer market across regions could be attributed to market inefficiencies owing to poor infrastructure, weak logistics systems, and low investments.

Briones' conjecture on the causes of inefficiencies is not unfounded. Llanto (2012) presented the case of Mindanao in the interregional trade of high-value agricultural commodities. He found that costs of transporting agricultural products from Mindanao to Metro Manila and Visayas (which were considered as demand centers) were high. With regard to the degree of inter-island group trade, only about 40 percent of Luzon and Visayas' agricultural produce were being traded to other island groups (Llanto et al. 2012). Clearly, the inefficiency of road and port networks limits the movement of agricultural products, causing inadvertent increases in retail price for consumers, and reductions in profit for supply chain players (Llanto 2012).

The nature of interregional trade in the country could largely be attributed to the topographical characteristics of the country. Being an archipelagic country, the infrastructure and logistics system vary depending on the need of each island group. For island groups consisting of contiguous regions (i.e., Luzon and Mindanao), the main mode of transportation are mainly via land-based transport networks such as roads and bridges.

On the other hand, port networks are more needed for the island group consisting of island regions (i.e., Visayas). As such, instead of the official island groupings (i.e., Luzon, Visayas, and Mindanao), a more sensible island grouping based on a visual inspection of the map of the country (Figure 4) would be Northern Philippines (CAR, Ilocos Region, Cagayan Valley, Central Luzon,

Figure 4. Suggested island grouping based on a visual inspection of the map of the country



CAR - Cordillera Administrative Region; NCR - National Capital Region; ARMM - Autonomous Region in Muslim Mindanao
Source: Securities and Exchange Commission (2018)

CALABARZON [Cavite, Laguna, Batangas, Rizal, and Quezon], National Capital Region [NCR], and Bicol Region), Central Philippines [MIMAROPA, Western Visayas, Central Visayas, and Eastern Visayas], and Southern Philippines (Zamboanga Peninsula, Northern Mindanao, Davao Region, SOCCSKSARGEN [South Cotabato, Cotabato, Sultan Kudarat, Sarangani and General Santos], Caraga, and ARMM). The main difference is that MIMAROPA should be regrouped with the other regions in Visayas, since these are all island regions.

Aside from poor infrastructure, the second cause of market inefficiency could be the lack of competition at the local level. Market inefficiency could happen when a firm or firms are able to exercise market power, such that when they can impose different prices on different locations and prevent resale of such products from one location to another (i.e., market segmentation by location). The price difference between segmented markets is greater than the transfer cost.

Briones (2016) reported that 483 licensed handlers of both pesticides and fertilizers in 2012 were engaged in various activities (e.g., area distributor, bulk handler, distributor, distributor-area-distributor, and importer-end-user). A recent publication of the Fertilizer and Pesticide Authority shows that dealers of both pesticide and fertilizers appear to be generally scattered across all regions (Table 1).

Given the number of activities and players in the fertilizer market, it is hard to imagine some players dominating and controlling prices. Nonetheless, the presence of market segmentation could be further verified and tested.

Table 1. Dealers of pesticide and fertilizer, by region (2017)

Region	Number of both pesticide and fertilizer dealers	Regional shares (%)
Ilocos Region	505	12.6
Cagayan Valley	491	12.2
Central Luzon	515	12.8
CALABARZON	90	2.2
MIMAROPA	209	5.2
Bicol Region	113	2.8
Western Visayas	457	11.4
Central Visayas	169	4.2
Eastern Visayas	184	4.6
Zamboanga Peninsula	171	4.3
Northern Mindanao	151	3.8
Davao Region	224	5.6
SOCCSKSARGEN	404	10.1
ARMM	4	0.1
CAR	182	4.5
CARAGA	146	3.6
Philippines	4,015	100.0

CALABARZON - Cavite, Laguna, Batangas, Rizal, and Quezon; MIMAROPA - Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan; SOCCSKSARGEN - South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos; ARMM - Autonomous Region in Muslim Mindanao; CAR - Cordillera Administrative Region
Source: Fertilizer and Pesticide Authority (2018)

REVIEW OF LITERATURE

Economic concepts

Law of One Price

The Law of One Price (LOP) is considered a fundamental principle in commodity arbitrage. It postulates that there is a price prevailing in all markets for a commodity (Baffes 1991). In terms of international trade models, the price of a commodity in country A must be the same with that in country B after expressing the prices in common currency and incorporating the transaction costs. The LOP is an economic law frequently tested to see if the one-for-one transmission of price changes happens in the short run.

A modified version of the LOP model, which was originally introduced by Richardson (1978), is denoted by the following standard bivariate regression equation (Fackler and Goodwin 2001). When β_1=1 and β_0=0, we say that the markets are perfectly integrated. In addition, if the model is evaluated in logarithmic form, the coefficients are interpreted as *price transmission elasticities*.

$$P_{1t} = \beta_0 + \beta_1 P_{2t} + \in_t$$

where P_{it} refers to the price in market *i*,

$\in_t$ refers to residual errors.

According to Spiller and Huang (1986) as cited in Sexton et al. (1991), there are three likely reasons for failing to adhere to LOP: (1) regions are not linked by arbitrage; (2) presence of impediments to efficient arbitrage; and (3) imperfect competition in one or more of the markets.

Market efficiency

Price variations drive market players to engage in trade because these create arbitrage opportunities. Markets are said to be efficient if they reach a point wherein all opportunities for spatial arbitrage profits have already been exploited by spatial traders. Rashid et al. (2010) defined market efficiency as "the degree to which markets minimize costs and match supply with demand" (p.3).

The concept of efficiency had been implicitly incorporated in early analyses of market integration. Roll (1979) as cited in Fackler and Goodwin (2001) was among the first to tackle the effects of having efficient commodity markets on spatial price linkages. Two decades after, Buccola (1989) provided a more general approach on price efficiency, wherein he suggested that "efficiency in prices corresponds to the set of prices that result in an optimal (efficient) allocation of resources" (Fackler and Goodwin 2001, p.980). If efficiency arising from spatial arbitrage exists, then all information on demand and supply situations (including transaction costs) should be manifested in market prices.

Market integration

A necessary but not sufficient condition of efficiency is market integration, which has become the subject of numerous empirical studies. Barrett (1996) described market integration as the condition in which prices, goods, and information move over time, space, and form without restraint. The ideal condition is known as perfect market integration, where prices in two or more markets are moving together instantaneously (Goodwin and Schroeder 1990).

Market integration has different forms. Whenever price signals are readily transmitted from one marketing channel to another, we say that vertical market integration exists. On the other hand, if these signals are transmitted between spatially distinct markets, it is called spatial integration (Barrett 1996).

In spatial market integration, any shock to prices in one market would immediately be reflected in other markets (Barrett 1996). Rufino (2008) described spatial market integration as a condition

wherein the difference between the prices of two geographically separated markets is being kept below the transfer cost by arbitrage activities. Spatial arbitrage happens when a commodity is transferred from a region with lower price to the region with a higher price. Such activity "force[s] prices at different locations to a unique equilibrium" (Goodwin and Schroeder 1990, p.173), which is the point wherein the price difference is equal to the transfer cost (Nga and Lantican 2009).

In the literature involving food commodity markets, the spatial arbitrage conditions are described by the following equations: $P_t^i+K_t^{ij}=P_t^j$

$P_t^i+K_t^{ij}>P_t^j$

where P_t^i refers to food price in the exporting market in period t

K_t^{ij} refers to transfer costs in the same period

P_t^j refers to food price in the importing market in period t

According to Baulch (1997), both of the conditions above are consistent with market integration. Whenever the first condition holds, trade occurs. However, when the second condition holds, there is no incentive to trade.

Some of the factors causing the lack of spatial integration are also the same ones that cause market failures. These include: (1) inadequate provision of public goods (such as infrastructure); (2) inefficient flow of information; (3) imperfect competition; and (4) incomplete or missing institutions for risk management like credit and insurance (Rashid et al. 2010).

Why is market integration important? Baulch (1997) described the possible outcomes in the absence of spatial market integration. First, areas having food surplus could not readily transfer commodities to food-deficit locations because transmission of price signal will be problematic. Second, prices will be unstable. Third, agricultural producers will find it hard to "specialize according to long-term comparative advantage" (Baulch, 1997, p.477). Lastly, trade gains will not be realized.

Moreover, Digal et al. (2010) explained that market integration helps people benefit from the gains brought about by development interventions such as new infrastructure facilities and those that improve the flow of market information. Furthermore, integrated markets are cheaper to finance since any intervention imposed on one market would have an effect on other markets. This helps reduce redundancies in government interventions. For example, in the context of agricultural price stabilization policies, it may be more appropriate to implement a decentralized stockpiling policy for segmented regions, while centralized stockpiling may work for integrated regions (Fackler and Goodwin 2001).

Standard market integration approaches

Correlation-based analysis is among the early methods of testing market integration. This type of analysis depends on price data only, and no transportation or trade flow data are utilized. Correlation tests involving time series had been widely criticized. For instance, Barrett (1996) and Harriss (1979) had identified a number of inferential problems in this approach. According to Harriss, correlation of price data is spurious and may incorrectly describe spatial market integration (Fackler and Goodwin 2001).[2]

Another approach that depends on the analysis of the co-movement of prices is the estimation of Ravallion's error correction model (1986). This standard approach follows a radial structure, "which assumes price shocks originate from one central market whose prices are weakly exogenous from those of other markets" (Barrett 1996, p.826). In addition, transfer costs are assumed to be constant.

[2] Spurious regression may come from common exogenous trends, common periodicity, and autocorrelation (Barrett 1996).

The inferential problem encountered when using correlation-based tests is largely caused by the lack of a time series property called stationarity. Unit root tests (the Augmented Dickey Fuller test, for example) are adopted to test for the stationarity of time series data, which is denoted by I(0).

Price data series are usually nonstationary or integrated by order d, which is denoted by I(d). This means that the price data series does not have time-invariant means, variances, and autocorrelations (Sims 2013). Nonstationarity may violate the basic Ordinary Least Squares assumption of homoskedasticity (i.e., the variance may not be constant). Thus, when this condition is violated, the estimators become inefficient and usual inferences are no longer valid. To address this issue, we may invoke data transformation. One way to transform time series is through differencing. When a nonstationary series is differenced d times, it is said to be integrated of order d or I(d).

Granger (1981) noted that it is possible to find a linear combination of a vector of nonstationary time series that has a stationary property. When two time series data are integrated of order 1, I(1), then the expected time for them to cross is infinite and that achieving an equilibrium may virtually never occur. They may need to undergo some transformation before achieving stationarity. On the other hand, for I(0) time series, there is no need for any transformation.

Cointegration among series may be used to test for long-run equilibrium relationship. Although prices may vary in the short run, they will eventually move closer to each other or toward a common "equilibrium" value if cointegration is established (Ardeni 1989).

One of the most common approaches is that of Johansen (1991), which applies maximum likelihood estimation (StataCorp 2015). Two test statistics are computed under this approach: (1) maximum eigenvalue test and (2) trace test. The null hypothesis of both test statistics is that there is no cointegration.

Related empirical studies

Market integration analysis techniques have been applied to real-world market setting, mostly in developing countries. Briones (2016) applied this technique in studying the fertilizer industry in the country. He observed that the industry has grown and that its policy regime has been transformed from being protectionist to market-oriented. He implemented a Vector Error Correction (VEC) analysis and found that the domestic fertilizer market is integrated with the international fertilizer market. The transmission elasticity was about 0.82 from world to domestic prices, holding exchange rate constant.

Rufino (2008) provided a succinct review of studies related to spatial market integration of various commodities (e.g., rice and corn) in different countries, including the Philippines. The bulk of Rufino's literature review focused on rice market integration. Among the studies within the Philippine setting is that of Baulch (1997). Baulch (1997) applied the Parity Bounds Model[3], which is a nonconventional test to detect market integration, to assess the degree of integration of wholesale rice markets in six selected regions of the country. Northern Luzon and Central Luzon represent the rice-surplus regions, while the NCR and Central Visayas represent the rice-deficit regions. In addition, Western Mindanao is included because of its ability to be rice self-sufficient although it is quite isolated. Using the Bureau of Agricultural Statistics' monthly wholesale price for special-grade rice for the period 1980 to 1993 and the transportation cost (i.e., shipping and freight costs) estimates gathered from interviews, Baulch (1997) implemented the maximum likelihood estimation of the Parity Bounds Model (PBM). Results show that the rice markets in the country are well integrated.

[3] In this model, transaction cost data are being used to "estimate the probability of attaining inter-market arbitrage conditions" (Barrett 1996, p.827).

In his paper, Rufino (2008) was also able to establish market integration in the wholesale rice market in the country. Using cointegration and other econometric techniques, he found that most of the pairwise combination of the 16 regions in the country are well integrated. Only a few pairs were found to be segregated.

Analyses of rice market integration were also conducted in other countries—e.g., Indonesia, Viet Nam, China, and India. Applying improvements on the Ravallion's model, Alexander and Wyeth (1994) examined the integration of the Indonesian rice market. Their model is an error correction version of the standard Ravallion model. They employed the Augmented Dickey Fuller procedure to establish cointegration in all the pairwise combinations of the seven rice-producing provinces. They found that only Surabaya to Ujung Pandang failed the cointegration test.

The study of the rice market of Viet Nam by Goleti et al. (1996) adopted a correlation-based analysis. Their analysis showed that for years 1986 to 1990, market integration was stronger than the subsequent period 1991 to 1995. They attributed the segregated nature of some of the market pairs in Viet Nam to the high cost of transportation, mainly due to poor port infrastructure and congestion, as well as high shipping cost in those areas.

In China, commodities such as rice and corn were also among the usual subjects of market integration analyses. Rozelle et al. (1997) assessed the integration of rice and corn markets in China. Apart from traditional statistical methods, the authors adopted the Parity Bounds Model originally introduced by Sexton et al. (1991) to help validate the hypothesis that rice and corn markets are indeed integrated. Laping (2001) analyzed rice, corn, and pork markets using different tools to test short- and long-run market integration. Results of his study confirmed the existence of market integration in the long run.

In India, Jha et al. (2005) found that 55 wholesale rice markets are not fully integrated due to excessive disruptions by government agencies on the markets. They adopted the Gonzalez-Rivera-and-Helfand (GRH) approach and utilized monthly data for the period 1970 to 1999.

A study by Nga and Lantican (2009) looked into the spatial integration of rice markets in Viet Nam using monthly retail price data for the period 1998 to 2005. They analyzed the extent, pattern, and degree of integration through various cointegration tests. Accordingly, they found that only 9 out of 34 rice markets are integrated into a common rice market.

Market integration analyses for other commodities such as livestock have also been done. For instance, Goodwin and Schroeder's (1990) study focused on testing the concept of the Law of One Price in cattle markets in the United States. The authors used the Generalized Method of Moments procedure, which addresses inferential issues such as simultaneity and serial correlation.

A more rigorous testing was done by Fafchamps and Gavian (1996) to assess whether Niger livestock markets are integrated. They applied tests for cointegration and Granger causality, and estimated Ravallion's model and PBM. All of these resulted in defining Niger livestock markets as related, but not closely integrated.

METHODOLOGY

Correlation. The correlation coefficients and their significance level were computed. Although pairwise correlation coefficients need to be interpreted with caution, it could still provide a good sense of the strength and direction of association among the variables.

Unit root test. Before proceeding with any time series analysis, the stationarity property of each time series was inspected by adopting the Augmented Dickey Fuller (ADF) test. The null hypothesis of the ADF test is that the series has a unit root—that is, it is not stationary—which is denoted by I(1).

Selecting the number of lags. After establishing the stationarity property of the series, the lag-order selection statistics was obtained. This served as a pre-estimation command to select the lag order for a vector autoregressive model or a vector error correction model (VECM). It reports the Akaike's information criteria, Schwarz's Bayesian information criteria, and the Hannan and Quinn information criteria lag-order selection statistics.

Testing for cointegration. The next step is to estimate the cointegrating rank of a VECM using the lags determined earlier. The cointegrating rank refers to the number of cointegrating equations in a VECM. If there is at least one cointegrating equation, it means that the parameters of cointegrating VECMs may be estimated.

Approach. This series of steps was executed in two approaches—pairwise and simultaneous. Under the pairwise approach, which is a standard method (e.g., Alexander and Wyeth 1994; Rufino 2008), each region was paired with another region. All possible pairs were included in the analysis. Under the simultaneous approach (Nga and Lantican 2009), cointegration test was applied to previously identified "anomalous" regions with respect to other regions in their corresponding island groups.

DATA

Time series data on monthly dealers' price of urea by region, in nominal terms, were used. A summary of the statistics and visual representation of the data are shown in Table 2 and Figure 5, respectively. These data were obtained from the Philippine Statistics Authority's CountryStat Philippines website. Only 16 regions were included since data were unavailable for the NCR. This study covered 324 observations spanning the years 1990 to 2016. The number of observations was enough to capture price relationships exhibited by each region pair in the long run.

Before implementing the standard methods in Stata 14, initial data processing and assessment were needed. All regional price series were transformed into their natural logarithmic form. Thus, instead of analyzing absolute price differences, proportional price differences were examined. Due to time and data constraints, this study only included the assessment of the spatial integration of fertilizer markets between regions. Integration across the different levels of the fertilizer supply chain was not covered.

DISCUSSION OF RESULTS

Correlation matrix

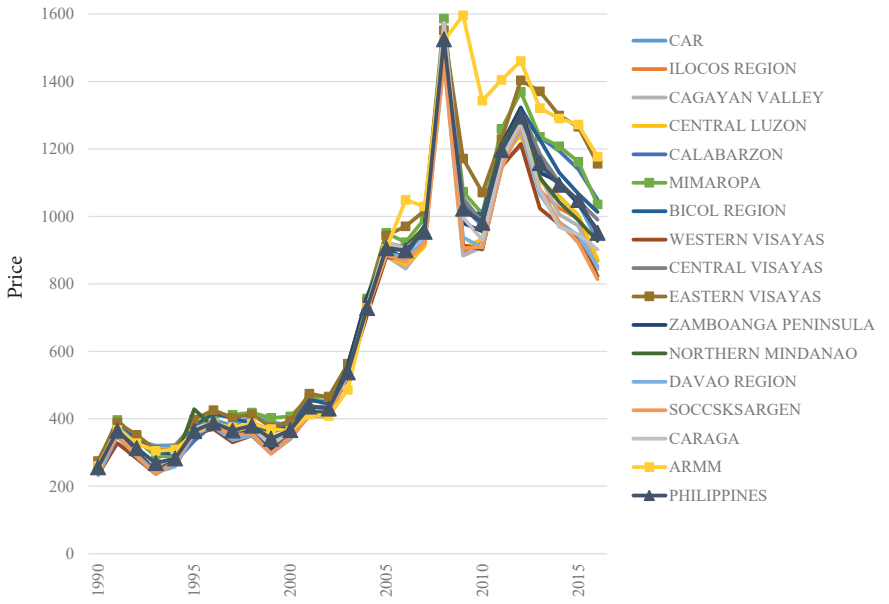
The resulting correlation coefficients figures are high, ranging from 0.97 to 0.99 (Table 3). This may seem to reflect integration of the regional fertilizer markets. However, as discussed earlier, correlation-based tests may give spurious relationships. Thus, further tests were needed to establish the presence of spatial market integration in the fertilizer market.

Table 2. Summary statistics on dealer's price of urea by region: Philippines

Variable	Observation	Mean	SD	Minimum	Maximum
Ilocos Region	324	668	371	190	1,983
Cagayan Valley	324	663	358	194	1,910
Central Luzon	324	673	368	190	1,935
CALABARZON	324	714	396	196	1,886
MIMAROPA	324	743	405	226	2,080
Bicol Region	324	717	388	235	1,940
Western Visayas	324	652	365	180	1,938
Central Visayas	324	701	400	206	1,946
Eastern Visayas	324	768	424	235	1,933
Zamboanga Peninsula	324	695	387	211	1,925
Northern Mindanao	324	687	389	207	1,902
Davao Region	324	661	375	182	1,945
SOCCSKSARGEN	324	657	363	196	1,863
CAR	324	703	371	213	1,967
CARAGA	324	682	376	214	1,911
ARMM	324	785	480	223	2,046

Notes: CALABARZON - Cavite, Laguna, Batangas, Rizal, and Quezon; MIMAROPA - Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan; SOCCSKSARGEN - South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos; CAR - Cordillera Administrative Region; ARMM - Autonomous Region in Muslim Mindanao; SD - Standard deviation
Source: Fertilizer and Pesticide Authority (2018)

Figure 5. Regional price of urea per region: Philippines, 1990-2016



CAR - Cordillera Administrative Region; CALABARZON - Cavite, Laguna, Batangas, Rizal, and Quezon; MIMAROPA - Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan; SOCCSKSARGEN - South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos; ARMM - Autonomous Region in Muslim Mindanao
Source of basic date: Philippine Statistics Authority (2017)

Table 3. Correlation table of urea prices by regional pairing

Region pairs with correlation <0.99		Correlation coefficient
ARMM	CAR	0.98
ARMM	Ilocos Region	0.97
ARMM	Cagayan Valley	0.97
ARMM	Central Luzon	0.98
ARMM	CALABARZON	0.98
ARMM	MIMAROPA	0.98
ARMM	Bicol Region	0.98
ARMM	Western Visayas	0.97
ARMM	Central Visayas	0.98
ARMM	Zamboanga Peninsula	0.98
ARMM	Northern Mindanao	0.97
ARMM	Davao Region	0.97
ARMM	SOCCSKSARGEN	0.97
ARMM	CARAGA	0.98
Eastern Visayas	Northern Mindanao	0.98

ARMM - Autonomous Region in Muslim Mindanao; CAR - Cordillera Administrative Region; CALABARZON - Cavite, Laguna, Batangas, Rizal, and Quezon; MIMAROPA - Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan; SOCCSKSARGEN - South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos
Note: All remaining region pairs have at least 0.99 correlation coefficient.
Source: Author's calculations

Unit root test

Table 4 shows the results of the unit root test. It can be observed that, without transformation, the time series data are nonstationary. However, after getting the first difference of each series, they became stationary and were classified as I(1) series. Although each series is I(1), there could be a linear combination of this vector of nonstationary time series that is stationary, I(0), which is the concept of cointegration.

Cointegration: Pairwise approach

The number of lags per region pair was identified following the Akaike information criterion. The lags varied across the region pairs. Information on lags was then incorporated in running the Johansen tests for cointegration. This test determined the existence of cointegrating equations based on their Trace statistics.

Results show that there is not enough statistical evidence to reject the null hypothesis of no cointegration among 14 market pairs. In other words, 12 out of the 120 regional market pairs (or equivalently, 10%) do not have a cointegrating equation at a 95-percent confidence level (Table 5). This means that there is no long-run equilibrium relationship in each of these region market pairs. These markets are spatially segmented, which means there could exist some market inefficiencies. Fortunately, these region market pairs do not show alarmingly high price differentiation for the past years.

Meanwhile, each of the remaining 106 regional market pairs has a cointegrating equation, especially the "anomalous" regions (MIMAROPA, Eastern Visayas, and ARMM). Since the null hypothesis of no cointegration is rejected for "anomalous" regions, price disparities among these regions are unlikely to be driven by market segmentation.

Table 4. Summary of Augmented Dickey Fuller statistics

	p-value (level)	p-value (first difference)	Remarks
CAR	0.313	0.000	I(1)
Ilocos Region	0.302	0.000	
Cagayan Valley	0.323	0.000	
Central Luzon	0.297	0.000	
CALABARZON	0.344	0.000	
Bicol Region	0.482	0.000	
MIMAROPA	0.391	0.000	
Western Visayas	0.319	0.000	
Central Visayas	0.441	0.000	
Eastern Visayas	0.447	0.000	
Zamboanga Peninsula	0.450	0.000	
Northern Mindanao	0.343	0.000	
Davao Region	0.345	0.000	
SOCCSKSARGEN	0.399	0.000	
CARAGA	0.500	0.000	
ARMM	0.609	0.000	

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Note: The natural log form of the series were used
Source: Author's calculations

Finding a cointegrating equation between each region pair formed a basis to estimate the VEC model. For brevity, only VECM long-run estimates concerning the "anomalous" regions are reported.[4] The long-run estimates— also known as price transmission elasticities—are all negative and significant, as expected. Prices in those regions have a long-run equilibrium relationship with that of other regions. This fact weakens the assumption that market segmentation is the main cause for anomalously high urea prices.

There are a number of alternative explanations for this finding. One possible explanation is the poor condition of transport infrastructure in the Philippines, which contributes to high transaction cost in the trading of urea.

Cointegration: Simultaneous approach

The "anomalous" regions in both Central and Southern Philippines were found to be well integrated with the regions in their respective island groups. The Central Philippines island group, which consists of four regions, has three cointegrating equations based on the cointegration test results (Table 6). Meanwhile, the Southern Philippines island group, which consists of six regions, has five cointegrating equations (Table 7).

Estimated long-run parameters of the multivariate cointegrating VECMs for Central Philippines and Southern Philippines are shown in Table 8 and Table 9, respectively. As expected, the price

[4] Results for other market pairs were not reported here, but are available upon request.

Table 5. Trace statistics (Pairwise approach)

	CAR	Ilocos Region	Cagayan Valley	Central Luzon	CALA-BARZON	MIMA-ROPA	Bicol Region	Western Visayas	Central Visayas	Eastern Visayas	Zamboanga Peninsula	Northern Mindanao	Davao Region	SOCCSK-SARGEN	CARAGA	ARMM
CAR		3.57	27.28	3.16	12.21	3.06	3.08	27.21	2.49	2.02	2.60	2.79	16.77	3.40	3.25	2.11
Ilocos Region			3.30	3.43	2.88	3.22	3.14	3.44	2.61	2.62	2.60	2.82	3.36	47.30	3.17	2.46
Cagayan Valley				3.30	3.47	3.73	50.74	3.75	2.97	2.73	3.19	2.76	3.26	3.66	3.63	2.67
Central Luzon					2.55	3.23	3.21	3.52	2.36	2.24	2.57	2.49	3.09	3.19	2.93	2.37
CALABARZON						3.02	3.00	2.71	2.87	2.91	2.98	3.03	13.25	14.31	14.05	2.39
Bicol Region							3.00	3.58	2.71	2.65	3.32	3.28	3.15	3.54	3.03	2.80
MIMAROPA								40.13	2.85	2.64	3.25	2.98	3.31	3.69	3.24	2.39
Western Visayas									3.08	2.68	3.21	3.54	3.47	42.49	3.65	2.43
Central Visayas										2.89	2.96	2.90	2.72	2.86	2.70	2.31
Eastern Visayas											2.86	2.93	2.48	2.39	2.62	2.57
Zamboanga Peninsula												2.96	1.96	2.34	3.13	2.33
Northern Mindanao													2.75	3.35	3.03	2.69
Davao Region														3.04	3.27	2.73
SOCCSKSARGEN															40.42	2.28
CARAGA																2.37
ARMM																

CAR - Cordillera Administrative Region; CALABARZON - Cavite, Laguna, Batangas, Rizal, and Quezon; MIMAROPA - Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan; SOCCSKSARGEN - South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos; ARMM - Autonomous Region in Muslim Mindanao
Note: Highlighted cells indicate lack of cointegration with p>0.05. 12 out of 120 (= 10%) region pairs are not cointegrated. The natural log form of the series were used.
Source: Author's calculations

Table 6. Number of cointegrating equations (Central Philippines)

Maximum rank	Trace Statistic	5% critical value
0	98.8334	47.21
1	49.1626	29.68
2	24.6122	15.41
3	2.8887*	3.76
4		

* denotes the value of maximum rank selected by the Johansen's trace test procedure
Source: Author's calculations

Table 7. Number of cointegrating equations (Southern Philippines)

Maximum rank	Trace Statistic	5% critical value
0	503.7442	94.15
1	308.7108	68.52
2	160.0085	47.21
3	82.6819	29.68
4	39.4837	15.41
5	3.1630*	3.76
6		

*denotes the value of maximum rank selected by the Johansen's trace test procedure
Source: Author's calculations

Table 8. VECM long-run relationship (Central Philippines)

Variable	Coefficient	z-value	P>z
Cointegrating vector 1:			
MIMAROPA	1.00		
Western Visayas	0.00		
Central Visayas	0.00		
Eastern Visayas	-0.97	-53.91	0.000
Constant	-0.19		
Cointegrating vector 2:			
MIMAROPA	0.00		
Western Visayas	1.00		
Central Visayas	0.00		
Eastern Visayas	-0.98	-34.06	0.000
Constant	0.08		
Cointegrating vector 3:			
MIMAROPA	0.00		
Western Visayas	0.00		
Central Visayas	1.00		
Eastern Visayas	-1.02	-50.93	0.000
Constant	0.25		

VECM - vector error correction model; MIMAROPA - Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan
Note: The natural log form of the series were used
Source: Author's calculations

Table 9. VECM long-run relationship (Southern Philippines)

Variable	Coefficient	z-value	P>z
Cointegrating vector 1:			
Zamboanga Peninsula	1.00		
Northern Mindanao	0.00		
Davao Region	0.00		
SOCCSKSARGEN	0.00		
CARAGA	0.00		
ARMM	-0.92	-36.55	0.000
Constant	-0.40		
Cointegrating vector 2:			
Zamboanga Peninsula	0.00		
Northern Mindanao	1.00		
Davao Region	0.00		
SOCCSKSARGEN	0.00		
CARAGA	0.00		
ARMM	-0.93	-33.94	0.000
Constant	-0.32		
Cointegrating vector 3:			
Zamboanga Peninsula	0.00		
Northern Mindanao	0.00		
Davao Region	1.00		
SOCCSKSARGEN	0.00		
CARAGA	0.00		
ARMM	-0.91	-31.30	0.000
Constant	-0.40		
Cointegrating vector 4:			
Zamboanga Peninsula	0.00		
Northern Mindanao	0.00		
Davao Region	0.00		
SOCCSKSARGEN	1.00		
CARAGA	0.00		
ARMM	-0.89	-30.31	0.000
Constant	-0.52		
Cointegrating vector 5:			
Zamboanga Peninsula	0.00		
Northern Mindanao	0.00		
Davao Region	0.00		
SOCCSKSARGEN	0.00		
CARAGA	1.00		
ARMM	-0.87	-29.77	0.000
Constant	-0.71		

VECM - vector error correction model; SOCCSKSARGEN - South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos; ARMM - Autonomous Region in Muslim Mindanao
Note: The natural log form of the series were used.
Source: Author's calculations

transmission elasticities are negative and significant. The same conclusion can be derived from the simultaneous approach, as compared with the pairwise approach. That is, the regional price dispersion anomaly cannot be attributed to market segmentation.

The two different approaches implemented in this study both point to the same conclusion: that regional fertilizer markets are well integrated. To further illustrate this point, imagine a urea dealer in Western Visayas (a low-priced region). This dealer from Western Visayas cannot be expected to sell urea to ARMM (a high-priced region) because he/she is aware that high transportation costs will only eat up the arbitrage opportunity.

The findings of this study reject the notion that the fertilizer market is segmented at the regional level. In the absence of segmented markets, spatial monopolies are an unlikely explanation for regional price differences. The number of market players in the fertilizer industry also contributes to the competitive nature of the industry.

CONCLUSION

Wide disparities in regional prices of fertilizer are apparent, based on official retail price data (i.e., dealers' price of urea). In this study's analysis of the spatial market integration of the fertilizer market at the subnational level, three regions were initially identified as "anomalous" regions—MIMAROPA, Eastern Visayas, and ARMM—since their fertilizer prices were consistently beyond the national average price during the study period. The study then adopted a more rigorous technique for further assessing market integration (i.e., cointegration test) under two approaches—pairwise and simultaneous.

Based on the results of the cointegration tests, regional fertilizer markets whose retail price of urea were initially observed to be higher than the average, were found to be spatially integrated with the other regional markets.

Based on the pairwise approach, 90 percent of all market pairs were found to be integrated. The same conclusion was observed using the simultaneous approach. Previously identified "anomalous" regions (i.e., MIMAROPA, Eastern Visayas, and ARMM) were well integrated with the regions in their respective island groups (Central Philippines and Southern Philippines). Thus, the hypothesis that market segmentation is the cause of inefficiency in the fertilizer industry is rejected.

Future studies may consider other explanations for such regional price differences in the Philippines, such as inefficiencies due to poor transport infrastructure. Such an initiative would entail the use of transfer costs data that, however, are usually difficult to obtain.

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Chronic Food Poverty and Weather Variability in the Philippines

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ABSTRACT

There are few studies in the Philippines that analyze poverty dynamics. Studies that examine the effects of weather variability on food poverty dynamics are even fewer. Because some sectors are more adversely affected by the changing weather patterns, an analysis of the effects of weather variability on poverty is essential. Using a simple-spells approach to understanding the food poverty dynamics in the Philippines, this paper finds that deviation of rainfall from its normal values and other key variables such as education, employment, assets, and armed conflict affect chronic food poverty. The study concludes with a discussion on the policy implications.

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INTRODUCTION

The Philippines has long been working to address poverty through the government's various anti-poverty and social protection programs. Despite efforts of various leaders, the country has missed its Millennium Development Goal (MDG) target of halving its 1990 poverty level by 2015. As of October 2016, the proportion of the population below national poverty threshold has remained 21.6 percent (PSA 2016), which is 4.4-percentage points higher than the MDG target. This lackluster reduction in poverty can be traced to the lack of clear focus on long-term interventions to help the poor (PSA various years).

Poverty studies in the Philippines abound but most of these use cross-section data (e.g., Intal 1994; Balisacan and Pernia 2002; Balisacan 2003a, 2003b). These reports only identify the poor at a given point in time and provide inadequate insights on the dynamics of poverty. Meanwhile, studies that use panel data in the Philippines include researches on poverty dynamics (Reyes et al. 2010, 2011; Bayudan-Dacuycuy and Lim 2013, 2014), vulnerability to poverty (Mina and Imai 2016), and income inequalities (Albert et al. 2015).

This paper aims to contribute to poverty studies in the Philippines by analyzing the effects of geographic attributes, like weather variability on food poverty. It is relevant for several reasons. One, World Development Indicators data show that around 29 percent of total employment in the county is still in agriculture, a sector most vulnerable to the vagaries of weather. People in rural areas can easily slip in and out of poverty given that their livelihood depends on stable environments, such as even temperature and steady supply of water. In the Philippines, climate and climate-related information are among the major factors farmers consider in their crop production activities (Domingo et al. 2009).

Two, weather is an integral part of human life, and weather shocks can have severe implications on income (see Schlenker et al. 2006; Deschenes and Greenstone 2007). It can have an impact on household consumption as well. For example, Bayudan-Dacuycuy (2017) specifically relates energy use to heat index variability, disclosing that the heat index fluctuation has the highest effects on the electricity consumption of balanced and female-majority households that are also female headed and living in rural areas. Weather variability can also be considered as a shock. As such, this paper is closely related to Bayudan-Dacuycuy and Lim's (2014) study, which uses the simple spells approach to analyze the effects of shocks on poverty in the Philippines.

Three, climate change and its adverse effects have received significant attention from local and international communities. Evidences point to altered patterns of weather parameters, such as wild swings in rain and snow, melting glaciers, and rising temperatures, that lead to drying out in some areas and in increased precipitation in others. There are several studies that analyze the effects of weather events on agricultural profit or output (Schlenker et al. 2006; Deschenes and Greenstone 2007), migration (Yang and Choi 2007), growth (Skidmore and Toya 2002; Dell et al. 2009; Noy and Vu 2010), and health (Murray et al. 2000; Thai and Falaris 2014). In the Philippines, Bayani-Arias and Palanca-Tan (2017) analyze the effects of extreme weather events on inequality. There are no known studies yet that analyzed the effects of weather events on food poverty, and this is a gap that this paper attempts to address.

Using a simple spells approach to analyze the poverty dynamics in the Philippines, this paper finds that rural areas have a substantially higher percentage of always food-poor households than urban areas. The National Capital Region (NCR) has the highest percentage of never food-poor households. Most Luzon and Visayas regions have very high percentages of never food-poor households. Most regions in Mindanao have high food poverty, the highest of which is

in the Autonomous Region in Muslim Mindanao (ARMM). This paper looks at the effects of key variables on food poverty using probit and multinomial logit regressions. Results show that education, employment, assets, conflict, and rainfall deviation affect food poverty. A discussion on the policy implications is provided.

DATA AND SOURCES

Annual Poverty Indicator Survey (APIS) and Family Income and Expenditure Survey (FIES)

This study used data from the Annual Poverty Indicator Survey (APIS) in 2004, 2007, and 2008; and the Family Income and Expenditure Survey (FIES) in 2003, 2006, and 2009 as collected by the Philippine Statistics Authority (PSA). Such data from the APIS and FIES could be merged to form a panel dataset since there was a master sample based on the results of the Census of Population and Housing, a portion of which was retained by the PSA and resurveyed for a period. These samples were replaced by another set of samples to be tracked again after a certain period. The PSA had four replicates and each replicate possessed the properties of the master sample.

For the purpose of this research, PSA provided the second rotation of replicate four of the datasets. The merging of these datasets was done by creating a household identification number through the concatenation of geographical variables, such as region, province, municipality, barangay,[2] enumeration area, sample housing unit serial number, and household control number. There were 6,517 samples common to the six datasets.

An issue that needs to be addressed when using the panel data pertains to households as the unit of observation. It is possible that members of a household in a particular year may not be the same composition of such household in the following year. This is the case when families migrate or when the household surveyed is composed of nonrelated members (e.g., the house is for rent). To ensure that it is the same households tracked down from 2003 to 2009, samples were further limited to households that satisfied two criteria: The sex of the household head should be the same throughout the period, and the age of the household head should be consistent as well. For example, the age difference of the household head in 2003 FIES and 2004 APIS should be either zero or one while the age difference of the household head between 2004 APIS and 2006 FIES should be either two or three. There were 1,954 samples left when these additional restrictions were imposed.

Both APIS and FIES followed a multistage sampling design. However, the panel data constructed for the current research did not make use of the sampling weights since the weights differed across survey data. Such limitation was acknowledged by this study at the outset.

Nonetheless, while it is true that PSA still had to collect genuine longitudinal survey data, this research remains relevant in terms of its contribution toward a better understanding of poverty in the Philippines.

Poverty Thresholds for non-FIES years

PSA generally releases official poverty thresholds for the FIES years, which are made up of the food and nonfood thresholds. Since no thresholds were released for 2004, 2007, and 2008, the poverty thresholds for these years were projected in this study using the poverty threshold in 2003 and the provincial consumer price index in the same year. A similar projection was done for the food thresholds. All the relevant APIS incomes and expenditures were multiplied by two since the reference period of APIS is over six months while the reference period of FIES is one year.

[2] This is the basic political unit in the Philippines, equivalent to a village.

Rainfall data

Rainfall data (in millimeters) are regularly collected by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) weather stations across the Philippines. Such data are measured, compiled, and disseminated through a public use file containing data from 50 PAGASA weather stations. To map the weather information with the APIS-FIES dataset, this study used the province of residence as the merging variable. The APIS-FIES dataset covered 83 provinces.

The PAGASA datasets have the following features: (1) several provinces host multiple weather station while (2) other provinces have no weather station but may be assigned weather stations based on the relative distance of each province from the location of the nearest weather station. In merging the PAGASA dataset with the APIS-FIES dataset, this study addressed the first feature by selecting the weather station located in or in close proximity to the provincial capital. As an illustration, Palawan Province, located in Luzon's Region 4B, has three stations: Coron, Cuyo, and Puerto Princesa. In this case, Puerto Princesa was chosen.

Due to the importance of accounting for similar weather patterns and enhancing data variability, households located in provinces without weather stations were not automatically removed from the sample. For example, Mountain Province and the provinces of La Union and Ifugao were assigned to the weather station in Baguio City, Benguet, while Tarlac was assigned to the weather station in Cabanatuan, Nueva Ecija. Assigning adjacent weather stations to provinces without their own stations maximized the number of households included in the estimation sample. Without this assignment, 28 provinces would have been removed from the sample, which translates to a reduction of 658 households.

Table 1 provides the mapping of the respective weather stations to provinces and cities. The first column lists the provinces in APIS-FIES while the second column lists the PAGASA weather station assigned to each. For provinces without weather stations, the air/straight distance between their capital and the nearby weather stations was computed using information from the website, http://distancecalculator.globefeed.com/Philippines_Distance_Calculator.asp. The fourth column shows the distance corresponding to the third column. Out of the 83 provinces, 24 were found to have weather stations, 57 were assigned to nearby weather stations, and two could not be reasonably mapped. Guimaras and Batanes were the two provinces where a match could not be found in the PAGASA weather data.

Increased precipitation results in floods that can cause the proliferation of vector-borne or water-borne diseases. Meanwhile, extreme hot or cold temperature increases mortality. Both affect food security by altering the production patterns in agriculture, fisheries, and resources sectors.

To come up with proxies for weather variabilities, rainfall data were compared to their normal values, defined as the 30-year average and compiled by PAGASA for the period 1971–2000. Rainfall is highly localized, and matching the rainfall data with the provinces can introduce substantial measurement error. To mitigate measurement error, this study used three samples, namely, households in provinces at most 10, 20, and 40 kilometers away from the assigned weather station.

FOOD POVERTY IN THE PHILIPPINES

Dynamics in food poverty between 2003 and 2009 was analyzed using the APIS-FIES data and the simple spells approach. The approach compared the per-capita food expenditure against the food threshold. A household in a given year was assigned 1 if the per-capita food expenditure is lower

Table 1. Mapping of APIS-FIES provinces with the PAGASA weather stations

APIS-FIES Province/City	Weather station	Provincial capital and weather station	Straight line/air distance (in km)
Province assigned to nearby weather station			
Misamis Oriental	Lumbia Airport, Misamis Oriental	Cagayan de Oror–Lumbia Airport	5.62
Benguet	Baguio City, Benguet	La Trinidad–Baguio City	8.63
Rizal	Science Garden, Quezon City	Rizal–Quezon City	8.93
Cebu	Mactan International Airport, Cebu	Cebu City–Mactan International Airport	10.7
Pangasinan	Dagupan City, Pangasinan	Lingayen–Dagupan City	10.83
Quezon	Taybas, Quezon	Lucena–Tayabas	11.04
Nueva Ecija	Cabanatuan, Nueva Ecija	Palayan City–Cabanatuan	17.96
Agusan del Norte	Butuan City, Agusan del Norte	Cabadbaran City–Butuan City	19.42
Cavite	Sangley Point, Cavite	Trece Martirez City–Sangley Point	20.66
Sarangani	General Santos, South Cotabato	Alabel–General Santos	21.08
Abra	Sinait, Ilocos Sur (former Vigan Station)	Bangued–Sinait	32.44
Sorsogon	Legaspi City, Albay	Sorsogon City–Legaspi	33.55
La Union	Baguio City, Benguet	San Fernando City–Baguio City	33.68
Bulacan	Science Garden, Quezon City	Bulacan–Quezon City	33.76
Batangas	Ambulong, Batangas	Batangas City–Ambulong	37.13
Tarlac	Cabanatuan, Nueva Ecija	Tarlac City–Cabanatuan	40.43
Kalinga	Tuguegarao, Cagayan	Kalinga–Tuguegarao	41.23
Aklan	Roxas City, Capiz	Aklan–Roxas City	43.61
Cotabato (North)	Davao City, Davao del Sur	Cotabato–Davao City	46.85
Davao del Norte	Davao City, Davao del Sur	Tagum City–Davao City	48.41
Davao del Sur	Davao City, Davao del Sur	Digos City–Davao City	49.5
Agusan del Sur	Butuan City, Agusan del Norte	Prosperidad–Butuan City	52.88
Basilan	Zamboanga City, Zamboanga del Sur	Basilan–Zambonaga City	55.65
Lanao del Sur	Lumbia Airport, Misamis Oriental	Marawi–Lumbia Airport	56.2
Laguna	Sangley Point, Cavite	Santa Cruz–Sangley	56.87
South Cotabato	General Santos, South Cotabato	Koronadal–General Santos	58.65
Nueva Vizcaya	Baguio City, Benguet	Bayombong–Kennon Road	59.51
Isabela	Tuguegarao, Cagayan	Ilagan–Tuguegarao	61.9

Table 1. (continuation)

APIS-FIES Province/City	Weather station	Provincial capital and weather station	Straight line/air distance (in km)
Isabela City	Tuguegarao, Cagayan	Isabela City–Tuguegarao	61.9
Catanduanes	Legaspi City, Albay	Virac–Legaspi	70.46
Biliran	Tacloban City, Leyte	Naval–Tacloban City	70.51
Eastern Samar	Guiuan, Eastern Samar	Borongan–Guiuan	71.26
Compostela Valley	Davao City, Davao del Sur	Nabunturan–Davao City	72.68
Apayao	Tuguegarao, Cagayan	Apayao–Tuguegarao	73.16
Marinduque	Tayabas, Quezon	Boac–Tayabas	75.46
Zamboanga del Sur	Dipolog. Zamboanga del Norte	Pagadian City–Dipolog	75.66
Ifugao	Baguio City, Benguet	Lagawe–Baguio City	78.65
Pampanga	Iba, Zambales	San Fernando City–Iba	79.15
Surigao del Sur	Hinatuan, Surigao del Sur	Tandag City–Hinatuan	80.76
Sultan Kudarat	General Santos, South Cotabato	Sultan Kudarat–General Santos	85.54
Mountain Province	Baguio City, Benguet	Bontoc–Baguio City	87.15
Misamis Occidental	Lumbia Airport, Misamis Oriental	Oroquieta City–Lumbia Airport	89.48
Masbate	Legaspi City, Albay	Masbate City–Legaspi City	90.04
Bataan	Iba, Zambales	Balanga–Iba	91.19
Davao Oriental	Davao City, Davao del Sur	Mati–Davao City	91.54
Camiguin	Lumbia Airport, Misamis Oriental	Mambajao–Lumbia Airport	92.3
Lanao del Norte	Lumbia Airport, Misamis Oriental	Tubod–Lumbia Airport	93.21
Iloilo	Roxas City, Capiz	Iloilo City–Roxas City	94.48
Camarines Sur	Virac, Catanduanes	Pili–Virac	100.13
Negros Occidental	Roxas City, Capiz	Bacolod City–Roxas City	104.27
Zamboanga Sibugay	Zamboanga City, Zamboanga del Sur	Ipil–Zamboanga City (from Zamboanga Del Sur)	111.18
Occidental Mindoro	San Jose, Oriental Mondoro	Mamburao–San Jose	113.17
Maguindanao	General Santos, South Cotabato	Shariff Aguak–General Santos	118.03
Antique	Roxas City, Capiz	San Jose de Buenavista–Roxas City	124.85
Quirino	Tuguegarao, Cagayan	Quirino–Tuguegarao	134.56
Cotabato City	Davao City, Davao del Sur	Cotabato City–Davao City	135.09
Sulu	Zamboanga City, Zamboanga del Sur	Jolo–Zambonaga City	149.25
Province with weather station			
Aurora	Baler, Aurora		
Oriental Mindoro	Calapan, Oriental Mindoro		

Table 1. (continuation)

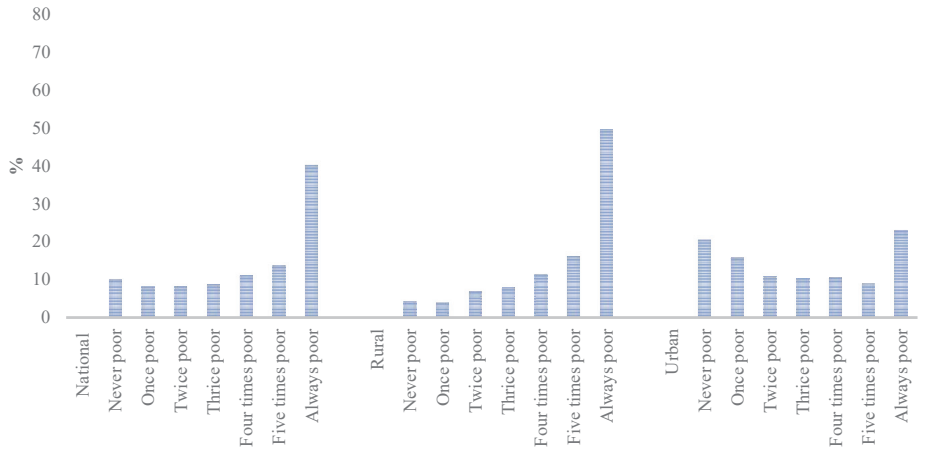
APIS-FIES Province/City	Weather station	Provincial capital and weather station	Straight line/air distance (in km)
Northern Samar	Catamaran, Northern Samar		
Samar (Western)	Catbalogan, Western Samar		
Camarines Norte	Daet, Camarines Norte		
Zamboanga del Norte	Dipolog, Zamboanga del Norte		
Negros Oriental	Dumaguete, Negros Oriental		
Zambales	Iba, Zambales		
Ilocos Norte	Laoag City, Ilocos Norte		
Albay	Legaspi City, Albay		
Southern Leyte	Maasin, Southern Leyte		
Bukidnon	Malaybalay, Bukidnon		
4th District of National Capital Region (NCR)	Ninoy Aquino International Airport, Pasay City		
Manila	Port Area (MC), Manila		
Palawan	Puerto Princesa City, Palawan		
Romblon	Romblon, Romblon		
Capiz	Roxas City, Capiz		
NCR-2nd District	Science Garden, Quezon City		
NCR-3rd District	Science Garden, Quezon City		
Ilocos Sur	Sinait, Ilocos Sur (former Vigan Station)		
Surigao del Norte	Surigao, Surigao del Norte		
Leyte	Tacloban City, Leyte		
Bohol	Tagbiliran City, Bohol		
Cagayan	Tuguegarao, Cagayan		
Province without weather station			
Batanes			
Guimaras			

PAGASA = Philippine Atmospheric, Geophysical and Astronomical Services Administration; APIS = Annual Poverty Indicators Survey; FIES = Family Income and Expenditure Survey; km = kilometer
Source: Author's compilation using data from Globefeed.com (2017)

than the food threshold and 0 if otherwise. The number of times a household fell below the threshold was counted. A count of 0 means that the household is never food poor and a count of 6 means that the household is always food poor.

Figure 1 shows that around 40 percent of the sample were always food poor while the rest were either never poor or were moving in and out of food poverty. In rural areas, 50 percent of the households were always food poor and around 2 percent were never food poor. Although the rest of rural households were moving in and out of food poverty, a larger percentage experienced high frequency of food poverty.

Figure 1. Food poverty, overall, and by urbanity: Philippines



Source: Authors' computation using data from PSA (various years)

The percentage of never food poor and always food poor in urban households were relatively similar at 20 percent and 22 percent, respectively. The rest of the urban households were moving in and out of food poverty. Among these, those once food poor had the highest percentage at around 15 percent. Meanwhile, those five times food poor had the lowest percentage at around 10 percent.

Food poverty among regions in Luzon is presented in Figure 2. NCR had the highest percentage of never food-poor households at 35 percent, followed by CALABARZON (Cavite, Laguna, Batangas, Rizal, and Quezon provinces) at around 20 percent, Cagayan Valley region[3] and Central Luzon[4] at around 15 percent, Ilocos region[5] at around 12 percent, and Cordillera Administrative Region (CAR)[6] at around 2 percent.

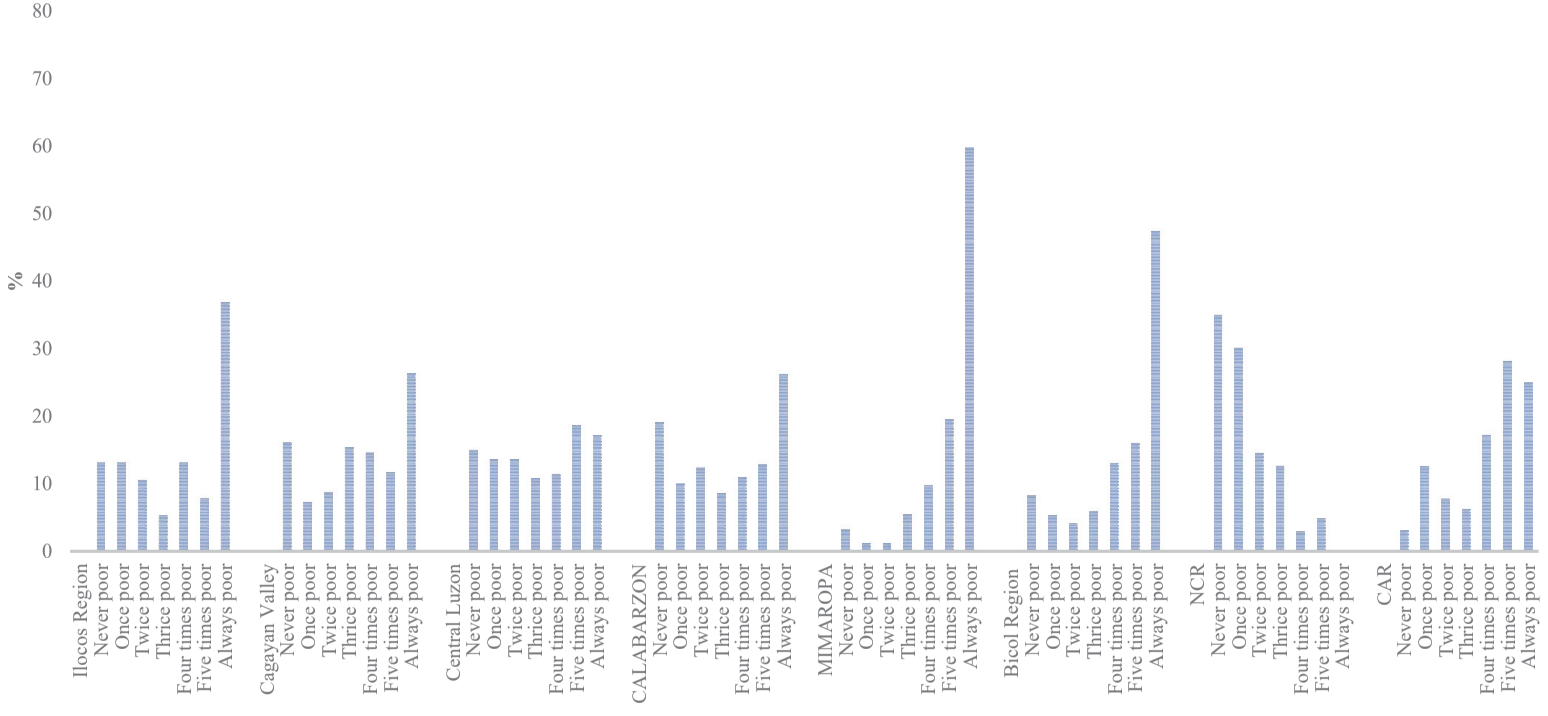
The percentage of always food-poor households was highest in MIMAROPA[7] at 60 percent, followed by Bicol region[8] at 48 percent, and Ilocos region at 38 percent. About 28 percent were always food-poor households in Cagayan Valley and CALABARZON. Meanwhile, in CAR, about 25 percent of households were always food poor and about 45 percent were four and five times food poor.

Food poverty among regions in the Visayas is presented in Figure 3. About 11 percent of households in Western Visayas[9] and Eastern Visayas[10] while 8 percent in Central Visayas[11] were never food poor, respectively. The percentage of always poor households in Central Visayas was around 48 percent while that of Western and Eastern Visayas was around 35 percent.

Figure 4 shows that most regions in Mindanao had high food poverty, of which the highest was from the Autonomous Region in Muslim Mindanao (ARMM)[12] at 70 percent. Davao region[13] and

[3] Batanes, Cagayan, Isabela, Nueva Vizcaya, and Quirino
[4] Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, and Zambales
[5] Ilocos Norte, Ilocos Sur, La Union, and Pangasinan
[6] Abra, Benguet, Ifugao, Kalinga, Mountain Province, and Apayao
[7] Mindoro, Marinduque, Romblon, and Palawan
[8] Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate, and Sorsogon
[9] Aklan, Antique, Capiz, Guimaras, and Iloilo
[10] Biliran, Eastern Samar, Leyte, Northern Samar, Samar, and Southern Leyte
[11] Bohol, Cebu, Negros Oriental, and Siquijor
[12] Basilan, Lanao del Sur, Maguindanao, Sulu, and Tawi-Tawi
[13] Compostela Valley, Davao del Norte, Davao del Sur, Davao Occidental, and Davao Oriental

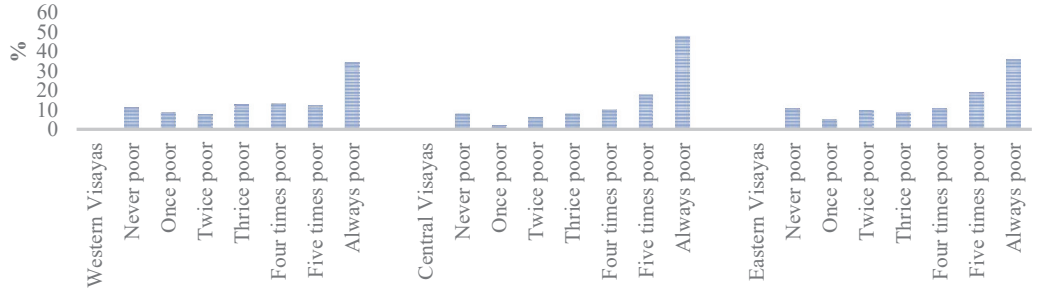
Figure 2. Food poverty in Luzon regions



CALABARZON = Cavite, Laguna, Batangas, Rizal, and Quezon; MIMAROPA = Occidental and Oriental Mindoro, Marinduque, Romblon, Palawan; NCR = National Capital Region; CAR = Cordillera Administrative Region

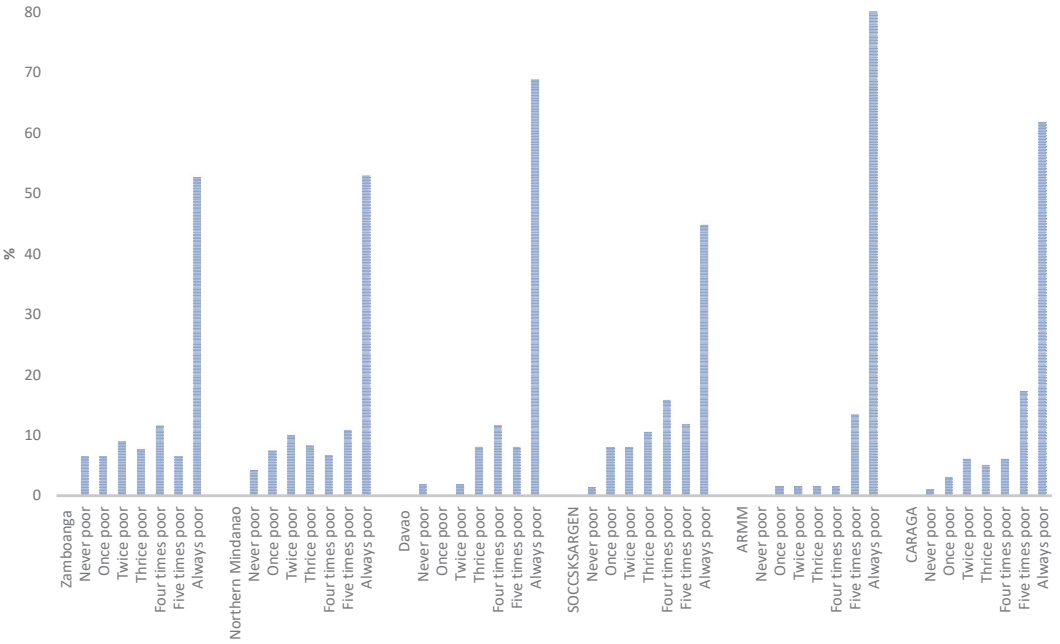
Source: Authors' computation using data from PSA (various years)

Figure 3. Food poverty in Visayas regions



Source: Authors' computation using data from PSA (various years)

Figure 4. Food poverty in Mindanao regions



SOCCSKSARGEN = South Cotabato, Cotabato, Sultan Kudarat, Sarangani, and General Santos; ARMM = Autonomous Region in Muslim Mindanao
Source: Authors' computation using data from PSA (various years)

CARAGA[14] had a food poverty rate of about 60 percent while Zamboanga Peninsula[15] and Northern Mindanao[16] had around 51 percent each.

Overall, NCR had the highest percentage of never food-poor households. CALABARZON, Central Luzon, and Cagayan Valley—regions close to the NCR—had high percentages of never food-poor households. In Luzon, always food-poor households were highest in MIMAROPA and Bicol, the regions beleaguered by the presence of the New People's Army (NPA) (Arguelless and Ostria 2018; Formoso 2017).

[14] Agusan del Norte, Agusan del Sur, Dinagat Islands, Surigao del Norte, and Surigao del Sur
[15] Zamboanga del Norte, Zamboanga Sibugay, Zamboanga del Sur, Isabela City, and Zamboanga City
[16] Misamis Oriental, Misamis Occidental, Bukidnon, Camiguin and Lanao del Norte

The Mindanao regions had a higher percentage of always food-poor households than Luzon and the Visayas. Among the Mindanao regions, the ARMM, where armed conflict often occurs, had the highest percentage of always food-poor households. Provinces, such as Camarines Norte, Camarines Sur, Sorsogon, Masbate, and Albay in the Bicol region and Western and Northern Samar in Eastern Visayas were vulnerable to frequent typhoons and at risk of rainfall change.

While the above discussion does not provide correlates, it presents the profiles of the regions that can potentially be associated with their food poverty statistics. Regional disparities, as seen in the food poverty statistics, were results of armed conflict, natural disasters, and weather shocks, among other factors (Schiavo-Campo and Judd 2005).

EMPIRICAL STRATEGY

This study assumed that $p(y_i=n|x,z)=f(x,z;\ e)$, where y was an indicator of poverty status. Two y indicators were constructed: y_1 was equal to 1 if the household is food poor and 0 if not food poor; and y_2 took the value of 0 up to 6 to represent the number of times the household has become food poor. Probit regression was used for y_1 while multinomial logit regression was used for y_2.

The variable x was a vector of the household head's attributes, such as age, education, and marital status, demographic composition, labor market participation, and membership in nongovernmental organization and/or cooperatives. The variable z referred to geographical characteristics, including rainfall deviation, a dummy for areas with armed conflict, and a dummy for urban areas. The variable e was assumed to be an independently and identically distributed error term.

To control for the heterogeneity in the capacity to pay/purchase, a score to the proxy for asset ownership was generated by the principal component analysis (PCA). PCA is a technique to reduce the dimension of the data by creating uncorrelated indices or components, where each component is a linear weighted combination of the initial variables.

The variance of each of the component was generated such that the first component contained the largest variation in the original data and the second explained additional but less variation, and so on (Filmer and Pritchett 2001). Based on Filmer and Pritchett's study, the PCA was applied on household assets to create an indicator for socioeconomic status in the absence of income and expenditure data. Positive scores generated by the PCA were associated with higher socioeconomic status (Vyas and Kumaranayake 2006).

While FIES had detailed data on asset ownership, the assets included in the PCA were collected from both the APIS and FIES. These included radio, television, component, refrigeration, washing machine, air conditioning unit, car, landline phone, personal computer, and gas range. The overall Kaiser-Meyer-Olkin measure of sampling adequacy was around 0.86 in each year, which indicated that these assets contained enough similar information to warrant the factor analysis[17]. Based on the score generated by the PCA, a dummy variable was created, where it was equal to 1 if the score was positive in all years and 0 if otherwise. Following Vyas and Kumaranayake (2006), this dummy variable proxied for high socioeconomic status.

Areas with conflict included Western Mindanao, Central Mindanao, ARMM, Davao del Sur, Sarangani, South Cotabato, Sultan Kudarat in Southern Mindanao, Quezon, Rizal, Mindoro, Bicol, Masbate, and Sorsogon. Provinces in Bicol region and MIMAROPA were plagued by unrest attributed

[17] The Kaiser-Meyer-Olkin (KMO) statistic tests if the data are suited for factor analysis by measuring the sampling adequacy for (1) each variable; and (2) for the complete model (Kaiser 1970). This statistic is a summary of how small the partial correlations are relative to the original correlations. If the variables share common factor/s, then the partial correlations should be small and the KMO should be close to 1.0.

to the presence of NPA, while the Mindanao areas were torn by the resistance to central control and the resentment toward the increasing number of Christian settlers (Schiavo-Campo and Judd 2005).

The labor market participation of the household head and the spouse was also included as explanatory variables. A dummy variable equal to 1 was created if the household head/spouse was employed in all the survey years and 0 if otherwise. Explanatory variables for y_1 were yearly values while explanatory variables for y_2, such as family size and demographic composition, were averages from 2003 to 2009.

Attrition bias

A common problem in the collection of longitudinal data is when the sample size becomes smaller in succeeding survey years. This problem is serious when nonparticipants have systematic characteristics that are related to poverty. If households with high opportunity costs (who also happen to be nonpoor) are to drop out of succeeding surveys, then estimates based on the remaining samples are likely to be bias upward.

Attrition bias, a case of selection bias, arises from the nonparticipation of respondents in succeeding survey years. It can affect the external and internal validities of multiwave studies (Miller and Hollist 2007). External validity means that the characteristics of the subsequent samples are generalizable to the initial samples. Internal validity means that the correlations among the variables are similar across survey years. While the PSA ensures that each replicate of the APIS and FIES possesses the properties of the master sample, this study has imposed additional restrictions based on the household head's age and sex to ascertain that the same families are tracked down throughout the survey years. These restrictions could present a possible attrition bias.

Following Miller and Wright's (1995) method of testing for attrition bias, a logit regression was ran on "stayers" using the independent variables extracted from 2003. Stayers was equal to 1 if the sample participated in the succeeding wave and equal to 0 if otherwise. Independent variables included the characteristics of the household head, household assets, demographic composition, and geographical location dummies. These should not be statistically significant to rule out attrition bias. The result indicated that the characteristics of the household head, the asset score, urban dummy, and some of the regional dummies were statistically significant determinants of participation in the entire survey wave[18]. Box M-test was used to check for internal validity and tests for the equality of the two covariance matrices for the samples observed only in the first period and for the samples observed in all periods. The null hypothesis using this test stated that the two covariance matrices were equal, indicating no threats to internal validity. The p-value computed using the Box M-test was 0.00, which indicated the rejection of the null hypothesis.

Following Heckman's (1979) method to correct for attrition bias, the Inverse Mills' Ratio[19] or

$$IMR = \frac{\phi(\beta x)}{\Phi(\beta x)}$$

was computed from the probit regression of the "stayers" against the characteristics of the household head, asset index, households' demographic composition, and geographical location dummies. The Inverse Mills' Ratio was included as one of the explanatory variables in the estimation in the next section.

[18] Results are available from the author upon request.

[19] $\phi(\beta x)$ is the probability density function and $\Phi(\beta x)$ is the cumulative density function.

DISCUSSION OF RESULTS

On the poor versus the nonpoor

Table 2 shows that households headed by persons with at least a college degree were less likely to be food poor relative to households headed by persons with less than a college degree. Households with members who belong to nongovernment organizations or cooperatives were also less likely to be food poor. Households with many members aged seven and below were more likely to be food poor. Households in urban areas and households with many older members were less likely to be food poor. On the other hand, households in areas with armed conflict and those that experience deviation in rainfall from its normal value were more likely to be food poor.

Table 2. Average marginal effects based on probit regression on food poor versus food nonpoor

	Distance (km)		
	At most 40	**At most 20**	**At most 10**
Attributes in 2003			
Household head age	0.00 *	0.00	0.00
	[0.00]	[0.00]	[0.00]
Married household head	-0.05	-0.03	-0.09
	[0.08]	[0.08]	[0.09]
College graduate household head	-0.16 ***	-0.16 ***	-0.17 ***
	[0.02]	[0.02]	[0.02]
Family size	0.08 ***	0.09 ***	0.08 ***
	[0.02]	[0.02]	[0.03]
Membership			
Nongovernment organization/Cooperative	-0.04 ***	-0.04 ***	-0.04 **
	[0.02]	[0.02]	[0.02]
Demographic characteristics			
Household members age < 1	0.08 ***	0.08 ***	0.08 ***
	[0.02]	[0.02]	[0.02]
Household members age ≥ 1 & age < 7	0.07 ***	0.06 ***	0.07 ***
	[0.01]	[0.01]	[0.01]
Household members age ≥ 7 & age < 15	0.05 ***	0.05 ***	0.05 ***
	[0.01]	[0.01]	[0.01]
Household members age ≥ 15 & age < 25	0.03 ***	0.03 ***	0.04 ***
	[0.01]	[0.01]	[0.01]
Household members age ≥ 25	-0.03 ***	-0.03 ***	-0.03 ***
	[0.00]	[0.00]	[0.01]
Positive asset score	-0.10 ***	-0.10 ***	-0.10 ***
	[0.01]	[0.01]	[0.01]
Labor market participation			
Job status of household head	0.02	0.01	0.02
	[0.02]	[0.02]	[0.03]

Table 2. (continuation)

	Distance (km)		
	At most 40	**At most 20**	**At most 10**
Employment of household head's spouse	-0.01	-0.01	0.00
	[0.01]	[0.01]	[0.02]
Geographic characteristics			
Areas with conflict	0.10 ***	0.08 ***	0.11 ***
	[0.02]	[0.02]	[0.02]
Urban *Rainfall deviation	-0.20 ***	-0.17 ***	-0.20 ***
	[0.02]	[0.02]	[0.02]
Weather variables			
Rainfall deviation	0.05 ***	0.06 ***	0.06 ***
	[0.01]	[0.01]	[0.01]
Urban*Rainfall deviation	0.01	-0.01	0.00
	[0.02]	[0.02]	[0.02]
Observations	5698	4821	3545
Wald chi ^{2}	762.03	643.4	494.19
Prob > chi ^{2}	0.00	0.00	0.00

km = kilometer
Notes: */**/*** Significant at 10/5/1% level. Figures in brackets are robust standard errors.
Estimates are generated using Probit regressions for panel data.
Inverse Mills Ratio is included in the explanatory variables.
Source: Authors' computation using data from PSA (various years)

On the frequency of poverty

Households headed by at least a college graduate were more likely to be never food poor and less likely to be always food poor (Tables 3a, 3b, 3c). These households were also more likely to be three times food poor although the probability was lower than being never food poor. Households with a big family size were less likely to be never food poor and more likely to be always food poor. In terms of household composition by age, those with many young members were less likely to be never food poor and more likely to be moving in and out food poverty. These households were also more likely to be always food poor although the probability was lower than being once, twice, thrice, or four times food poor. In addition, households headed by persons who work and those with durable assets were more likely to be either never food poor or once food poor.

In terms of geographical attributes, households in armed conflict areas were less likely to be once or twice food poor and more likely to be always food poor. Urban households were more likely to be never food poor although they were also more likely to be once or twice food poor and less likely to be always food poor. While rainfall deviation increased the probability of households being either never food poor or five times food poor, its effect was higher on the latter. Relative to households in the rural areas, urban households that experience rainfall deviation were less likely to be never food poor and more likely to be always food poor.

On the predicted chronic food poverty based on some scenarios

Chronic food poverty, defined as six times food poor from 2003 to 2009, was predicted based on the multinomial logit regression estimates. To assess the contribution of different variables on chronic

Table 3a. Estimates using multinomial logit regression on the frequency of food poverty

	Distance at most 10 km						
	Never poor	Once poor	Twice poor	Thrice poor	Four times poor	Five times poor	Always poor
Attributes in 2003							
Household head age	0.00**	0.00	0.00	0.00	0.00**	0.00	-0.00**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Married household head	0.01	0.03	-0.02	0.00	0.04	0.00	-0.06
	[0.03]	[0.03]	[0.03]	[0.03]	[0.04]	[0.04]	[0.06]
College graduate household head	0.12***	0.01	0.02	0.05**	-0.03	-0.03	-0.15***
	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.04]	[0.04]
Family size	-0.05***	-0.01	-0.02	0.03*	-0.02	0.00	0.07***
	[0.02]	[0.02]	[0.01]	[0.02]	[0.02]	[0.02]	[0.02]
Membership							
Nongovernment organization/ Cooperative	0.01	0.02	0.03	-0.02	-0.02	0.00	-0.02
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Demographic characteristics							
Household members age < 1	-1.00***	0.29***	0.15***	0.16***	0.17***	0.11**	0.12**
	[0.09]	[0.05]	[0.06]	[0.06]	[0.04]	[0.05]	[0.06]
Household members age ≥ 1 & age < 7	0.03	-0.04*	0.04	-0.04	0.02	-0.01	0.01
	[0.03]	[0.02]	[0.02]	[0.03]	[0.03]	[0.02]	[0.03]
Household members age ≥ 7 & age < 15	0.02	-0.03	0.00	-0.04**	0.02	0.00	0.03
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Household members age ≥ 15 & age < 25	0.03	0.00	0.02	-0.03	0.02	0.01	-0.03
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Household members age ≥ 25	0.01	0.03	0.02	-0.04	0.03	0.01	-0.06*
	[0.03]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.04]
Always positive asset score	0.13***	0.08***	0.04	0.00	0.06	-0.13	-0.18
	[0.02]	[0.02]	[0.03]	[0.05]	[0.04]	[0.11]	[0.11]
Labor market participation							
Job status of household head	0.01	-0.04	-0.03	-0.01	0.03	-0.03	0.07
	[0.02]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.05]
Employment of household head's spouse	0.05**	-0.03	-0.01	-0.03	0.01	0.01	0.00
	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.04]
Geographic characteristics							
Areas with conflict	-0.01	-0.11***	-0.05*	0.01	0.03	0.00	0.13***

Table 3a. (continuation)

	Distance at most 10 km						
	Never poor	Once poor	Twice poor	Thrice poor	Four times poor	Five times poor	Always poor
	[0.03]	[0.03]	[0.03]	[0.03]	[0.02]	[0.03]	[0.04]
Urban	0.16***	0.11***	0.05*	0.04	-0.02	-0.03	-0.32***
	[0.03]	[0.03]	[0.03]	[0.03]	[0.03]	[0.04]	[0.05]
Weather variables							
Rainfall deviation	0.14**	0.02	-0.09	0.02	-0.12	0.16**	-0.13
	[0.07]	[0.08]	[0.09]	[0.09]	[0.08]	[0.08]	[0.11]
Urban*Rainfall deviation	-0.29**	-0.1	-0.19	-0.16	0.11	-0.1	0.74***
	[0.12]	[0.13]	[0.20]	[0.15]	[0.17]	[0.18]	[0.25]
Observations	699						

km = kilometer
Notes: */**/*** Significant at 10/5/1-percent level. Figures in brackets are robust standard errors.
Estimates are generated using multinomial logit regression. Continuous dependent variables, such as age, demographic composition, and rainfall deviation, are averages. Labor market participation is a binary variable equal to 1 if the head (spouse) has participated always. Inverse Mills Ratio is included in the explanatory variables.
Source: Authors' computation using data from PSA (various years) merged with data on distance of the weather stations of the Philippine Atmospheric, Geophysical and Astronomical Services Administration

Table 3b. Estimates using multinomial logit regression on the frequency of food poverty

	Distance at most 20 km						
	Never poor	Once poor	Twice poor	Thrice poor	Four times poor	Five times poor	Always poor
Attributes in 2003							
Household head age	0.00	0.00	0.00	0.00	0.00**	0.00	-0.00***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Married household head	-0.01	0.04	-0.02	0.00	0.02	0.04	-0.07
	[0.02]	[0.03]	[0.02]	[0.03]	[0.03]	[0.04]	[0.05]
College graduate household head	0.10***	0.02	0.03	0.05***	-0.01	-0.02	-0.17***
	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.03]	[0.04]
Family size	-0.04***	-0.01	-0.02*	0.02*	-0.01	-0.01	0.07***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]
Membership							
Nongovernment organization/ Cooperative	0.02	0.02	0.01	-0.01	-0.01	-0.02	0.00
	[0.02]	[0.01]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Demographic characteristics							
Household members age < 1	-0.82***	0.22***	0.14***	0.12***	0.15***	0.13***	0.06
	[0.07]	[0.04]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]

Table 3b. (continuation)

	Distance at most 20 km						
	Never poor	Once poor	Twice poor	Thrice poor	Four times poor	Five times poor	Always poor
Household members age ≥ 1 & age < 7	0.01	-0.03	0.02	-0.03	-0.01	-0.01	0.04
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Household members age ≥ 7 & age < 15	0.00	-0.01	0.00	-0.04**	0.01	0.00	0.03
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
Household members age ≥ 15 & age < 25	0.02	0.00	0.02	-0.03*	0.00	0.03	-0.03
	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]
Household members age ≥ 25	0.01	0.03	0.02	-0.02	0.01	0.02	-0.06**
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.03]
Always positive asset score	0.10***	0.06***	0.07***	0.03	0.02	-0.12	-0.17*
	[0.02]	[0.02]	[0.02]	[0.03]	[0.04]	[0.09]	[0.09]
Labor market participation							
Job status of household head	0.00	-0.02	-0.04*	0.01	0.06*	-0.01	0.01
	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.03]	[0.04]
Employment of household head's spouse	0.04**	-0.01	0.00	0.00	0.00	0.00	-0.03
	[0.02]	[0.02]	[0.03]	[0.03]	[0.03]	[0.03]	[0.04]
Geographic characteristics							
Areas with conflict	-0.01	-0.09***	-0.05**	0.00	0.01	0.01	0.12***
	[0.02]	[0.03]	[0.02]	[0.03]	[0.03]	[0.03]	[0.03]
Urban	0.14***	0.11***	0.03	0.04*	0.03	-0.07*	-0.28***
	[0.03]	[0.03]	[0.02]	[0.02]	[0.03]	[0.04]	[0.05]
Weather variables							
Rainfall deviation	0.11*	-0.01	-0.14**	0.05	-0.02	-0.02	0.04
	[0.07]	[0.07]	[0.06]	[0.06]	[0.05]	[0.07]	[0.08]
Urban*Rainfall deviation	-0.24***	-0.15	-0.05	-0.20*	-0.03	-0.03	0.70***
	[0.09]	[0.11]	[0.11]	[0.11]	[0.13]	[0.20]	[0.21]
Observations	962						

km = kilometer

Notes: */**/*** Significant at 10/5/1-percent level. Figures in brackets are robust standard errors.

Estimates are generated using multinomial logit regression. Continuous dependent variables, such as age, demographic composition, and rainfall deviation, are averages. Labor market participation is a binary variable equal to 1 if the head (spouse) has participated always. Inverse Mills Ratio is included in the explanatory variables.

Source: Authors' computation using data from PSA (various years) merged with data on distance of the weather stations of the Philippine Atmospheric, Geophysical and Astronomical Services Administration

Table 3c. Estimates using multinomial logit regression on the frequency of food poverty

	Distance at most 40 km						
	Never poor	Once poor	Twice poor	Thrice poor	Four times poor	Five times poor	Always poor
Attributes in 2003							
Household head age	0.00	0.00	0.00	0.00	0.00**	0.00	-0.00***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Married household head	-0.03	0.03	-0.02	0.02	0.01	0.04	-0.05
	[0.02]	[0.03]	[0.02]	[0.03]	[0.03]	[0.03]	[0.04]
College graduate household head	0.10***	0.02	0.03	0.05***	-0.01	-0.01	-0.17***
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.04]
Family size	-0.03**	-0.02	-0.02	0.03**	-0.01	-0.02	0.07***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]
Membership							
Nongovernment organization/ Cooperative	0.02	0.01	0.01	-0.02	-0.01	-0.01	-0.01
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
Demographic characteristics							
Household members age < 1	-0.09	-0.01	0.02	-0.02	0.05	0.06*	-0.01
	[0.06]	[0.03]	[0.03]	[0.04]	[0.03]	[0.04]	[0.04]
Household members age ≥ 1 & age < 7	-0.01	-0.03	0.01	-0.04*	0.00	0.03	0.04
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
Household members age ≥ 7 & age < 15	0.00	-0.01	0.00	-0.04**	0.00	0.01	0.03
	[0.02]	[0.02]	[0.02]	[0.01]	[0.02]	[0.02]	[0.02]
Household members age ≥ 15 & age < 25	0.00	0.00	0.01	-0.03**	0.00	0.04***	-0.03
	[0.02]	[0.01]	[0.01]	[0.01]	[0.02]	[0.01]	[0.02]
Household members age ≥ 25	0.00	0.03*	0.02	-0.03	0.01	0.03	-0.07**
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Always positive asset score	0.10***	0.06***	0.07***	0.02	0.01	-0.08	-0.18**
	[0.02]	[0.02]	[0.02]	[0.03]	[0.04]	[0.06]	[0.08]
Labor market participation							
Job status of household head	-0.02	-0.03	-0.04*	0.01	0.05**	0.00	0.03
	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.03]	[0.04]
Employment of household head's spouse	0.06***	-0.03	0.00	-0.01	0.00	0.00	-0.02
	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.03]	[0.03]
Geographic characteristics							
Areas with conflict	-0.04*	-0.09***	-0.03	0.00	0.02	0.02	0.11***

Table 3c. (continuation)

	Distance at most 40 km						
	Never poor	Once poor	Twice poor	Thrice poor	Four times poor	Five times poor	Always poor
	[0.02]	[0.03]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Urban	0.12***	0.11***	0.04**	0.04*	0.03	-0.05*	-0.28***
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]	[0.04]
Weather variables							
Rainfall deviation	-0.04	0.01	-0.05	0.07	0.03	0.01	-0.03
	[0.06]	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]	[0.06]
Urban*Rainfall deviation	-0.12	-0.1	-0.11	-0.18**	-0.03	-0.19	0.73***
	[0.08]	[0.08]	[0.09]	[0.09]	[0.12]	[0.20]	[0.20]
Observations	1145						

km = kilometer

Notes: */**/*** Significant at 10/5/1% level. Figures in brackets are robust standard errors.

Estimates are generated using multinomial logit regression. Continuous dependent variables, such as age, demographic composition, and rainfall deviation, are averages. Labor market participation is a binary variable equal to 1 if the head (spouse) has participated always.

Inverse Mills Ratio is included in the explanatory variables.

Source: Authors' computation using data from PSA (various years) merged with data on distance of the weather stations of the Philippine Atmospheric, Geophysical and Astronomical Services Administration

food poverty, a benchmark household[20] with the following characteristics was used: The household is headed by a person who is married, is not always employed, has less than a college degree, and has a spouse who is not always employed. The benchmark household was also assumed to have two members who are less than one year old, one member who is between one year old and six years old, with asset scores that are at times less than 0, and located in an area beset by armed conflict. The benchmark household was also assumed to experience 0 rainfall deviation.

Chronic food poverty was predicted by changing one attribute in the benchmark characteristics each time. Comparisons of predicted chronic food poverty are presented in Figure 5. Prediction was made using households in provinces at most 20 kilometers away from a weather station.[21]

Chronic food poverty using benchmark characteristics in rural areas was around 46 percent—20-percentage points higher than in urban areas.

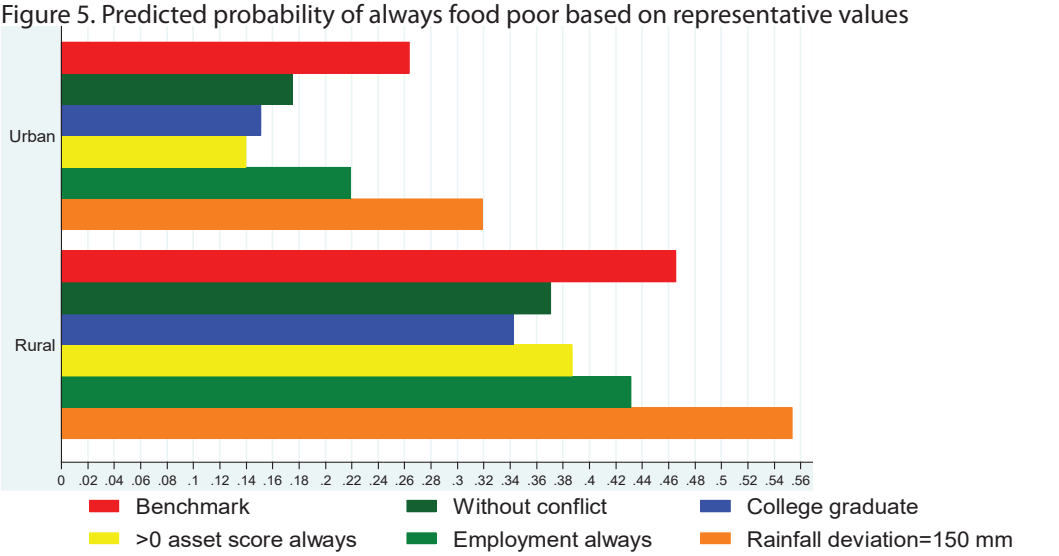
The study based on benchmark attributes showed that chronic food poverty in urban areas was around 8-percentage points lower for households in nonconflict areas and 11-percentage points lower for households headed by persons with at least a college degree. Chronic food poverty was around two times lower for households that always have a positive asset score while it was around 4-percentage points lower when the household head and spouse are always employed. When rainfall deviation is 150 millimeters[22] higher than the benchmark, chronic food poverty was around 6-percentage points higher.

[20] Evaluating the marginal effects using benchmark characteristics or marginal effects calculated at representative values, is different from the marginal effects at the means and the average marginal effects in that the latter two rely on averages.

[21] Similar exercises were done for samples at most 40 kilometers and 10 kilometers away from a weather station. Trends were similar.

[22] This is the maximum value of the rainfall deviation in the dataset. Other values of rainfall deviation are also used and the trends are similar to the trends presented here.

Figure 5. Predicted probability of always food poor based on representative values



Source: Authors' computation using data from PSA (various years) merged with data on distance of the weather stations of the Philippine Atmospheric, Geophysical and Astronomical Services Administration

Meanwhile, chronic food poverty in rural areas was around 9-percentage points lower for households in nonconflict areas and 12-percentage points lower for households headed by members with at least a college degree. It was also around 8-percentage points lower for households that always have a positive asset score while it was around 3-percentage points lower when the household head and spouse are always employed. When rainfall deviation was 150 millimeters higher than the benchmark, chronic food poverty was around 8-percentage points higher.

SUMMARY AND CONCLUSIONS

Using a simple spells approach, this paper found that rural areas had a substantially higher percentage of always food-poor households than do urban areas. The NCR had the highest percentage of never food-poor households. Most Luzon and Visayas regions had very high percentage of never food-poor households. Meanwhile, most regions in Mindanao had high food poverty, the highest of which was the ARMM. This paper analyzed the effects of key variables on food poverty using probit and multinomial logit regressions. Results indicated that predicted chronic food poverty was affected by education, employment, assets, conflict, and rainfall deviation. This merits a quick overview of the policy environment on these different factors so as to put the results in context.

In the education front, President Rodrigo Duterte has signed into law the bill on free tuition fee in state universities and colleges although there are still other issues that need to be addressed. Tuition is just a portion of education-related expenditures. Assistance on daily expenditures, such as meals and transportation, should also be strengthened to keep students from poor households in school until they complete their college education. Consequently, this will guarantee that public investments in these students' education are not wasted.

In addition, the *Pantawid Pamilyang Pilipino* Program (4Ps), a national social protection program, is a promising approach to building resilience among the poor. It has not only assisted the poor in sending their children to school but has enhanced the community and the *bayanihan*

spirit[23] as well. It has empowered members of poor families through the family development sessions and educated beneficiaries on biointensive gardening, communal gardening, and reforestation, among others.

The possible role of assets in consumption smoothing should be emphasized as well. Accumulation of assets—i.e., financial as well as social and human capital—is assured when livelihoods are stable. Along this line, the government should explore the role of social enterprises (SE), which use local knowledge and resources to address financial as well as social and environmental issues within a community. The Department of Social Work and Development's Sustainable Livelihood Program (SLP), through its employment facilitation track, can give SEs some incentives to put up enterprises in communities where the SLP is in place. Ballesteros and Llanto (2017) identify the following government support for SEs: (1) legal/regulatory framework to facilitate experimentation and innovation; (2) incentives for mixed financing; and (3) improvement of the suitability of the environment for grants, international aid, and venture capital.

Armed conflict, however, can destroy different assets. It damages (1) human assets by disrupting children's schooling and worker's mobility and (2) social assets, such as informal network within the community, by displacing people. It also disrupts the delivery of social protection programs to the affected communities. Finding solutions to armed conflict is not easy, but a good first step is to get stakeholders to understand the needs of the community, come up with feasible initiatives, and develop strong ownership for these initiatives. One way to achieve the sustainable use of the environment for livelihood, end armed conflict, and eventually address chronic poverty is to involve dissenting groups (e.g., NPA) into the Department of Environment and Natural Resources' ecotown projects.

Weather-related events also affect chronic food poverty. Based on PAGASA's projections using the midrange emissions scenario, weather events, such as increasing temperature and precipitation, are likely to be due to climatic shifts. People in rural areas can easily slip in and out of poverty since their livelihood depends on stable environments, such as even temperature and a steady supply of water.

To address the adverse effect of sustained weather fluctuations, local government units LGUs) should spearhead the development of a climate-smart agriculture that fits the needs of the community. By working to harness communities' local skills and knowledge in the development of good agricultural and livelihood practices, LGUs instill strong ownership among community members, making adaptation more likely to succeed.

The *Philippine Development Plan 2017-2022* acknowledges that at the LGU levels, funding for climate change adaptation competes with other development priorities. However, it should be noted that there are some adaptation funds that remain untapped. One, the People's Survival Fund (PSF), through Republic Act 10174 signed on August 16, 2012, was created as an annual fund that LGUs can use to implement climate change adaptation programs/projects. The PSF is appropriated PHP 1 billion per year.

While there have been a number of grant proposals submitted to the Climate Change Commission (CCC) for the PSF, only two projects have been approved (one each in Surigao del Sur and Surigao del Norte), with a total requested PSF funding of around PHP 120 million.

The PSF secretariat noted that most of the proposals submitted to CCC lacked the climate change adaptation component and were returned to proponents for revision. This indicates that CCC may need to enhance LGUs' technical capability by conducting an annual technical workshop on how to craft proposals with strong climate change adaptation initiatives. CCC should also improve

[23] A Filipino custom where people in a community work together to foster cooperation and unity in problem-solving.

its campaigns to inform the public on what CCC does and to increase awareness on what climate change adaptation is and how to access the various CCC services.

Aside from the PSF, another financing alternative is the Adaptation Fund,established under the Kyoto Protocol of the United Nations Framework Convention on Climate Change. The Adaptation Fund is a direct access to international financing mechanisms that enable country institutions to directly participate in the design, implementation, and monitoring of the climate change adaptation project.[24] To avail of the fund, the country must designate a national implementing entity (NIE), which once accredited, will be fully responsible for program/project implementation and management. The CCC can be the best national agency to spearhead the NIE and determine how the country can tap this additional adaptation funding source.

Proposals need to be evaluated for the Adaptation Fund grant. This again highlights how CCC-led capacity-building initiatives are needed to enable LGUs to come up with community-driven and well-defined adaptation projects and programs.

The government should also explore adaptive social protection (ASP) initiatives. These initiatives support propoor climate change adaptation and disaster risk reduction by strengthening the resilience of vulnerable populations to shocks (Davies et al. 2009). One ASP initiative that can be explored is the integration of environmental protection into the 4Ps. 4Ps strengthens human capital and self-sufficiency but currently does not explicitly address risks associated with climate change and with resulting shifts in weather patterns. Without adaptation, those at risk of being food poor are most vulnerable to adverse shifts in weather patterns. The environmental protection component under the ASP such as planting certain number of trees each year, beach reforestation, or management of household solid wastes, can become part of the 4Ps.

There are acknowledged limitations in this paper, which can be areas for further research in the future. One, the paper has not analyzed the lagged effects of weather shocks on chronic food poverty. Two, all estimations in the paper did not use weights since the weights assigned to households differ in each survey year. Future studies using the Philippines' dataset can devise a way to make the sample representative of the population. Three, to introduce variability and capture more weather shocks across the years, the paper has combined APIS and FIES datasets. This, however, raises several concerns, such as the differences in reference periods and the need to project poverty thresholds for the non-FIES years. Future studies that address these concerns will enhance estimation results and consequently, improve our understanding of chronic food poverty in the country.

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[24] The adaptation fund has several disadvantages. One, it is a direct access to international financing mechanism that enables country institutions to directly participate in the design, implementation, and monitoring of the project. Two, based on data from Institute for Climate and Sustainable Cities (ICSC) and Oxfam (2010), 86 percent of funds coming from bilateral donors to finance adaptation projects (1992-2018) are loans and 14 percent are grants; and 61percent of funds coming from bilateral donors to finance mitigation projects (1992-2018) are loans and 39 percent grants. Assistance through loans goes against the principle of common but differentiated responsibilities, which acknowledges that countries have different responsibilities and capabilities in addressing climate change. Developed countries contribute to high greenhouse gas emissions and are more capable of climate change mitigation and adaptation. If the assistance comes in the form of loans, ICSC and Oxfam (2010, p. 14) argue that this "reverses the burden-sharing role and imposes new debts to those severely affected by global climate change despite having contributed less to it."

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Social Protection and Demand for Health Care Among Children in the Philippines

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ABSTRACT

The Philippines has recently introduced two distinct but related large-scale social protection programs that, first, provide conditional cash transfers (CCT) to poor households, and, second, automatically enroll them into the government's social health insurance program. This has resulted in dramatic increase in health insurance coverage, especially among the poor. This paper assesses the joint impact of the two programs on the healthcare demand for children. Overall, the study finds encouraging impacts on the demand for healthcare services. While no direct impact on morbidity was found, results suggest that the social health insurance and the CCT program jointly induced greater hospital visits for both preventive and curative care, and lowered out-of-pocket expenditures. However, the study also documents possible implementation failures in the government's programs, as well as potential indication of healthcare service differentiation based on quality. Both these concerns may undermine the expected outcomes of the country's social protection programs.

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INTRODUCTION

Access to health care remains an important global concern. In a recent report, the World Health Organization and the World Bank estimated that about 400 million people worldwide have no access to essential healthcare services (WHO 2015). They also reported that 6 percent of the total population in developing countries are pushed (further) into poverty because of catastrophic health spending. Policy responses to improve access to healthcare services vary around the world, but generally range from the more traditional supply-side interventions, such as direct provision of healthcare services, to more recent innovations to induce healthcare demand, including the expansion of social health insurance and the introduction of conditional cash transfer (CCT) programs (Cotlear et al. 2015; Tangcharoensathien et al. 2015). Among the demand-side interventions, social health insurance (SHI) appears to be the most common (cf. Cotlear et. al. 2015), with many of the important reforms introduced in recent years (Wagstaff 2010a; Lagomarsino et al. 2012).

While it is widely accepted that health insurance coverage promotes better access to health care and greater financial security against catastrophic spending (e.g., Hsiao and Shaw 2007; WHO 2010), empirical assessment of the actual impact of social health insurance, especially in developing country contexts, remains limited. In the Philippines, for instance, social health insurance has been found to be positively associated with greater utilization of healthcare services (e.g., Kozhimannil et al. 2009; Gouda et al. 2016) and substantial reduction in out-of-pocket (OOP) expenses (Capuno et al. 2009), but utilization remains at suboptimal levels (Quimbo et al. 2008). There are also documented second-round impacts on health outcomes (Kraft et. al. 2009), and even on child school attendance (Capuno et al. 2009), but the evidences are weak. These earlier results in the Philippines are consistent with the general findings in other countries. For example, Acharya et al. (2013) systematically reviewed 64 papers on the effect of health insurance in low- and middle-income countries and presented a summary of the results from 19 studies that took into account selection into insurance. Overall, they found little evidence on the impact of health insurance on health status, some evidence on utilization, weak evidence on OOP health expenditures, and unclear effects on the poorest.

This dearth in evidence may be attributed, in part, to the difficulty in establishing the causal impact of health insurance on different important outcomes. In typical settings, those with health insurance differ from those without insurance along a number of characteristics that may or may not be observed by the researcher. Indeed, much of the empirical work in establishing the causal impact of insurance is on unraveling nonrandom selection into insurance coverage from the causal impact itself (cf. Wagstaff 2010b).

It is rarely that insurance coverage is assigned randomly. The few exceptions include the RAND Health Insurance Study (Newhouse 1993) in the United States, and the Quality Improvement Development Study (Shimkhada et al. 2008) in the Philippines. But studies that address confounding from unobserved heterogeneity, by design, have, to a large extent, implicitly disregard the contribution of unobserved idiosyncratic returns, which may play important roles in shaping the outcomes. For instance, difficulties complying with documentary requirements to file claims or lack of awareness of insurance benefits, both of which may not be readily observable to the researcher, may have profound impact on the utilization of social health insurance (Quimbo et al. 2008).

We depart from the literature in this regard. Rather than implicitly assuming away the contribution of unobserved confounding, we instead use it to our advantage. More specifically, we employ a large-scale, yet imperfect natural experiment to limit the direction of the potential bias

from unobserved heterogeneity, which, at the same time, allows estimation of the joint impact of two related but distinct social protection programs.[2]

This paper reports the impact of social health insurance coverage on children using a large-scale social protection intervention in the Philippines, i.e., the *Pantawid Pamilyang Pilipino* Program (4Ps), a CCT program that targets poor households, as instrument. As part of the intervention, 4Ps beneficiary-households, along with all other poor households identified in the government's national targeting system, are automatically enrolled in the country's social health insurance program. As beneficiaries of the CCT program, households need to comply with various conditions, including school attendance of children, pre- and post-natal checkup of mothers, and preventive checkups of children aged 0 to 5 years old.[3] A key difference between 4Ps and other cash transfer programs is the requirement for beneficiaries to attend regular workshops, called family development sessions (FDS), that cover topics on self-development, health, and civic empowerment, among others (c.f. Kandpal et al. 2016). Health and nutrition are discussed prominently in the FDS, with separate modules dedicated for health and nutrition, and environmental health. Other health-related topics, such as the importance of breastfeeding, response to health emergency, and home remedies for common ailments are included in other FDS modules.

The country's SHI and CCT programs have a combined budget of about USD 3.5 billion in 2017, or about 1 percent of the country's gross domestic product for that year. During the same year, the CCT program has 4.4 million active household beneficiaries. The country's SHI program, on the other hand, covers 93 percent of the total Philippine population. Among those included in the SHI program, about 40 percent are covered under the sponsored programs.

On the one hand, using enrollment in the CCT program as instrument for SHI coverage poses an estimation challenge since, at worst, we cannot fully isolate the impact of SHI coverage on health outcomes. On the other hand, it also provides a rare opportunity to unravel how unobserved heterogeneity may be important in designing social protection programs. While selection into the CCT program may be external to households, program interventions are expected to directly influence demand for healthcare services through an income effect from direct cash transfers, and information spillovers from the different program interventions. Combined with the price effect from health insurance coverage, the opportunity for gains from having both programs simultaneously may be large. We attempt to recover the distinct impact of SHI by way of calibration using results from earlier impact evaluation studies on the 4Ps. We show that the separate contributions of either programs are nontrivial.

Overall, the study finds encouraging impacts of social protection on the demand for health care. While we find no direct impact on morbidity, results suggest that SHI and the CCT program jointly induced greater hospital visits for both preventive and curative care and lowersed OOP expenditures. However, we also document possible implementation failures in the government's programs, as well as potential indication of healthcare service differentiation based on quality. Both these concerns may undermine the expected outcomes of the country's social protection programs.

[2] Social protection refers to policies and programs that are designed to minimize vulnerability to risks and to raise standards of living above a set minimum threshold. It typically includes contributory social insurance and pension systems, noncontributory social assistance and safety nets programs, and labor market programs.

[3] Monitored children in elementary school and high school receive PHP 300 and PHP 500 per month, respectively, as education grant for attending school. Up to three children may be enrolled as beneficiaries under 4Ps. Prior to 2014, only children up to 14 years of age may be enrolled as part of the CCT program. This age limit has since been extended up to age 18. Health grants worth PHP 500 per month are provided to households with pregnant mothers or with infants in exchange for regular health checkups and for attending FDS. More recently, 4Ps beneficiaries are also provided a rice subsidy equivalent to PHP 7,200 per year.

The Philippine case is interesting because of its relatively long history of SHI reforms compared to other developing countries. The Philippines's national health insurance program (NHIP) was created in 1969, reorganized 26 years after, and, in the past 10 years, made great strides in closing the gap in universal health coverage, at least in terms of health insurance enrolment, through the various reforms it has introduced. Some of the more recent reforms include a shift from a fee-for-service to a case rate payment system and the greater reliance on taxes, specifically on alcohol and tobacco products, to finance the health insurance coverage of the poor. These innovations are in many ways shared with other SHI systems around the world, but in some respects also unique.[4]

This study is also particularly appealing in regard to the optimal design of CCT programs around the world. To a large extent, SHI systems and CCT programs have evolved independently of each other, although there are pieces of evidence that CCT-receipt is associated with greater propensity for health insurance enrollment (e.g., Biosca and Brown 2015). Several meta-analyses have shown that CCT programs are associated with greater health facility use (Lagarde et al. 2009; Malqvist et al. 2013) and better child nutrition (Manley et al. 2012), which may be a direct consequence of the program conditionalities rather than the accompanying financial incentives (Bassani et al. 2013). In many parts of the world, CCT programs are often designed together with other complementary programs, such as supply-side interventions, in addition to the demand-side conditionalities (Ranganathan and Lagarde 2012; Glassman et. al. 2013). However, these different interventions are often studied separately, and in some instances without regard to the potential spillovers among these complementary programs. For instance, Colombia's household targeting system is used to identify eligibility in subsidized health insurance, but also in CCT and other social protection programs (e.g., Miller et al. 2013). Being able to identify which complementary programs jointly provide the greatest impact is imperative in designing social protection programs especially when resources are constrained.

SOCIAL HEALTH INSURANCE IN THE PHILIPPINES

The Philippine SHI system has existed for almost half a century. In 1969, health insurance funds were established under the country's autonomous pension systems for public and private sector workers. A separate medical care program was instituted for the rest of the population not covered by the national pension systems. These together formed the country's Medical Care Plan (Medicare). With the reorganization of the country's SHI system in 1995, the separate health insurance funds of the two pension systems were combined to become part of the core of what is now the Philippine Health Insurance Corporation (PHIC). PHIC is mandated to build on and expand the programs of the original Medicare to eventually have a universal health insurance program covering the whole population.

The PHIC maintains generally three types of membership, although its naming convention has changed through the years. There are the self-contributing members, from both the formal and informal sectors, who pay premium contributions either through their employers or remitted directly by them to PHIC. There are lifetime members who have reached retirement age, had paid a minimum of 120 monthly premium contributions, and are no longer required to pay premium contributions to remain insured by the system. Finally, there are sponsored members whose premium contributions are paid by other parties, such as the national government or the local government units. Dependents of principal members share the benefits of the SHI system but need not pay premium contributions.

[4] See for instance Lagomarsino et. al. (2012) and Vidcu et. al. (2016) for cross-country comparison of social health insurance systems, including that of the Philippines.

The insurance coverage by PHIC pays for both inpatient and outpatient healthcare services, although outpatient coverage is provided only for sponsored members and their dependents.[5] Until 2011, PHIC operates on a first-peso fee-for-service system wherein purchased medical goods and services by patients are reimbursed up to a fixed ceiling. This system has since been abandoned with the adoption of the first-peso case rate payment system wherein PHIC pays a fixed rate covering both professional and other fees for every patient's medical or surgical case. Any fees in excess of the case rates provided by PHIC are borne by the patient or by the health facility depending on the individual's membership type. In either system, physicians need to be accredited by PHIC to be able to participate in the country's NHIP.

The Philippines' NHIP is a hybrid SHI system where insurance payments are paid for by contributions of paying members and through taxes paid by the general population that covers the premium contribution of sponsored members. In the earlier years of PHIC the tax-based premium contributions cover only a very small portion of its premium collections, but has increased dramatically in recent years (Pantig 2013). In 1998, tax-based premium contributions comprise only two percent of all premium collections by PHIC. This has ballooned to about 30 percent by 2012, and to almost half by 2014. In 2016, the PHIC's reported premium contributions totaled USD 2 billion, but 98 percent of this has been used for expenses on benefit claims.

Official estimates by PHIC point to about 93 percent of the population being covered by SHI in 2017, up from only 73 percent in 2007. However, independent estimates show wide variation in coverage rates across different regions in the country (e.g., Silfverberg 2013). Overall, PHIC remains a small portion of healthcare funding in the country, covering only 16 percent of all personal health care expenditures in 2014 (PSA 2016), although there is a general increasing trend since its creation.

With the reorganization of the Philippine's NHIP in 1995, a special membership category for indigents was created.[6] Unlike other types of members who directly pay PHIC, the payment of premium contributions of indigent members are paid by the government. In the early years of the program, the contributions of indigent members are shared by the PHIC, the national government, and the local government units.

In 2008, primary members in the sponsored program for indigents totaled 3.3 million, or about a fifth of all primary members of PHIC. Various programs initiated thereafter resulted in significant increase in the PHIC-sponsored program membership.

Starting in 2010, the PHIC adopted the means test protocol of the National Household Targeting System for Poverty Reduction (NHTS-PR), more commonly known as *Listahanan*, by the Department of Social Welfare and Development (DSWD) to identify poor families eligible for the PHIC's sponsored program. Households identified as poor in the NHTS-PR, which includes CCT program recipients, are automatically enrolled under PHIC.[7]

In 2011, PHIC introduced the "no-balance billing" (NBB) policy for sponsored members and their dependents who are admitted in government hospitals. The NBB policy requires cooperating health facilities to cover the costs of health services provided to sponsored program beneficiaries beyond what is paid for under the PHIC case rates.

[5] See Pantig (2013) for an excellent discussion of PHIC coverage rates and benefit programs.

[6] Under the National Health Insurance Act of 2013 or Republic Act (RA) 10606, an indigent refers to a "person who has no visible means of income or whose income is insufficient for family subsistence."

[7] Starting in 2010, the government adopted the NHTS-PR as a mechanism to identify poor households that may be recipients of its various social protection program. However, it is not until in 2013, with the adoption of RA 10606, when all poor households identified in the NHTS-PR are automatically included as part of PHIC's sponsored program.

Beginning in 2012, PHIC has been receiving a greater portion of excise taxes on alcohol and tobacco products[8] collected by the national government to support the NHIP. By 2013, PHIC has enrolled close to 10 million indigent primary members in its sponsored program, or about a third of all its primary members. With the latest amendments in the Philippines' National Health Insurance Act taking effect in 2014, the national government started fully subsidizing the premium contributions of poor households.

DATA

We used the 2013 National Demographic and Health Survey (NDHS) (PSA 2013) to investigate the potential impacts of insurance coverage on morbidity, household health facility utilization and OOP expenditures, physician behavior, and consumer satisfaction. The 2013 NDHS is the tenth in a series of demographic and health surveys conducted every five years since 1968 by the PSA (previously the National Statistics Office). The NDHS is a nationally representative survey of reproductive-aged women with the primary objective of providing information on women's fertility, family planning practices, and health. In 2013, the NDHS includes modules on insurance coverage and on health facility utilization by every member in surveyed households, which we exploit in our analysis.

This study focused on the impact of insurance coverage on children living with their mother at the time of the survey. All children living with surveyed mothers were included regardless of the child's age. The sample contained information on 25,534 individuals in total, but regression models were based on a more limited sub-sample of individuals depending on the availability of information on control variables or on restrictions imposed by the behavioral outcomes measured.

Table 1 presents descriptive statistics for various child and household characteristics that we use in our analysis. Separate estimates were provided by insurance type for the full sample of children, and for children in the first and second poorest household quintiles in the sample. Overall, the demographic characteristics of children and parents appeared similar across insurance coverage status. But insured children have lower propensity to pay OOP for hospitalization. The share of OOP expense for hospitalization was also substantially lower among insured children.

At the time of the survey, the 4Ps had an annual budget of about USD 0.9 billion, and covered almost four million beneficiary households that were spread over 1,627 cities and municipalities in 97 provinces. This is about a fifth of the total number of households in the country of around 20 to 23 million between 2010 and 2015. When the program was introduced in 2008, the 4Ps only covered 160 cities and municipalities in provinces with the highest headcount poverty incidence rates (World Bank 2014; DSWD 2014). In contrast, the share of CCT household beneficiaries in our sample was slightly higher, comprising about 27 percent of the 9,656 households in our 2013 NDHS sample. This difference potentially reflects the specific population covered by the NDHS, i.e., reproductive-aged women.

As mentioned in the previous section, CCT program beneficiaries are automatically enrolled in the sponsored program of PHIC. This does not mean that all children living in CCT-beneficiary households are insured however. For instance, children who are 21 years old and over may not be claimed as dependents of PHIC primary members. Also, it is possible that not all members of multi-family, multi-generation households are included as beneficiaries of the CCT program. In any case, having a CCT beneficiary in the household raises the propensity of a child in the same household being covered by health insurance. In our sample, 79 percent of children living

[8] Between 1995 and 2013, 25 percent of the incremental tax revenue collected from tobacco products was earmarked for the Philippine's NHIP. Beginning in 2014, the share was raised to 80 percent, and for the incremental tax collections on both alcohol and tobacco products.

Table 1. Descriptive Statistics for various child and household characteristics used in the analysis

	All Households				Poor Households			
	Insured		Not Insured		Insured		Not Insured	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Child characteristics								
Age	9.48	6.03	9.94	7.59	9.08	5.61	9.27	7.40
Female	0.48	0.50	0.46	0.50	0.48	0.50	0.46	0.50
Education, highest grade completed								
Primary	0.38	0.49	0.31	0.46	0.43	0.49	0.34	0.47
Secondary	0.18	0.38	0.19	0.39	0.15	0.36	0.15	0.36
Higher	0.06	0.24	0.07	0.25	0.02	0.13	0.03	0.16
Sick in past 30 days	0.26	0.44	0.27	0.44	0.28	0.45	0.28	0.45
Visited health facility in past 30 days	0.14	0.34	0.15	0.36	0.16	0.36	0.15	0.35
Confined in hospital in past 30 days	0.06	0.23	0.05	0.22	0.05	0.22	0.05	0.22
Paid out-of-pocket for services outside of hospital	0.97	0.17	0.97	0.17	0.97	0.17	0.97	0.18
Paid out-of-pocket for hospitalization	0.77	0.42	0.98	0.13	0.83	0.38	0.98	0.13
Out-of-pocket expense (share of total bill)	0.45	0.39	0.97	0.15	0.37	0.40	0.97	0.15
Household characteristics								
CCT Household	0.47	0.50	0.18	0.38	0.76	0.43	0.26	0.44
Wealth index (studentized)	0.18	1.06	0.30	0.94	-1.05	0.56	-1.01	0.59
Father's age	40.34	8.50	39.34	10.13	40.29	8.54	38.52	10.08
Father's education, highest grade completed								
Primary	0.27	0.45	0.31	0.46	0.44	0.50	0.43	0.49
Secondary	0.43	0.49	0.48	0.50	0.44	0.50	0.42	0.49
Higher	0.28	0.45	0.16	0.37	0.08	0.28	0.07	0.26
Mother's age	37.03	7.09	35.72	8.70	36.72	7.10	35.03	8.67
Mother's education, highest grade completed								
Primary	0.34	0.47	0.37	0.48	0.55	0.50	0.51	0.50
Secondary	0.36	0.48	0.42	0.49	0.33	0.47	0.34	0.48
Tertiary or higher	0.27	0.44	0.17	0.37	0.07	0.26	0.07	0.26
Parents are living together	0.93	0.26	0.94	0.24	0.96	0.19	0.95	0.21

SD = standard deviation; CCT = conditional cash transfer

Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014)

in CCT households have health insurance coverage, compared to only 53 percent of children in non-CCT households.

ESTIMATION

Health insurance coverage status in our data are not randomly assigned. To the extent that selection into health insurance coverage are influenced only by observable characteristics, e.g., educational attainment, sex or age, then adjusting for these characteristics, say through an ordinary least squares (OLS) model, will provide an unbiased estimate of the impact of insurance coverage on outcomes of interest.

Reality, however, is much more complex. For example, one can think of enrolment in health insurance packages as being related to individual preferences for risk-taking, which, in turn, also influences health-seeking behaviors (e.g. Arrow 1963). Failing to account for individual appetite for risks – or any other unobserved factors that are related to both health-seeking behavior and insurance coverage, for that matter – will generally lead to biased impact estimates. One can also imagine cases where the demands for health inputs, including insurance coverage, and health may be simultaneously determined (e.g., Grossman 1972; Zweifel and Manning 2000)., which would, again, introduce bias in the impact estimates of insurance coverage on health-seeking behavior.

To correct for the bias introduced by the endogeneity of health insurance coverage, we employ a large-scale natural experiment to estimate the impact of health insurance on various behavioral outcomes. Identification strategy was based on an instrumental variable (IV) model, where we compare the change in behavioral outcomes to the change in insurance coverage status induced by an exogenous instrument. The IV-estimator, τ_{IV}, is given by

$$\tau_{IV} = \frac{E[Y|X = x, Z = 1] - E[Y|X = x, Z = 0]}{E[D|X = x, Z = 1] - E[D|X = x, Z = 0]},$$

where Y is the outcome of interest, D is insurance coverage status, Z is our binary instrument, X is a vector of controls, and $E[f(.)|g(.)]$ is the conditional expectation operator with arguments $f(.)$ and $g(.)$. We estimate τ_{IV} using two-stage least squares (IV/2SLS) with household membership in the national CCT program as instrument.

Our identification strategy relied on two key assumptions.[9] First, the instrument must be relevant such that it influences insurance coverage status. This may be directly tested by showing that

$$E[D|X = x, Z = 1] - E[D|X = x, Z = 0] \neq 0.$$

In the case where the instrument does not affect coverage status, i.e. when the above difference equals zero, nothing is gained from instrumenting: the IV-estimator is inconsistent and biased the same as the OLS-estimator. When the explanatory power of the instrument is "weak", then conventional asymptotics fail thereby affecting hypothesis testing (e.g., Bound et al. 1995; Staiger and Stock 1997). We are not concerned of such pathologies in our case. Among poor households in our sample, children living in CCT households are 47.2 percentage points (S.E. = 0.007) more likely to be covered by health insurance, either as primary members or as dependents.

Second, our identification strategy assumes that conditional on the vector of controls X the

[9] These assumptions are based on the structural econometrics literature. See the seminal work by Angrist et al. 1996 for a discussion on the assumptions when framed in Rubin's potential outcomes framework.

instrument Z and the outcome of interest Y are uncorrelated. This exogeneity assumption ensures that the IV-estimator captures only the impact of insurance coverage, and nothing else. In the case that this assumption is violated, for instance, when the instrument also directly influences the outcome of interest while also affecting insurance coverage status, the IV-estimator is biased towards the direction of the impact of Z on Y. That is, the IV-estimator captures the joint impact of SHI coverage and CCT membership.

It is important to emphasize that unlike the first assumption, the exogeneity of the instrument cannot be tested. But we can rule out some sources of bias based on the design of the CCT program. More specifically, we believe that the contribution of the CCT program on the impact estimates, if any, is a direct result of the CCT program interventions, rather than selection into the CCT program.

Membership into the CCT program are determined by a proxy means test that predicts household per capita income based on observable characteristics, including parents' education and household asset holdings, gathered through the NHTS-PR. To the extent that our additional controls are able to substitute for the contribution of proxy means test explanatory variables, then assignment into the CCT program in our sample households is exogenous. The additional control variables will be able to net out the potential bias from selection into the CCT program that may also affect our selected outcomes of interest.

While one may be able to control for observable characteristics that determine selection into the CCT program, a household may potentially game the system by misreporting or, alternatively, targeting household characteristics that will give them a higher propensity of being enrolled into the CCT program. But this may be of limited concern in this study. First, households do not have access to the weights used in NHTS-PR to predict household per capita income. This makes it generally difficult for households to target being a beneficiary of the CCT program. Second, a household at the time of the survey could only potentially gain as much as about USD 300 per year when the household has three eligible children. This translates roughly to only USD 0.15 per person per day for a five-member household, thus the potential gain for a non-poor to game the system may be limited. Finally, the CCT program has a built-in mechanism wherein households are vetted by their community before they are admitted into the program.

A more serious concern relating to the consistency and unbiasedness of the effect estimates is the potential impact of the CCT program itself on the health-seeking behavior of households. This may be in the form of an income effect from the windfall cash transfers of the CCT program, which allows households to consume more healthcare apart from that provided by SHI. In addition, the CCT program interventions may alter the information set available to beneficiaries. An integral component of the CCT program is the regular attendance of parent-beneficiaries to FDS, where various development topics, including health and nutrition, are discussed. Separate FDS modules are dedicated for health and nutrition (Module 7) and for environmental health (Module 9), although other health-related topics, including breastfeeding, emergency care response, and home remedies are also included in other FDS modules. Also, pregnant mothers and children below five years old are required to have regular health checkup, which may expose them to better health practices. If the CCT program is able to positively influence the health-seeking behavior of households, then impact estimates will be biased upward since this includes the impacts of both insurance coverage and of the CCT program.

Indeed, a recent evaluation documented that the CCT program induced greater access to essential health services among households (DSWD 2014). However, the same evaluation showed that the program has not increased utilization of PHIC benefits, which the evaluators attributed to the CCT beneficiaries' lack of knowledge about SHI benefits. This is supported by Bredenkamp et al.

(2017), presenting evidence that the DSWD, in general, and the CCT program, in particular, only play secondary roles in providing information about PHIC insurance coverage benefits. Among sampled CCT households in 2015, less than a tenth responded that they have learned about PHIC benefits from DSWD and the CCT program. The most important sources of information on health insurance benefits among CCT program beneficiaries are social networks (73%) and the PHIC itself (27%).

RESULTS AND DISCUSSION

Morbidity

We start by presenting the impact of health insurance coverage on morbidity in Table 2. Morbidity is measured as an indicator variable that takes on a value of one when the child ever got sick in the past month prior to the survey, and zero if otherwise. We incrementally added control variables to determine the severity of omitted variable bias, if any. In the base model, we controlled for household wealth quintile. The second model, in addition, controls for the child's characteristics and region of residence. In the last model, we added controls for parents' characteristics. We provided separate estimates for the full sample of children, and for children living in households in the poorest two quintiles. OLS estimates are provided to show the relative bias against the IV/2SLS models. For the rest of our discussion, we focus on the results of the IV/2SLS models.

As mentioned in the previous section, we included in the analysis all children living with their mothers at the time of the survey regardless whether the child is actually an adult. This allowed the use of an additional instrument based on age. Child-dependents of PHIC primary members are limited to their children below 21 years old. In addition to an indicator variable measuring whether the household is enrolled in the CCT program (=1) or not (=0), we included as instrument an interaction variable indicating whether the child may be claimed as a child-dependent in a CCT household.

Analysis was limited to estimates where the Hansen's J-statistic are low, i.e. close to zero, which indicates that our overidentifying restrictions are valid. The Cragg-Donald F- and the Kleibergen-Paap $\chi 2$-statistics provide test measures of the degree of association between our instruments and the endogenous variable. These test statistics are both above the conventional critical values in all specified models, indicating that weak- or under-identification is not an issue in any of our models.

Overall, no evidence was found to support that health insurance coverage impacts morbidity. But this is not unexpected, and should not be taken as evidence against the effectiveness of health insurance coverage. In its classical formulation, insurance is designed to allow consumption smoothing by pooling the risks over a population, and defraying the costs when the risks are realized. This does not preclude, however, any second-round effects of insurance coverage on health outcomes, for instance, due to the reallocation of resources within the household (e.g., Quimbo et al. 2011), to delays in access to healthcare services (e.g., Kraft et al. 2009) or to the impact of recent innovations in the health insurance market, such as wellness incentives (e.g., Short 2003).

Healthcare utilization

We then turn our attention to the impact of health insurance coverage on two health facility use indicators (Tables 3 and 4). We looked at the impact of health insurance coverage on the propensity of a child to (1) visit a health facility for consultation and treatment and (2) be confined in a hospital or clinic in the past month prior to the survey.

Table 2. Health insurance coverage and morbidity

	All Households						Poor Households					
	OLS			IV/2SLS			OLS			IV/2SLS		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Est.	0.020	0.013	0.009	-0.036	-0.026	-0.025	0.004	0.005	0.001	-0.025	-0.017	-0.020
S.E.	0.007	0.007	0.007	0.018	0.020	0.020	0.010	0.010	0.010	0.019	0.020	0.021
p-value	0.005	0.050	0.209	0.052	0.189	0.228	0.701	0.599	0.906	0.192	0.415	0.339
Obs.	25,534	25,514	23,781	25,534	25,514	23,781	13,355	13,343	12,675	13,355	13,343	12,675
RMSE	0.442	0.409	0.410	0.443	0.410	0.410	0.448	0.412	0.411	0.448	0.412	0.411
Kleibergen-Paap Wald χ-sq.				1,098	902	835				961	752	661
Cragg-Donald F				865	628	579				803	568	501
Hansen's J-statistic				122.138	0.403	0.604				91.616	0.012	0.344
Household wealth quintile	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cubic function of child's age		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
Child is female		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
Child's education		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
Region		Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes
Parents' age			Yes			Yes			Yes			Yes
Parents' occupation			Yes			Yes			Yes			Yes
Parents are living together			Yes			Yes			Yes			Yes

OLS = ordinary least squares; IV/2SLS = ; RMSE = Root mean square error

Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014). The Kleibergen-Paap Wald χ2 and the Cragg-Donald F statistics test the hypotheses that the system of equations is under- and weakly identified, respectively. The Hansen's J statistic, on the other hand, tests the hypothesis that the overidentifying restrictions used in the IV/2SLS model is valid.

We found that insurance coverage induces more healthcare facility visits among children in our sample (Table 3). Insured children were more likely to visit a healthcare facility by 8.7- to 12.8-percentage points, on average, compared to non-insured children (Panel A). Relative to the unconditional propensity to visit a health facility of around 15 percent only (Table 1), these estimates were quite substantial.

In Panels B and C, we provided separate estimates for healthcare facility visits by morbidity status of children, which were used as proxy for a need of curative healthcare. Results show that sick children who are insured by PHIC were 18- to 30-percentage points more likely to visit a health facility (Table 3, Panel B). Non-sick children, on the other hand, were more likely to visit a healthcare facility by 5.9 to 8.3 percentage points when they are insured (Panel C). We take these as indications of positive impact of insurance coverage on both curative and preventive healthcare.

The limited impact on the demand for preventive healthcare was not surprising. Compared to inpatient care, PHIC's benefit packages for primary care checkups targeted towards sponsored members were neither as extensive, as generous, nor as well-established in 2013, when our data were collected. Also, beyond the targeted primary care benefits, PHIC has limited coverage for outpatient care (Bredenkamp and Buisman 2015).

An important concern with health insurance provision is whether it induces over-provision of healthcare services (Pauly 1974). In a first-peso system, for instance, individuals may elect medical procedures that they do not need but are covered by the health insurance. Health service providers, on their part, may prescribe more medical procedures than necessary to gain more from a fee-for-service health insurance system. However, greater healthcare utilization even among non-sick children does not necessarily signify over-provision. This may be an indication of previously unmet healthcare demand that households are now able to fulfill with SHI.

Results in Table 4 show that insured children were statistically no more likely to be advised by their physician for confinement (Panel A) or to be actually confined in a hospital or clinic (Panel B) compared to non-insured children. We take this as an indication that over-provision of healthcare services from physician-induced demand and from adverse selection of patients may be of limited concern to SHI in the Philippines.

It must be emphasized though that our study focuses on the impact induced by the government's CCT program, which automatically enrolls beneficiaries to the sponsored program by PHIC. As mentioned in the previous section, PHIC's "no balance billing" policy applies to insured individuals in the sponsored program. Thus, the costs of over-provided health services are borne by health facilities, which may explain the results. What we see may very well be cost-containment measures of healthcare providers who will otherwise assume the healthcare costs in excess of what is covered by PHIC. The case may be different for other types of PHIC membership.

Health expenditures

PHIC's covered population has been increasing through the years, but the financial protection it provides against healthcare costs had remained small resulting in high OOP payments (Kwon and Dodd 2011). The reforms initiated since 2010 aimed to address this shortcoming by increasing the number of poor families enrolled in PHIC, including more comprehensive benefits packages to members, and reducing copayments by patients.

Table 5 shows the impact of health insurance coverage on hospital expenditures of children confined in the last year prior to the survey. In all of the specifications, we controlled for the place, reason, and duration of hospital confinement. Despite PHIC's "no balance billing" policy, we found that poor patients still paid OOP for hospitalization.

Table 3. Insurance coverage and health facility visit

	All Households						Poor Households					
	OLS			IV/2SLS			OLS			IV/2SLS		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
All children												
Est.	0.020	0.033	0.030	0.087	0.130	0.128	0.013	0.027	0.021	0.078	0.112	0.107
S.E.	0.005	0.005	0.006	0.015	0.017	0.017	0.008	0.008	0.008	0.015	0.016	0.017
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.100	0.000	0.008	< 0.001	< 0.001	< 0.001
Obs.	25,534	25,514	23,781	25,534	25,514	23,781	13,355	13,343	12,675	13,355	13,343	12,675
RMSE	0.356	0.333	0.333	0.357	0.335	0.336				0.362	0.339	0.339
Kleibergen-Paap Wald χ-sq.				1,098	902	835				961	752	661
Cragg-Donald F				865	628	579				803	568	501
Hansen's J-statistic				80.099	0.429	0.010				60.328	0.001	0.002
Sick children												
Est.	0.029	0.065	0.060	0.230	0.297	0.295	0.019	0.055	0.042	0.180	0.244	0.249
S.E.	0.015	0.015	0.016	0.045	0.048	0.050	0.021	0.021	0.022	0.045	0.049	0.053
p-value	0.061	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.350	0.008	0.056	< 0.001	< 0.001	< 0.001
Obs.	6,842	6,839	6,434	6,842	6,839	6,434	3,709	3,709	3,551	3,709	3,709	3,551
RMSE	0.498	0.482	0.480	0.507	0.493	0.490				0.504	0.491	0.488
Kleibergen-Paap Wald χ-sq.				472	394	352				421	330	270
Cragg-Donald F				318	263	233				287	231	194
Hansen's J-statistic				2.232	0.009	0.308				0.920	0.141	0.611

Table 3. Continuation

	All Households						Poor Households					
	OLS			IV/2SLS			OLS			IV/2SLS		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Not sick children												
Est.	0.005	0.013	0.013	0.062	0.083	0.082	0.008	0.014	0.013	0.059	0.074	0.071
S.E.	0.003	0.003	0.003	0.009	0.010	0.010	0.005	0.005	0.005	0.009	0.010	0.010
p-value	0.138	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.079	0.004	0.008	< 0.001	< 0.001	< 0.001
Obs.	18,692	18,675	17,347	18,692	18,675	17,347	9,646	9,634	9,124	9,646	9,634	9,124
RMSE	0.179	0.173	0.173	0.181	0.176	0.175				0.190	0.184	0.183
Kleibergen-Paap Wald χ-sq.				935	750	705				817	624	566
Cragg-Donald F				751	529	494				704.712	485.471	437.291
Hansen's J-statistic				2.329	1.765	0.8				5.208	0.571	0.063

Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014). See Table 2 for the list of variables included in each model. The Kleibergen-Paap Wald χ2 and the Cragg-Donald F statistics test the hypotheses that the system of equations is under- and weakly identified, respectively. The Hansen's J statistic, on the other hand, tests the hypothesis that the overidentifying restrictions used in the IV/2SLS model is valid.

Table 4. Health insurance coverage and hospital confinement

	All Households						Poor Households					
	OLS			IV/2SLS			OLS			IV/2SLS		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Advised for hospital confinement by physician during visit												
Est.	-0.004	-0.004	-0.010	-0.006	0.003	-0.015	-0.005	-0.003	-0.006	-0.020	-0.019	-0.033
S.E.	0.009	0.009	0.010	0.028	0.030	0.032	0.012	0.012	0.013	0.029	0.031	0.033
p-value	0.678	0.629	0.297	0.839	0.928	0.628	0.664	0.815	0.618	0.491	0.547	0.323
Obs.	3,794	3,791	3,563	3,794	3,791	3,563	2,049	2,049	1,961	2,049	2,049	1,961
RMSE	0.236	0.234	0.232	0.236	0.234	0.232	0.226	0.224	0.222	0.227	0.224	0.222
Kleibergen-Paap Wald χ-sq.				262	229	205				206	184	160
Cragg-Donald F				155	132	116				125	111	94
Hansen's J-statistic				1.995	0.995	0.984				1.174	0.304	0.026
Confined in hospital in past 30 days												
Est.	0.000	0.006	0.005	0.004	0.024	0.024	0.006	0.012	0.011	0.013	0.028	0.024
S.E.	0.008	0.008	0.008	0.020	0.024	0.026	0.010	0.010	0.011	0.023	0.026	0.029
p-value	0.979	0.446	0.524	0.853	0.319	0.356	0.544	0.258	0.311	0.557	0.279	0.403
Obs.	3,761	3,758	3,531	3,761	3,758	3,531	2,020	2,020	1,933	2,020	2,020	1,933
RMSE	0.207	0.205	0.202	0.207	0.205	0.203	0.192	0.191	0.187	0.192	0.191	0.187
Kleibergen-Paap Wald χ-sq.				284	232	208				217	182	157
Cragg-Donald F				182	141	123				141	117	96
Hansen's J-statistic				0.958	0.303	0.365				0.189	0.116	0.001

OLS = ordinary least squares; IV/2SLS = Instrumental Variable/Two-stage Least Squares; RMSE = Root mean square error

Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014). See Table 2 for the list of variables included in each model. The Kleibergen-Paap Wald χ2 and the Cragg-Donald F statistics test the hypotheses that the system of equations is under- and weakly identified, respectively. The Hansen's J statistic, on the other hand, tests the hypothesis that the overidentifying restrictions used in the IV/2SLS model is valid.

Table 5. Insurance coverage and out-of-pocket payments

	All Households						Poor Households					
	OLS			IV/2SLS			OLS			IV/2SLS		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Bought ought-of-pocket medicine/service apart from hospital												
Est.	-0.001	-0.004	-0.001	0.029	0.050	0.077	-0.009	-0.010	-0.009	0.024	0.054	0.082
S.E.	0.015	0.015	0.016	0.044	0.046	0.037	0.023	0.019	0.021	0.062	0.067	0.059
p-value	0.960	0.793	0.947	0.508	0.278	0.037	0.702	0.613	0.646	0.701	0.427	0.161
Obs.	760	760	710	760	760	710	372	372	352	372	372	352
RMSE	0.164	0.159	0.153	0.165	0.161	0.156	0.167	0.158	0.148	0.168	0.160	0.151
Kleibergen-Paap Wald χ-sq.				71	51	58				47	28	25
Cragg-Donald F				48	31	31				30	15	12
Hansen's J-statistic				4.660	0.010	1.388				2.597	0.406	0.027
Paid out-of-pocket for confinement												
Est.	-0.240	-0.217	-0.204	-0.386	-0.317	-0.217	-0.328	-0.290	-0.270	-0.284	-0.094	-0.092
S.E.	0.022	0.023	0.024	0.107	0.136	0.117	0.034	0.037	0.040	0.115	0.162	0.150
p-value	< 0.001	< 0.001	< 0.001	< 0.001	0.020	0.064	< 0.001	< 0.001	< 0.001	0.013	0.561	0.540
Obs.	989	989	925	989	989	925	432	432	411	432	432	411
RMSE	0.345	0.332	0.320	0.350	0.334	0.320	0.389	0.361	0.338	0.390	0.369	0.344
Kleibergen-Paap Wald χ-sq.				68	47	57				48	28	29
Cragg-Donald F				42	26	30				29	14	13
Hansen's J-statistic				1.266	1.311	0.235				0.375	0.474	1.519

	All Households						Poor Households					
	OLS			IV/2SLS			OLS			IV/2SLS		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Total paid out-of-pocket for confinement, log												
Est.	-0.436	-0.388	-0.479	-0.751	-0.747	-0.628	-0.413	-0.322	-0.347	-1.036	-0.994	-1.007
S.E.	0.100	0.104	0.108	0.311	0.370	0.329	0.139	0.143	0.148	0.355	0.446	0.412
p-value	< 0.001	< 0.001	< 0.001	0.016	0.044	0.057	0.003	0.025	0.019	0.004	0.026	0.014
Obs.	818	818	767	818	818	767	320	320	306	320	320	306
RMSE	1.245	1.208	1.178	1.252	1.217	1.179	1.184	1.104	0.976	1.219	1.137	1.007
Kleibergen-Paap Wald χ-sq.				61	49	61				46	33	37
Cragg-Donald F				39	29	36				27	18	18
Hansen's J-statistic				0.231	0.753	0.678				0.242	1.055	0.959
Total paid for confinement, log												
Est.	0.402	0.461	0.406	0.189	0.351	0.341	0.450	0.529	0.463	0.335	0.399	0.269
S.E.	0.082	0.086	0.091	0.254	0.320	0.289	0.110	0.113	0.115	0.279	0.385	0.383
p-value	< 0.001	< 0.001	< 0.001	0.457	0.272	0.238	< 0.001	< 0.001	< 0.001	0.229	0.301	0.483
Obs.	977	977	913	977	977	913	424	424	403	424	424	403
RMSE	0.921	0.899	0.876	0.925	0.900	0.876	0.868	0.828	0.770	0.869	0.830	0.773
Kleibergen-Paap Wald χ-sq.				66	46	55				46	26	27
Cragg-Donald F				41	25	29				27	13	12
Hansen's J-statistic				0.367	3.230	2.802				0.263	1.850	1.379

OLS = ordinary least squares; IV/2SLS = Instrumental Variable/Two-stage Least Squares; RMSE = Root mean square error

Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014). See Table 2 for the list of variables included in each model. The Kleibergen-Paap Wald $\chi 2$ and the Cragg-Donald F statistics test the hypotheses that the system of equations is under- and weakly identified, respectively. The Hansen's J statistic, on the other hand, tests the hypothesis that the overidentifying restrictions used in the IV/2SLS model is valid.

Panel A show that insured and non-insured children were statistically as likely to pay for medicines and health services that are not available in the hospital where they are confined. This constitutes about 97 percent of all hospitalized children in our sample (Table 1). In Panel B, we find that insured children were less likely to pay OOP by 9.2- to 38.6-percentage points compared to non-insured children, depending on specification (Panel B). With a base rate of 98.2 percent of non-insured children paying OOP for hospitalization (Table 1), this still leaves about 60 to 90 percent of poor households in our sample exposed to paying for hospitalization partly or wholly on their own after controlling for various confounders in our models.

Health insurance coverage, by design, could reduce the OOP spending by individuals. However, as pointed out above, health insurance coverage may also induce greater demand for healthcare, which, ultimately, increases OOP spending. Whether the overall impact is positive or negative is an empirical question.

Among households that are not fully insured, OOP payments by those insured under PHIC were between 46.6 and 64.5 percent less[10] than by those who are not insured (Panel C). Combined with estimates from Panel B, this indicates an average insurance support value in our sample of around 50 to 80 percent of total hospitalization costs. Our estimates are comparable to the figures reported in earlier studies on the proportion of healthcare costs covered by SHI in the Philippines based on other data sources (Caballes et al. 2012; Pantig 2013; Tobe et al. 2013).

We now turn to the impact of health insurance coverage on total healthcare demand. Panel D shows that the healthcare services availed by insured and non-insured children as measured by total hospitalization costs, i.e., combined payment by the health insurance and from OOP, do not differ statistically. Although the point estimates showed that insured children spent between 20 and 50 percent more than non-insured children, we have no enough evidence to claim that the differences are statistically different from zero.

This differs from the earlier results by Gertler and Solon (2002) who found evidence of price differentiation in health services among Philippines hospitals based on the health insurance coverage of patients. In their study, Gertler and Solon (2002) found that healthcare providers charge insured patients more for the same type of healthcare service provided. We must emphasize though that unlike in their study, we are not able to control for specific healthcare inputs provided during hospital confinement.

Based on estimates of the impact of health insurance coverage on OOP payments and on total hospitalization expenditure, we may estimate the own-price elasticity of demand for healthcare in the Philippines as a ratio of the two estimates. The price elasticity of demand for healthcare captures how sensitive the demand for healthcare is to changes in prices paid by households. A price elasticity of demand of −1.0, for instance, indicates that a one-percentage drop in healthcare prices is related to a matching one-percentage increase in healthcare demand. In our sample, own-price elasticity of demand for healthcare ranges between −0.39 and −0.87 depending on the specification, which are on the upper end of the −0.2 to −2.1 range cited by Gertler and van der Gaag (1990).

The above estimates of price elasticities suggest that the demand for healthcare among our sample of children is price inelastic. That is, the demand for healthcare is not very responsive to price changes, such as the effective drop in prices faced by those covered by SHI, which implies that greater resources may be needed to induce higher healthcare demand among households relative to when healthcare demand is more price elastic. This may be a direct consequence of the reasons for hospital confinement stated by the respondents: sickness or injury (92.0%) and child birth (7.6%), which both may require

[10] Calculated as exp ($\widehat{\tau_{IV}}$)-1

urgent care (c.f., Duarte 2012). It is important to note though that the estimated price elasticities of demand represent averages for the whole population. As shown, for instance, in Gertler and van der Gaag (1990), the elasticities may differ across sub-populations. In their estimates, poor households are more price-sensitive, i.e., with greater absolute price elasticity of demand, than richer households.

Patient satisfaction

While we have no enough evidence showing that the impact of SHI coverage on the total hospitalization bill between insured and non-insured children are statistically different, we find that those who are insured have lower propensity to indicate that they were satisfied with the service that they have had received during confinement. Table 6 shows that, on average, insured children were 8.2- to 22.9-percentage points less likely to indicate that they were satisfied with the service that they have had received, although it is only marginally statistically significant for the full model (Columns 6 and 12).

We conjecture some possible explanations, which are not necessarily mutually exclusive. First, health facilities cannot legally price discriminate based on insurance coverage on certain segments of the market because of PHIC's "no balance billing" policy. But they may still discriminate based on the quality of service that they provide. If such is the case, then our results may be treated as an indication of such product differentiation. Second, it is also possible that our estimates actually reflect the impact of the CCT program on empowering the poor. And, related to this, third, health insurance coverage may have raised the expectations of households about the acceptable quality of healthcare that they should receive. Unfortunately, we cannot disentangle these related explanations in our current analysis.

Figure 1 shows the differences in the propensities of each factor to be cited as reason why the patients were dissatisfied. We limit our sample to children from poor households, while controlling for the place, reason, and duration of hospital confinement, and child, parent and household characteristics (Model 3). Overall, the largest percentage point differences in reasons cited were on how patients are treated by healthcare professionals during their confinement. Insured children were more likely to cite uncaring or rude staff (11.5-percentage point difference) or unfair treatment (10.7-percentage point difference) as reasons compared to non-insured children. The availability of other health inputs, or the lack thereof, were only secondary but remains as important source of differences in patient satisfaction: insufficient medicines (10.6-percentage point difference), insufficient equipment (8.6-percentage point difference), and insufficient staff (7.9-percentage point difference).

CCT-effect

The estimates that have so far been presented rest on the assumptions that were emphasized in the previous section, but are worth revisiting. We have shown that children living in CCT-beneficiary households were more likely to be covered by SHI. But we cannot directly test whether the CCT program has any direct effect on the various outcomes that we presented. The estimates we have presented reflect the impact of health insurance coverage to the extent that the control variables that we have included in the models were able to net out the effect of potentially unobserved confounders that are both related to selection into the CCT program and insurance coverage. In addition to selection into the CCT program, however, if the CCT program also influences the health-seeking behavior of its beneficiaries directly, then our estimates in effect reflect the joint impact of these two programs.

To the extent that the control variables we included captured the bias from unobserved confounding, OLS provides unbiased estimates of the impact of SHI coverage, and are thus preferred to the IV/2SLS estimates. Assuming that the contributions of SHI coverage and of the CCT program are additively separable, subtracting the OLS estimate from the IV/2SLS estimate isolates the impact of

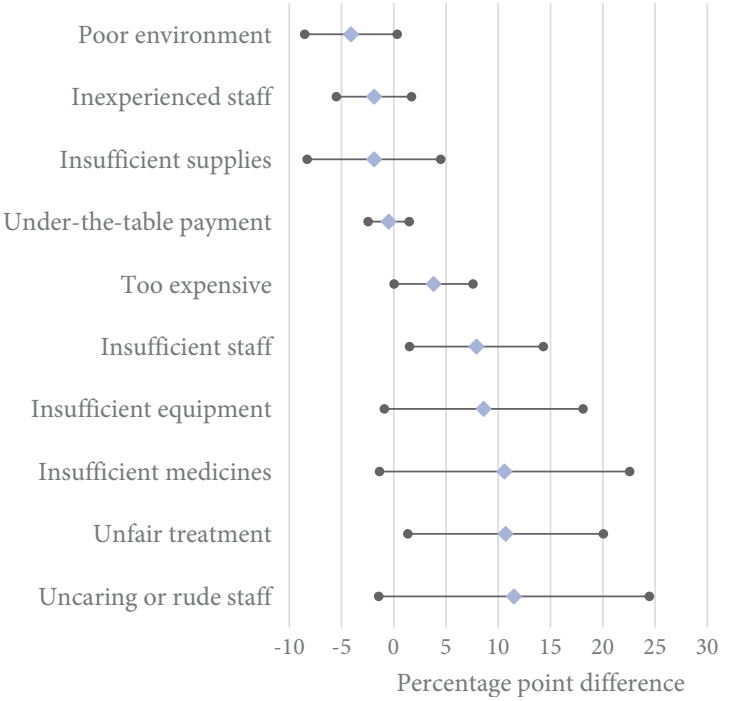
Table 6. Insurance coverage and patient satisfaction

	All Households						Poor Households					
	OLS			IV/2SLS			OLS			IV/2SLS		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Est.	0.006	0.010	0.008	-0.123	-0.135	-0.189	0.007	0.009	-0.029	-0.082	-0.135	-0.229
S.E.	0.024	0.024	0.025	0.080	0.095	0.095	0.033	0.031	0.029	0.081	0.092	0.114
p-value	0.811	0.695	0.750	0.126	0.158	0.045	0.843	0.777	0.305	0.311	0.141	0.045
Obs.	1,083	1,083	1,015	1,083	1,083	1,015	491	491	467	491	491	467
Log-likelihood	-224.215	-203.836	-164.468	-242.011	-224.650	-199.352	-60.497	-41.540	-8.152	-65.223	-52.537	-27.761
RMSE	0.298	0.292	0.285	0.303	0.298	0.294	0.274	0.263	0.246	0.276	0.269	0.257
Kleibergen-Paap Wald χ-sq.				78	53	63				56	32	34
Cragg-Donald F				49	31	35				34	18	17
Hansen's J-statistic				0.055	0.020	0.129				0.581	0.020	0.002

OLS = ordinary least squares; IV/2SLS = Instrumental Variable/Two-stage Least Squares; RMSE = Root mean square error

Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014). See Table 2 for the list of variables included in each model. The Kleibergen-Paap Wald χ2 and the Cragg-Donald F statistics test the hypotheses that the system of equations is under- and weakly identified, respectively. The Hansen's J statistic, on the other hand, tests the hypothesis that the overidentifying restrictions used in the IV/2SLS model is valid.

Figure 1. Reason for dissatisfaction: Poor households



Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014)

the CCT program. With unobserved confounding, however, the direction of the OLS bias is generally unknown. In this case, while the IV/2SLS estimates are still biased, it might be more informative than OLS if we can calibrate the bias of the IV/2SLS estimates.

We attempted to calibrate our estimates based on an earlier study assessing the impact of the Philippines' CCT program on health facility utilization among children. More specifically, we utilized results from the first-wave of impact evaluation of the CCT program (WB 2013), which is based on a randomized control trial of CCT beneficiaries in 2008 and 2009. Intervention in priority areas was rolled out in phases, allowing the evaluators to use the areas receiving CCT in later phases as control areas. We focused on their impact estimate on health facility utilization. In the evaluation, the CCT program was estimated to increase health facility visits among children aged 0 to 5 years old who are sick with fever and cough by 13.2 percentage points (S.E. = 0.035). The subsequent second-wave impact evaluation is based on a regression discontinuity design. In order to estimate the impact of CCT, the design exploits the non-trivial jump in the propensity of CCT receipt around the household income threshold that is used to identify program eligibility. Estimates from the second-wave evaluation provided a slightly lower estimate at 8.8-percentage points (S.E. = 0.102), and the estimate was not statistically significant (DSWD 2014).

We compare this with IV/2SLS estimates using our sample of children aged 0 to 5 years old who reported having cough or fever (Table 7). Assuming that that the contribution of SHI coverage and the CCT program are additively separable, our estimates point to SHI increasing health facility utilization in this specific sample of children by as much as 20.2-percentage points (S.E. = 0.079), or about two-thirds of the IV/2SLS estimate. This points to a still size-able impact of SHI coverage even after netting out the contribution of the impact of the CCT program.

We also provided separate IV/2SLS estimates for children aged 6 to 10 years old. As discussed in the earlier section, children aged 5 years old and below in CCT households are required to have regular health facility visits as one of the conditions to remain in the program. Comparing the estimates for those aged 0 to 5 with those aged 6 to 10 may, therefore, provide a ballpark estimate of the impact of the CCT program on health facility utilization. Interestingly, the estimate based on our most elaborate models (Columns 3 and 6) point to a CCT-effect of 12.- percentage points, or about the same size as that reported in the first-wave evaluation, although the difference is not statistically significant

Table 7. Insurance coverage and health facility visit among children reported with cough or fever

	Age 0-5			Age 6-10		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Est.	0.279	0.306	0.334	0.290	0.241	0.210
S.E.	0.061	0.063	0.071	0.084	0.079	0.079
p-value	< 0.001	< 0.001	< 0.001	0.001	0.002	0.008
Obs.	2,020	2,020	1,950	735	735	704
Log-likelihood	-1508	-1453	-1389	-520	-496	-457
RMSE	0.510	0.497	0.493	0.491	0.475	0.463
Kleibergen-Paap Wald χ-sq.	254	223	178	119	128	117
Cragg-Donald F	330	296	228	185	211	205

RMSE = Root mean square error

Note: Authors' calculations based on 2013 Philippine National Demographic Health Survey (PSA and ICF International 2014). See Table 2 for the list of variables included in each model. The Kleibergen-Paap Wald $\chi 2$ and the Cragg-Donald F statistics test the hypotheses that the system of equations is under- and weakly identified, respectively. The Hansen's J statistic, on the other hand, tests the hypothesis that the overidentifying restrictions used in the IV/2SLS model is valid.

CONCLUSIONS

It is a widely held belief that health insurance coverage promotes better access to healthcare, and greater financial security against catastrophic spending–i.e., the twin goals of health insurance (e.g., WHO 2010; Hsiao and Shaw 2007). However, empirical evaluation of the actual impacts of insurance coverage, especially in developing countries, are limited, mainly since the availability of natural or field experiments that allow controlling for selection are equally scant. Recent innovations in SHI programs in many parts of the developing world have resulted in dramatic improvements in coverage, making thorough empirical assessments of the impacts needed to guide policy more crucial than ever.

In this paper, we used a nationally representative survey in the Philippines to study the impact of SHI coverage on the demand for healthcare among children. The study exploited a large-scale, yet imperfect, natural experiment, i.e., the Philippines' CCT program, which automatically enrolls beneficiaries into the government's SHI program. While selection into the CCT program may be external to households, the large-scale experiment may directly impact the health-seeking behavior of individuals, thereby confounding our impact estimates. On the other hand, this allowed direct evaluation of the combined contribution of two different social protection programs. More

specifically, we have estimated the joint effect of insurance coverage and of a CCT program on morbidity, household health facility utilization and OOP expenditures, physician behavior, and consumer satisfaction.

We find strong positive impacts of social protection coverage on both demands for curative and preventive healthcare, which we proxied by health facility visits of sick and non-sick children. The effect on preventive care, however, is less pronounced. This is not surprising given that insurance benefits for outpatient care, specifically primary healthcare, in the Philippines were not as well-developed as inpatient care benefits during our study period. We provide evidence that over-provision of healthcare induced by health insurance coverage may be of limited concern, at least in our sample. We also find significant reduction in OOP spending. A non-trivial portion of the estimated impacts may be attributed to the CCT program.

While we find no evidence of healthcare service differentiation based on price, we documented a large negative effect of social protection on patient satisfaction. Further, we find evidence of potential implementation failure of the PHIC's no-balance billing policy, wherein poor households who are supposed to be fully covered by SHI were charged OOP for health care. Both these concerns may undermine the expected outcomes not just of the SHI program, but also of the country's poverty reduction programs.

Based on these evidences, we highlight two important observations. First, insurance coverage alone may not be enough to promote better access to healthcare. This is in-line with the findings by Accad (2015), who showed that the joint impact of the CCT program and insurance coverage on the utilization of outpatient care is greater than the separate impacts of the CCT program and of insurance coverage. The confluence of the income effect–in this case, from direct cash transfer of the CCT program–, the price effect–in this case, from the social insurance coverage–, and the information effect–in this case, from various CCT program interventions–may be necessary components in designing effective SHI programs. Second, healthcare differentiation, either using price or quality, based on health insurance coverage may undermine the intended impacts of the program. Following Gertler and Solon (2002), product differentiation may allow healthcare providers to extract for themselves much of the economic surplus from health insurance, which are otherwise originally intended for patients.

We recognize that our analysis is limited in a number of ways. First, we only looked into the impact of insurance coverage among children in poor households. But their health insurance benefits are starkly different from the rest of the population. Whether our results extend to outside our sample is, at least for now, only speculative. Second, the health outcomes that we have included in our analysis are limited. Furthermore, in many instances, we have proposed possible explanations to our results based on theory, but these explanations were not empirically substantiated. Finally, we analyzed the impact of SHI coverage on the demand for healthcare without taking into account supply-side considerations. While insurance coverage may induce greater demand for healthcare, access may be hampered when the supply of healthcare services is limited or, even, non-existent. To a large extent, these limitations is a function of the data available to us to assess the impact of insurance coverage. In any case, these limitations highlight important research questions, which we leave for future investigation.

This study opens new avenues for future research. While we have shown that the SHI and the CCT programs jointly increases healthcare demand among poor children, it may also be interesting, for example, to measure the vicarious effect from having both programs together, in addition to each program's separate effects. To what extent are CCT and SHI programs complementary or substitutable? Further, under what conditions is CCT, SHI or both programs together more effective

in raising healthcare demand? Finally, what other complementary initiatives to CCT or SHI programs are needed to induce greater healthcare demand and improve health outcomes?

Overall, the evidences presented here suggest that the social protection programs in the Philippines have contributed to better access to healthcare services, and to greater financial security against catastrophic healthcare spending. Although we highlight that improvements in health per se are not directly affected by these social protection programs, it is not unconceivable that increased access to healthcare will ultimately lead to improved health outcomes in the longer term through different secondary channels.

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Impact of Foreign Linkages on Innovation Activity of Manufacturing Firms in CALABARZON

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ABSTRACT

Despite several studies exploring innovation activities in the Philippines, no clear answer has been provided to the question of whether having foreign linkages can induce knowledge transfer and innovation. This study probes deeper into the role of foreign linkages in the innovation activities of manufacturing firms in the CALABARZON (Cavite, Laguna, Batangas, Rizal, and Quezon provinces) region. Using a probit estimation and an IV regression to control for endogeneity brought by omitted variable bias, the results show that foreign linkages can positively affect a firm's likelihood to undertake product innovation that involves the development of a new product using technology new to the firm. On the other hand, process innovation has consistently shown to be positively influenced by foreign linkages. These results indicate that having foreign linkages and participating in the global value chain can have a positive impact on both process and product innovations. Thus, it is important to highlight the need to promote stronger regional and global linkages to sustain the manufacturing growth in CALABARZON. Moreover, trainings that teach the 5S system through government channels such as the Technical Education and Skills Development Authority and state universities and colleges are as important. Highlighting the role of industrial parks and recognizing the value of establishment-level data are also key points in this study.

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INTRODUCTION

Most of the innovation studies in the Philippines (Albert et al. 2013; Albert et al. 2017; del Prado and Rosellon 2017a) have found that manufacturing firms rely on external sources of information for their innovation activities. In this study, the relationship between external linkages and innovation activity of local firms is further explored. It attempts to determine whether participating in global value chains induces knowledge transfer and innovation.

This study also contributes to existing literature on innovation by presenting a causal relationship between foreign linkages and innovation activity in firms. So far, most of the quantitative analyses on innovation activities were able to show, at best, correlations between the explanatory variables and innovation activity (Macasaquit 2009; Albert et al. 2013; Llanto and del Prado 2015). By using an exogenous incident, this study strengthens the initial findings on the role of linkages in innovation activity.

REVIEW OF RELATED LITERATURE

Linkages (foreign or domestic) and innovation activity

Innovation activities may be either product or process.[2] Product innovation is the introduction of a new product or outcome whereas process innovation is the adoption of new tools, devices, or knowledge in the technology that transform inputs to outputs (Gopalakrishnan and Damanpour 1997). Developing new products and improving on existing products are examples of product innovation whereas examples of process innovation include the adoption of activities to significantly improve process innovation such as on management, procurement, and workplace efficiency.[3]

Using a systems of innovation approach to study the sources of innovation of firms, Fukugawa (2018) explains that firms have access both to their internal resources and external resources in the form of customer feedback, inputs from suppliers, and reverse engineering of competitors' products. Academic research activities done privately and publicly are other external resources from which firms can benefit. Linkages[4] across institutions and firms both locally and internationally serve as the first step in the sequence of learning and innovation (Rasiah 2011). Linkages, both formal and informal, facilitate the dissemination of knowledge from experiences allowing firms to learn from the activities of other firms and reduce the cost of innovation, which may be too high in developing countries.

[2] The innovation literature has used various ways of classifying innovation. Gopalakrishnan and Damanpour (1997) provides an extensive survey of definitions and classification of innovation. Ariffin and Figueiredo (2006) distinguishes between routine production capability (i.e., produce goods at given levels of efficiency and given input requirements) and innovative technological capability (i.e., create, change, or improve products, processes, and production organization or equipment.)

[3] The elimination of necessary distribution steps through an enterprise-wide information system that directly connects all retail locations, distribution warehouses, and major suppliers is an example of a retail industry process innovation applicable to logistics (Furey and Diorio 1994). Process innovations that improve information exchange, such as the digitization of information and database construction, remove unnecessary procedures [See the case of improving accounts payable processes in Ford Motors Corporation as mentioned in Attaran (2004) and of improving organizational collaboration in Frito Lay as discussed in Malone and Rockart (1991).]

[4] External linkages may be ranked according to the degree of interaction or collaboration. Patra and Krishna (2015) adopts a framework developed by Ariffin (2000) that ranks external linkages from low (Rank 0) to high (Rank 4). In an ascending order, this includes (0) no linkage, (1) arm's length, (2) human resource recruitment, education, and training, (3) joint adaptation, and (4) joint research. Arm's length linkages are characterized by informal or one-off type of interactions. Employee exchanges and recruitment, on the other hand, fall under the rank 2 linkage. Ranks 3 and 4 are more formal and structured and can take many forms but the key difference is that joint adaptation modification linkages are focused on acquisition and sharing of knowledge whereas joint research is in the collaboration for developing new knowledge. However, this study adopts a more general definition of linkages as the data are not able to support Patra and Krishna's methodology.

Process innovation, in particular, that uses areas of frontier science may be difficult and expensive for firms in developing countries. Foreign partnerships or linkages may be an effective mechanism for developing innovation capabilities in frontier science of local firms or even public research institutions (Hall 2006). Such experience has been observed in China wherein Chinese firms often rely on their foreign partner's advanced technological competence, marketing expertise, or advanced managerial skills to address operational weaknesses and stimulate product and process innovation (Shenkar 1990; Luo 2002).

For the Philippines, a number of studies looked at the innovation activity in specific sectors or industries. Macasaquit (2009) studied the role of linkages in facilitating innovation activities of electronic firms. Quimba and Rosellon (2011) explored the innovation activities of automotive parts manufacturers and assemblers and found that Filipino-owned firms tend to have used external linkages more than foreign-owned firms or joint ventures.

Meanwhile, Rosellon and Yasay (2012) observed that government institutions and access to government support programs were critical for fruit juice processing firms to upgrade their production process. Ledda and del Prado (2013) interviewed four Philippine transnational corporations to identify the role of innovation in the outward push to other countries. Studying the innovation activities in the garments industry, del Prado and Rosellon (2017a) found that even without formal research and development (R&D), both product and process innovations are still possible as long as the appropriate personnel and supporting mechanisms in the company are in place.

In a different study, del Prado and Rosellon (2017b) explored the innovation activities in the fruit juice manufacturing industry. They found that upgrading the capability of local firms through sharing of knowledge has occurred in the Philippines. The study identified a case where knowledge has been shared from large foreign firms to a large firm in the country. Using the information from their foreign partners, the domestic firm was able to improve its production process and meet the requirements of the customers.

Using various surveys of Philippine firms, quantitative studies have also been conducted (Macasaquit 2009; Albert et al. 2013; Llanto and del Prado 2015; Albert et al. 2017) to investigate the determinants of innovation activities using firm-level data. Primarily, Macasaquit (2009) looked into the process by which industrial upgrading and innovation activity of electronics manufacturing firms can be facilitated by linkages with firms in their value chain and collaboration with knowledge partners. Meanwhile, the 2009 survey of innovation activities (SIA) showed that firms rely on their partners (firms within their value chain) for sources of information and innovation activity (Albert et al. 2013). Aside from investigating the determinants of innovation, Llanto and del Prado (2015) were also able to relate innovation with firm performance. Their study indicated that product and process innovations lead to an increase in sales and profits, and improved labor productivity.

The analysis of innovation activities of firms has also been done at the international level. Using data from member-states in the Association of Southeast Asian Nations (ASEAN), including that of the Philippines, Harvie et al. (2010) found that innovation is an important determinant of small and medium enterprises' (SMEs) participation in global value chains. It is through product and process innovations that SMEs are able to meet the requirements of higher tier firms. Furthermore, Machikita and Ueki (2010) used the establishment survey on innovation and production network conducted in Indonesia, Philippines, Thailand, and Viet Nam to examine the effects of having a variety of linkages (both internal and external) on innovation performance. They found that firms with more foreign linkages are able to introduce new products, improve procurement processes, and explore new markets more. However, firms with linkages to multinational corporations (MNCs) have fewer propensities to produce new products but have greater propensities to find new markets (Machikita and Ueki

2011). Meanwhile, various linkages with universities and public organizations were found to have no significant relationship with innovation performance (Machikita and Ueki 2010, 2011).

Globally, and East Asia in particular, Machikita and Ueki (2011) further found that in-house R&D activities not only improve upon product innovations but also extend benefits to process innovations in general. Moreover, firms with more diverse internal resources are able to explore more opportunities than those with less varieties. They also found that different linkages with local firms facilitate process innovations particularly with procurement and market creating innovations. The same authors observed that process innovation resulting from a firm's foreign linkage to MNCs does not work well with firms that are primarily engaged in the domestic market but work well with firms that have more engagements with international consumers.

Drivers of innovation

The size and age of firms matter such that innovation is found to be more common in old, large firms (EBRD 2014; Serafica 2016). This may imply that said firms have significant financial and human resources that can be allocated to formal R&D (Vieites and Calvo 2011). However, in emerging markets, younger but larger firms (possibly successful start-ups) can be more innovative (Ayyagari et al. 2007). An enabling environment that is supportive of start-ups and entrepreneurial research is also an important determinant of innovation in emerging markets (Vieites and Calvo 2011).

The legal structure of the firm can also influence its likelihood to innovate. In particular, foreign-owned MNCs innovate more (EBRD 2014; Serafica 2016). Moreover, having managers with experience in handling MNCs could further strengthen innovation capability. Market orientation as a driver of innovation posits that exporting firms are more innovative (Ayyagari et al. 2007).

Formal R&D leads to more innovation (EBRD 2014); however, considering that R&D requires an adequate level of investment, SMEs are often left with no means to innovate formally. However, innovation can still occur without formal R&D through technology adoption, minor modifications, incremental changes, imitation, or combining existing knowledge with new ways (Romijin and Albaladejo 1999; del Prado and Rosellon 2017a). This implies that cost is a significant barrier to innovation for SMEs in the Philippines (Albert et al 2013).

The EBRD (2014) study finds that the human resources of a firm with degrees in science, technology, engineering, and math (STEM) and experience in MNCs are relevant factors that affect the innovation activity of firms. Those without STEM degrees often led to less scientifically grounded innovation and more toward sales and marketing improvement. Moreover, managers with experience in SMEs only often innovated in a simpler, less radical, and less expensive way (Romijin and Albaladejo 1999).

The adoption of Lean Management principles particularly 5S (Seiri [sorting], Seiton [straightening], Seiso [shining], Seiketsu [standardizing], and Shitsuke [sustaining]) has been an attractive way for old manufacturing companies to improve production performance without large capital investments (Purohit and Shantha 2015). 5S is a workplace organizational and housekeeping methodology that aims to achieve high levels of quality through the minimization of waste. Case studies in India (Purohit and Shantha 2015), Colombia (Lamprea et al. 2015), and Indonesia (Ratnawati et al. 2016) have shown that employee satisfaction and productivity increased through the successful implementation of the 5S methodology.

Firms that are able to use information and communications technology tend to innovate more and so are firms whose investments are sourced from foreign banks (EBRD 2014). The likelihood of being an innovator also increases as the proportion of the financed investment increases (Ayyagari et al. 2007).

Innovation activities can also be driven by embeddedness. Grossetti (2018) explains embeddedness as the dependence of an identity vis-à-vis the links that it has with others. Foreign linkages as a driver of innovation comes into the equation internally through intracorporate counterparts or externally through local organizations (Patra and Krishna 2015). The reciprocal of embeddedness is decoupling or the formation of an identity. Together, both embeddedness and decoupling form a dynamic force where firms' personnel interactions first form commonalities before these detach and form identities. Firms with foreign linkages benefit from having relational chains as these facilitate learning processes with firms in their proximity particularly customers and suppliers (Heidenreich 2012). The concept of embeddedness becomes more prominent in firms with multiple and diverse linkages both domestically and internationally once relational chains expand. In essence, the whole process becomes a sophisticated form of knowledge dissemination.

The role of innovation intermediaries as bridges for knowledge dissemination is recognized by Quimba et al. (2017) as these can help facilitate innovation by providing physical and social capital. For instance, the Philippine Economic Zone Authority (PEZA) influences the operations of locators in industrial parks. Indirectly, the agglomeration of firms in industrial parks provides a conducive environment for expansion of existing network of these firms.

In a study exploring the innovative behavior of Philippine firms, the active engagement in knowledge management practices, the size of the firm, and its location inside an industrial park managed by PEZA were the major determinants found (Albert et al. 2013). Furthermore, the effects of innovation were often largely customer-driven. On the impact of the geographic market, the study found weak evidence that firms with a geographic market limited to the local economy are at risk of not being an innovator. In contrast, the results of the 2015 SIA conducted by the Philippine Institute for Development Studies (PIDS) indicated that firms catering to the domestic market tend to innovate more and their export orientation has a negative relationship with process innovation (Albert et al. 2017). Looking at the case of the automotive industry, some micro, small, and medium enterprises (MSMEs) in the sector have difficulty pursuing innovation activities because of limits imposed by parent companies abroad (Quimba and Rosellon 2011). Given these conflicting relationships, it is no surprise that the ASEAN-Japan Center finds that, for the Philippines, the relationship between participation in global value chains and gross domestic product (GDP) growth is tenuous (AJC 2017).

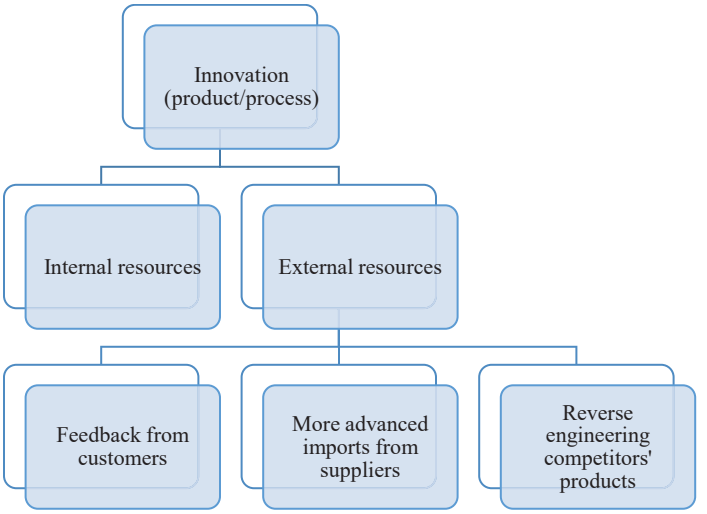
METHODOLOGY

Theoretical framework

This study is guided by the theoretical framework of Fukugawa (2018) as shown in Figure 1. The framework shows that firms innovate by using both internal resources and tapping into external resources available to them. The latter ones can be classified further into foreign and domestic sources of knowledge.

Transfer of knowledge from foreign and domestic sources is mainly determined by the type of knowledge involved. There are three types of knowledge categories: (1) analytical, which is based on science; (2) synthetic, which draws from technology; and (3) symbolic, which is grounded on culture. These categories of knowledge differ by how knowledge is produced and transferred. Among these three, analytical knowledge is the quickest to be transferred as it can flow through the academe and licensing processes while the more challenging is synthetic knowledge as it requires the interaction between high-skilled professionals. This interaction involves the participation of engineers and scientists to gather and take a heuristic approach to learning. Finally, the more intangible symbolic knowledge is both vague and difficult to transfer as it will entail having to experience the phenomenon (i.e., learning by doing and observing).

Figure 1. How do firms innovate?



Source: Fukugawa (2018)

Profile of datasets

Primary data on the innovation activities of firms in CALABARZON have been collected since 2008 by the Economic Research Institute for ASEAN and East Asia (ERIA). This study, however, includes only datasets for the years 2011 to 2014 as earlier years have used a survey instrument that is significantly different from the more recent ERIA surveys.

A total of 855 firms were surveyed from 2011 to 2014 but Laguna was not included in the 2011 survey. The sample firms were systematically drawn until a proportional allocation from different industries of various sizes within each province was reached. Table 1 summarizes key information of the datasets used.

From the 855 firms in this study, 417 (48.8%) are identified as product innovators. Based on the ERIA survey questionnaire used in this study, a firm is considered as a product innovator if it has achieved at least one of the following: (1) introduced a new product, redesigning packaging or significantly changing appearance design of existing products; (2) introduced a new product, significantly improving existing products; (3) developed a totally new product based on the firm's existing technology; or (4) developed a totally new product based on new technology for the firm.

Meanwhile, 425 (49.7%) are identified as process innovators. The ERIA survey questionnaire used in this study lists five process-related innovation activities. A firm is considered a process innovator if it has adopted a new method or has significantly improved one of the following: (1) procurement; (2) sales management; (3) accounting; (4) inventory control; or (5) logistics. There are 258 firms (30.2%) that are engaged in both product and process innovation. In terms of firm size, majority (55.3%) are small and micro enterprises. Most firms (77.7%) were established in the period 1990 to 2011. Also, the majority of firms (66.3%) have limited R&D spending in any given year.

In terms of manufacturing principles by the firm, 66.1 percent engaged in some form of learning system. Those using the 5S system comprised 66.6 percent of firms, whereas 73.2 percent of firms observed a quality control circle. Finally, 62.9 percent of firms in the study produced final products.

Batangas, Cavite, and Laguna have the highest proportion of product innovators with more than half of firms identified as product innovators (Table 2). Meanwhile, in terms of process innovation,

Table 1. Summary statistics: Frequency by reference year

Indicator	Reference Year				Total
	2011	2012	2013	2014	
Total firms	207	236	213	199	855
Product innovator	93	118	115	91	417
Nonproduct innovator	114	118	98	108	438
Process innovator	85	100	120	120	425
Nonprocess innovator	122	136	93	79	430
Both product and process innovator	48	67	76	67	258
Enterprise					
Large	44	67	59	55	225
Medium	40	44	35	38	157
Small and micro	123	125	119	106	473
Decade established					
1950–1959	3	2	3	2	10
1970–1979	3	4	4	5	16
1970–1979	10	13	10	8	41
1980–1989	27	34	33	30	124
1990–1999	93	104	92	87	376
2000–2011	71	79	71	67	288
Research and development, (% of total sales)					
No expenditure	137	160	142	131	570
Less than 0.50%	34	35	42	39	150
0.50-0.99%	17	20	11	11	59
More than 1.00%	19	21	18	18	76
System of learning					
With	124	159	148	134	565
Without	83	77	65	65	290
Usage of 5S system					
With	129	157	147	136	569
Without	64	60	54	51	229
Export activity					
Exporter	108	145	131	113	497
Nonexporter	99	91	82	86	358
Intellectual property right					
With	38	229	65	66	398
Without	169	7	148	133	457
Industrial park location					
Inside	96	118	104	94	530
Outside	111	118	109	105	325

Table 1. Continuation

Indicator	Reference Year				Total
	2011	2012	2013	2014	
Final product produced					
Raw materials	8	11	9	7	35
Raw materials processing	14	11	7	12	44
Components and parts	53	78	52	55	238
Final products	132	136	145	125	538

5S=sort, set, shine, standardize, and sustain
Source: Authors' calculations

Batangas and Laguna were the leaders at 57.6 percent and 65.3 percent, respectively. These figures are much higher than the overall average of 49.7 percent. In Laguna, 45.7 percent of the firms surveyed undertook both product and process innovations. In contrast, only 8.0 percent of the firms in Rizal undertook both types of innovation.

Batangas, Cavite, and Laguna also have the highest proportion of respondent firms that implemented a system of learning in their firm (Table 2). They also have the highest proportion of firms that have used a 5S system in their production.

In terms of the use of intellectual property rights (i.e., patent, utility model, proprietary software rights, or trademark), Batangas and Laguna have reported more firms that hold intellectual property than those that do not have. Finally, most firms in Batangas (60.4%), Cavite (85.4%), and Laguna (81.5%) are located inside an industrial park.

Table 2. Summary statistics: frequency by location

Indicator	**Province**					**Total**
	Batangas	**Cavite**	**Laguna**	**Quezon**	**Rizal**	
Total firms	111	377	81	48	235	852
Product innovator	66	203	49	9	88	415
Nonproduct innovator	45	174	32	39	147	437
Process innovator	64	174	53	19	113	423
Nonprocess innovator	47	203	28	29	122	429
Both product and process innovator	44	115	37	4	56	256
Enterprise						
Large	37	117	44	8	17	223
Medium	30	70	12	11	33	156
Small and micro	44	190	25	29	185	473
Decade established						
1950–1959	4	0	0	3	3	10
1970–1979	7	0	0	4	5	16
1970–1979	0	14	10	5	12	41
1980–1989	13	19	6	14	72	124
1990–1999	35	215	45	14	65	374

Table 2. Continuation

Indicator	Province					Total
	Batangas	Cavite	Laguna	Quezon	Rizal	
2000–2011	52	129	20	8	78	287
Research and development, (% of total sales)						
No expenditure	71	250	55	32	159	567
Less than 0.50%	26	71	12	7	34	150
0.50–0.99%	3	24	5	3	24	59
More than 1.00%	11	32	9	6	18	76
System of learning						
With	77	281	66	24	116	564
Without	34	96	15	24	119	288
Usage of 5S system						
With	76	299	71	22	99	567
Without	35	78	10	26	136	285
Export activity						
Exporter	61	300	63	18	54	496
Nonexporter	50	77	18	30	181	356
Intellectual property right						
With	63	172	45	22	93	395
Without	48	205	36	26	142	457
Industrial park location						
Inside	67	322	66	11	63	529
Outside	44	55	15	37	172	323
Final product produced						
Raw materials	0	10	4	7	13	34
Raw materials processing	1	17	3	10	13	44
Components and parts	28	128	39	1	42	238
Final products	82	222	35	30	167	536

5S = sort, set, shine, standardize, and sustain
Source: Authors' calculations

By product category, a large portion of firms (13.7%) produce food, beverages, and tobacco products (Table 3). Following these are metal products (12.5%), other electronic products (10.8%), apparel and leather products (10.1%), and plastic and rubber products (9.2%).

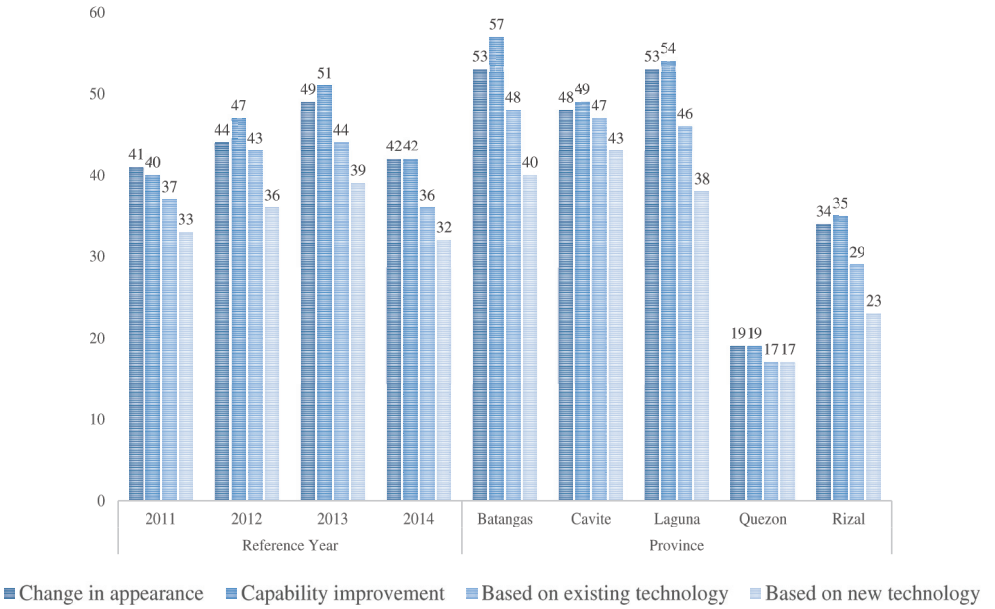
Disaggregating the product innovation activity conducted by firms, producing a new product using a technology new to the firm is the least common product innovation activity conducted from 2011 to 2014 (35.0%) (Figure 2). Moreover, product innovation mostly occurred in Batangas, Cavite, and Laguna. Quezon province fell below the regional average of about 37.7 percent across all activities. For all provinces, the most common product innovation activity is the manufacture of a new product involving a change in appearance or packaging, or the manufacture of a new product involving an improvement in product quality or usability.

Table 3. Number of respondent firms by year and main product

Activity	Reference Year				Total
	2011	2012	2013	2014	
Total firms	207	236	213	199	855
Apparel, leather	24	22	21	19	86
Automobile, autoparts	16	20	11	15	62
Chemicals, chemical products	5	10	9	8	32
Computers and computer parts	0	5	8	3	16
Food, beverages, tobacco	25	30	32	30	117
Iron, steel	5	6	5	3	19
Machinery equipment, tools	11	10	15	10	46
Metal products	25	32	21	24	102
Nonferrous metals	0	1	4	4	9
Other electronics and components	23	30	20	19	92
Other nonmetallic mineral products	11	12	11	9	43
Other transportation equipment and parts	4	3	3	2	12
Others, not elsewhere classified	17	18	10	10	55
Paper, paper products, printing	5	7	7	7	26
Plastic, rubber products	20	18	22	19	79
Precision instruments	2	1	5	3	11
Textiles	7	6	4	6	23
Wood, wood products	7	5	5	8	25

Source: Authors' calculations

Figure 2. Product innovation in respondent firms by reference year and by province (%)

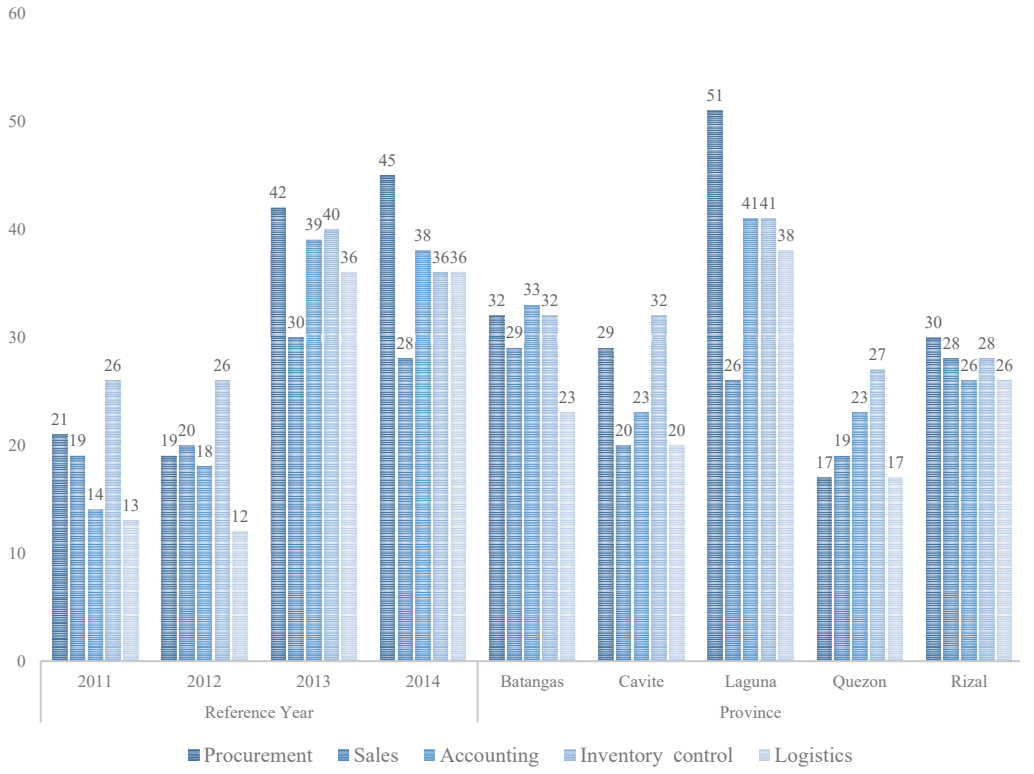


Source: Authors' calculations

On the other hand, when it comes to process innovation activities, there is a marked increase in the number of process innovations in 2013 (Figure 3). Further research is necessary to ascertain the reasons for this trend since the survey instrument is designed to let firms indicate the conduct of innovation activity without specifying the innovations. This strategy allows the firms to still maintain their innovation activities as their competitive advantage with rival firms. Most firms reported the conduct of process innovations in procurement. Among the provinces in CALABARZON, Laguna is notably the most active in process innovation.

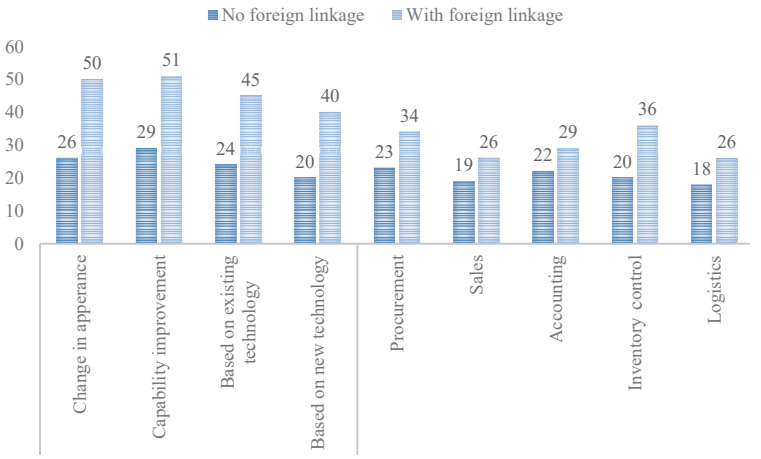
Finally, relating the number of firms that engage in product or process innovation with having a foreign linkage, more firms with foreign linkages engage in product innovations (Figure 4). Based on the ERIA survey questionnaire of this study, having foreign linkages is defined as having satisfied any of the following conditions: (1) engages in export activity; (2) has an MNC or joint venture (JV) customer in a foreign country that is reportedly a 'very important' or 'somewhat important' source of information and technology; or (3) has an MNC or JV supplier in a foreign country that is reportedly a 'very important' or 'somewhat important' source of information and technology. While still more firms engage in process innovations, the difference is relatively small as compared to that of product innovation activities.

Figure 3. Process innovation in respondent firms by reference year and by province (%)



Source: Authors' calculations

Figure 4. Innovation activity of firms by foreign linkage status (%)



Source: Authors' calculations

Econometric model

This study aims to quantify the relationship between innovation activity and external international linkages using the following econometric specification: $Ii = \alpha + \rho Li + \beta Xi + \varepsilon i$ wherein I is 1 if innovator or 0 if non-innovator, L is the presence of foreign linkages, X is a vector of explanatory variables, which include indicators on establishment size, assets, R&D spending, management characteristics, being located in an industrial park, and other similar indicators, and ε is the error term. As the determinants of doing product innovation may be different from that of process innovation, estimations for product and process innovation will be estimated separately with their respective components.

Since L might be correlated to unobservables (captured by εi) that might result in selection-on-unobservables, an instrument variable approach was used. Omitted variables that might confound the results include domestic firm's attitude toward risk or the overall working environment of the firm. Innovation behavior can also affect the decision to engage with foreign partners resulting in a possible simultaneity issue in the probit model.

The instrument for foreign linkages is the GDP growth rate of the partner country that the firm has identified. The top three countries were selected, and its average is taken for the current year. This study exploits the exogeneity of GDP growth rate of countries and its relationship with foreign linkages. This exogenous variable directly affects Philippine firms through their linkage with their customers and/or suppliers but it does not, however, directly affect Philippine firms' innovation activity. Technically, it can be shown that the instrument is partially correlated with foreign linkages once other exogenous variables have been netted out (Wooldridge 2002). This makes the variable a valid instrument for foreign linkages. By using this, issues on simultaneity and omitted variable bias could be addressed.

The model was estimated using instrument variable estimation with the average GDP growth rate of the partner country as identified by the firm as the instrument for foreign linkages. As

noted by Angrist and Pischke (2009), the model can be estimated using the STATA command *ivreg* estimation procedure despite innovation activity and foreign linkages being both binary. The estimated coefficients can be interpreted as the marginal effects.

DISCUSSION

Results of the probit estimation

The marginal effects of changes in the explanatory variable to the probability of being a product or process innovator are presented in Table 4. Consistent with the literature (Albert et al. 2013; EBRD 2014; Llanto and del Prado 2015; Serafica 2016; Albert et al. 2017), large firms were found to be more likely to be an innovator. This positive relationship reflects how a large, well-established firm engages in product or process innovation to maintain its competitiveness.

The marginal effects of 0.151 and 0.110 indicate a positive and significant relationship between R&D spending and the probability of conducting product and process innovation, respectively. This result provides evidence to the theory that firms rely on internal sources of information particularly R&D to conduct innovation activities (Fukugawa 2018). This study also finds a positive and significant relationship between the probability of being a product innovator and the adoption of a learning system that is consistent with the results of prior studies (Albert et al. 2013; Albert et al. 2017).

Table 4. Summary results of the probit estimation in innovation

Variables	Product Innovator		Process Innovator	
	Coefficient	Robust Standard Errors	Coefficient	Robust Standard Errors
Medium firms	0.0225	0.0516	-0.00838	0.0489
Large firms	0.124***	0.0470	0.0977**	0.0460
Age	-0.000249	0.00189	0.000238	0.00178
R&D expenditure	0.151***	0.0219	0.110***	0.0204
Foreign linkages	0.0705	0.0509	0.118**	0.0485
Has a learning system	0.0935*	0.0531	0.131**	0.0510
Produces components	0.0358	0.0747	-0.0517	0.0729
Produces final products	0.149**	0.0630	-0.0198	0.0645
Uses 5S system	0.160***	0.0450	0.0817*	0.0451
Utilizes a quality-control circle	-0.0168	0.0553	-0.0423	0.0538
100% Filipino-owned firm	-0.0286	0.0521	0.0762	0.0520
Top management				
is engineer	-0.0286	0.0405	0.0511	0.0388
has MNC experience	0.000293	0.0414	-0.000153	0.0401
is founder or founder's family	-0.0970**	0.0411	-0.119***	0.0402
Firm has an IPR	0.0614*	0.0802	0.0346	0.0363
Industrial park location	0.0802	0.0518	-0.0500	0.0519

R&D = research and development; 5S = sort, set, shine, standardize, and sustain; MNC = multinational corporation; IPR = intellectual property rights
Source: Authors' calculations, *** p<0.01, ** p<0.05, * p<0.10

Knowledge management practices and learning systems facilitate the transfer of knowledge from external sources to and within the firm contributing to a higher probability to innovate. Another manufacturing principle that is also positively and significantly associated with product innovation activity is the adoption of the 5S system. To incorporate an analysis in the relationship of value chain participation and innovation behavior, dummy variables indicating whether a firm is a 'parts and components' manufacturer or a 'final products' manufacturer were included in the model.

Compared to manufacturers of raw materials, firms that produce final products are more likely to be product innovators. For food manufacturers producing final products, this finding is plausible as they have more room to modify production processes to produce new products. Firms that have an intellectual property rights (IPR) are more likely to be product innovators because these IPR, when commercialized, could be new products sold in the market.

Firms that are completely Filipino-owned are likely to engage in process innovation but not in product innovation. The case of automotive parts manufacturers and assemblers (Quimba and Rosellon 2011) provides an explanation for this as Filipino-owned firms could not be dictated by parent companies regarding improvements of processes allowing them to engage in process innovations while remaining true to the product specifications of their customers.

The regression results show that the background of the top management influences the innovation activity of the firm. Firms where the top management is a founder or is a founder's family member are less likely to conduct either product or process innovation. An explanation for the negative relationship is that whenever the top management is the founder or a founder's family member, it is likely that the top management has a greater commitment to maintain the status quo and, thus, avoid innovation activities.

The study also finds that having foreign linkages is a positive influence to the conduct of process innovation only. There is a need to understand this result in the context of the components of process innovation. This result reveals the need for a more detailed analysis of the determinants of innovation and each of the components of the type of innovation activity involved.

To achieve this, the determinants of product innovation components have been calculated (Table 5). Results similar to Table 4 have been found particularly for the following variables: large firm, R&D expenditure, learning system, final product, and use of a 5S system. What changes, however, is with the variable on the top management being a founder or a founder's family member. Specifically, the case of the product innovation in changing appearance shows the variable of top management being a founder or a founder's family member to be nonsignificant albeit it remains to be a negative determinant to the other product innovation activities.

Being located in an industrial park has a positive influence for a majority of product innovation components. This finding reiterates that location matters to product innovation activities. Moreover, it is possible that since firms are located adjacent to one another in an industrial park, this could lead to a greater degree of embeddedness and expands the linkage network firms have. This point provides support that innovation intermediaries such as PEZA can indirectly influence innovation by providing a conducive environment for innovation activities to improve. Interestingly, the presence of an IPR is nonsignificant when product innovation is disaggregated across its components. Foreign linkages remain to be a nonsignificant influence to product innovation.

Similarly, the determinants of process innovation by component show that firms with large R&D spending are still more capable to undertake process innovations (Table 6). Moreover, the same result from Table 4 on the use of a learning system is obtained. However, what is interesting is that while both the final product and the use of a 5S system is nonsignificant in the aggregate, it has been significant to select subcomponents. For instance, producing final products is a negative influence

Table 5. Summary results of the probit estimation in product innovation components

Variables	Product Innovation	Change in appearance	Capability improvement	Based on existing technology	Based on new technology
Medium firms	0.0208	-0.0148	0.0201	0.022	-0.0124
	-0.0456	-0.0458	-0.0456	-0.0448	-0.0445
Large firms	0.111**	0.139***	0.127***	0.062	0.0304
	-0.0434	-0.0437	-0.0438	-0.044	-0.0434
Age	-0.000373	-0.000252	-0.000644	-0.0016	-0.00243*
	-0.00148	-0.00147	-0.00146	-0.00148	-0.00147
R&D expenditure	0.128***	0.133***	0.137***	0.144***	0.118***
	-0.0172	-0.0183	-0.0176	-0.0177	-0.0194
Foreign linkages	0.0705	-0.0507	0.0139	0.175	0.352**
	-0.181	-0.183	-0.184	-0.181	-0.175
Has a learning system	0.0784	0.104**	0.0725	0.0646	0.0576
	-0.0495	-0.0508	-0.0498	-0.0511	-0.0511
Produces components	0.0234	0.026	0.0111	-0.00555	-0.00514
	-0.0614	-0.0587	-0.0588	-0.06	-0.0624
Produces final products	0.116**	0.154***	0.135***	0.0916*	0.075
	-0.0523	-0.0492	-0.0507	-0.051	-0.0542
Uses 5S system	0.139***	0.117**	0.108**	0.0576	0.048
	-0.0464	-0.0457	-0.0461	-0.0453	-0.0455
Utilizes a QC circle	-0.0141	-0.00614	0.0228	-0.0208	0.00224
	-0.044	-0.0449	-0.0442	-0.0449	-0.0453
100% Filipino-owned firm	-0.0216	-0.0384	-0.0575	-0.0311	0.0221
	-0.0601	-0.06	-0.0591	-0.0573	-0.057
Top management					
is engineer	-0.0311	-0.00458	-0.0283	-0.0591	-0.0680*
	-0.0384	-0.0383	-0.0376	-0.0373	-0.0371
has MNC experience	-0.00172	0.0283	-0.0241	-0.00429	-0.0447
	-0.0367	-0.0367	-0.0363	-0.0362	-0.0362
is founder or founder's family	-0.0872**	-0.0468	-0.0802**	-0.0787**	-0.0754**
	-0.0372	-0.037	-0.0372	-0.0361	-0.0371
Firm has an IPR	0.0522	0.0297	0.0459	0.0467	0.0385
	-0.0323	-0.0324	-0.0323	-0.0319	-0.0321
Industrial park location	0.0669	0.0921*	0.0587	0.062	0.0305
	-0.0508	-0.0523	-0.0522	-0.0516	-0.0518
Constant	0.133	0.1	0.153	0.103	-0.0215
	-0.109	-0.11	-0.108	-0.107	-0.107
Observations	855	855	855	855	855
R-squared	0.192	0.178	0.19	0.176	0.113

R&D = research and development; 5S = sort, set, shine, standardize, and sustain; QC = quality control; MNC = multinational corporation; IPR = intellectual property rights
Source: Authors' calculations, *** p<0.01, ** p<0.05, * p<0.10, robust standard errors in parentheses

Table 6. Summary results of the probit estimation in process innovation components

Variables	Procurement	Sales	Accounting	Inventory Control	Logistics
Medium firms	0.0399	-0.00538	-0.0129	-0.0182	0.00161
	-0.0456	-0.0397	-0.0416	-0.0443	-0.0408
Large firms	0.0968**	0.02	0.0404	0.115***	0.0881**
	-0.0426	-0.0389	-0.04	-0.0428	-0.0392
Age	0.00225	-0.000277	0.00305**	-0.00177	0.00202
	-0.00168	-0.0015	-0.00152	-0.00168	-0.00142
R&D expenditure	0.0751***	0.0502***	0.0464***	0.0428**	0.0696***
	-0.017	-0.015	-0.0162	-0.0169	-0.0148
Foreign linkages	0.0276	0.0716*	0.0329	0.103**	0.0388
	-0.045	-0.0376	-0.0423	-0.0431	-0.0396
Has a learning system	0.0936**	0.133***	0.147***	0.0799*	0.111***
	-0.043	-0.0378	-0.0394	-0.0446	-0.0388
Produces components	0.0686	-0.0931*	-0.0737	0.00726	-0.0215
	-0.0683	-0.0497	-0.0567	-0.071	-0.0585
Produces final products	0.0728	-0.0940*	-0.0162	0.0571	0.0369
	-0.0572	-0.0511	-0.0543	-0.0617	-0.0513
Uses 5S system	0.0763*	0.0518	0.023	0.0607	0.0751**
	-0.0394	-0.0356	-0.0384	-0.0404	-0.0349
Utilizes a QC circle	-0.0227	-0.0799*	-0.0471	-0.0326	-0.0870*
	-0.0477	-0.0478	-0.048	-0.049	-0.0485
100% Filipino-owned firm	0.0938**	0.0808*	0.0329	0.0335	0.0224
	-0.0458	-0.0416	-0.0439	-0.0469	-0.0422
Top management					
is engineer	0.0227	0.0252	0.0463	0.0532	0.0641**
	-0.0353	-0.0328	-0.0335	-0.0354	-0.0323
has MNC experience	0.0412	-0.0172	-0.0254	0.00984	-0.00396
	-0.0361	-0.0324	-0.0337	-0.0365	-0.0321
is founder or founder's family	-0.0956***	-0.031	-0.0884**	-0.152***	-0.0844***
	-0.0363	-0.033	-0.0346	-0.036	-0.0327
Firm has an IPR	-0.0448	0.0381	0.00182	0.0541	-0.0521*
	-0.0327	-0.0298	-0.0308	-0.033	-0.0292
Industrial park location	0.0229	-0.0692*	-0.0225	-0.0929**	-0.0786*
	-0.0463	-0.0415	-0.0435	-0.0465	-0.0418

R&D = research and development; 5S = sort, set, shine, standardize, and sustain; QC = quality control; MNC = multinational corporation; IPR = intellectual property rights
Source: Authors' calculations, *** p<0.01, ** p<0.05, * p<0.10, robust standard errors in parentheses

to innovating in sales-related processes whereas the use of a 5S system is a positive influence to procurement and logistics innovation.

The location of the firm in an industrial park has interestingly shown as well that firms located in industrial parks are less likely to innovate in sales, inventory, and logistics processes. Perhaps, this stems from the fact that firms situated in an industrial park have easier access to customers within the same park and access to improved logistics services. Thus, the results are implying a limited need for process innovation. However, foreign linkages that have previously been significant in the aggregate are found to be significant only for select processes, such those of sales and inventory control. [5]

Results of the first-stage regression: Determinants of foreign linkages

The first-stage regression results of the instrument variable approach are presented in Table 7. The GDP growth rate of the foreign country with which the firm has linkages is a positive and significant determinant of the probability of having foreign linkages. This shows that the condition that the instrument is partially correlated with the endogenous variable once other exogenous variables have been netted out is satisfied (Wooldridge 2002). Other tests also show that the instrument is not a weak instrument.

Moreover, those practicing a 5S system and/or a learning system have an increased likelihood of having foreign linkages. Understandably, firms with purely Filipino capital are less likely to have foreign linkages. Finally, firms where the manager is an engineer, a founder, or a founder's family member are positive determinants of the likelihood of a firm to have foreign linkages.

Results of the IV regression

As shown in Table 8, having foreign linkages can increase the probability of firms to innovate new products using technology new to the firm by 35.2 percent. This is despite foreign linkages having been consistently nonsignificant both for the aggregate (product innovation) and the disaggregated (product innovation components) probit estimations. This result may reflect the fact that, after having controlled for omitted variables and the possible simultaneity, foreign linkages increase the likelihood of firms to undertake the most difficult form of product innovation that would involve a technology new to the firm.

Meanwhile, R&D expenditure remains to be a significant determinant of product innovation across all types of subactivities as it is with large firms. This is consistent with the probit estimation results. It further supports the findings of Llanto and del Prado (2015) wherein firm performance is improved by innovation activities, thus, increased R&D capability will be beneficial for the industry. Finally, another robust result was with firms whose top management is a founder or part of the founder's family as being less likely to undertake product innovation.

On the other hand, when it comes to process innovation (Table 9), the same results as with the probit estimation can be observed. For instance, firms doing R&D are still more likely to conduct process innovations. The same goes with that of having a learning system. As with the probit estimation, producing final products, having the top management as a founder or a founder's family member, or the firm being located in an industrial park can all be negative influences to the likelihood of the firm to innovate in processes.

[5] By participating in regional procurement and following internationally accepted accounting standards, domestic firms with foreign linkages may likely have limited room for innovation in the procurement (including logistics) and accounting systems, respectively.

Table 7. Determinants of foreign linkages

Variables	Coefficient	Robust Standard Errors
Average foreign GDP growth	0.0541***	0.00753
Medium firms	-0.0299	0.0344
Large firms	0.0362	0.0289
Age	0.000753	0.00145
R&D expenditure	0.0280**	0.0131
Has a learning system	0.152***	0.0363
Produces components	-0.0579	0.0505
Produces final products	0.0419	0.0479
Uses 5S system	0.120***	0.0340
Utilizes a quality-control circle	-0.00646	0.0377
100% Filipino-owned firm	-0.180***	0.0353
Top management		
is engineer	0.0788***	0.0258
has MNC experience	0.0232	0.0250
is founder or founder's family	0.0547**	0.0273
Firm has an IPR	0.0299	0.0245
Industrial park location	0.146***	0.0333
Constant	0.393***	0.0694
Observations	855	

GDP = gross domestic product; R&D = research and development; 5S = sort, set, shine, standardize, and sustain; MNC = multinational corporation; IPR = intellectual property rights
Source: Authors' calculations, *** p<0.01, ** p<0.05, * p<0.10

Table 8. Summary results of the IV regression in product innovation components

Variables	Product Innovation	Change in appearance	Capability improvement	Based on existing technology	Based on new technology
Medium firms	0.0208	-0.0148	0.0201	0.022	-0.0124
	-0.0456	-0.0458	-0.0456	-0.0448	-0.0445
Large firms	0.111**	0.139***	0.127***	0.062	0.0304
	-0.0434	-0.0437	-0.0438	-0.044	-0.0434
Age	-0.000373	-0.000252	-0.000644	-0.0016	-0.00243*
	-0.00148	-0.00147	-0.00146	-0.00148	-0.00147
R&D expenditure	0.128***	0.133***	0.137***	0.144 ***	0.118***
	-0.0172	-0.0183	-0.0176	-0.0177	-0.0194

Table 8. continuation

Variables	Product Innovation	Change in appearance	Capability improvement	Based on existing technology	Based on new technology
Foreign linkages	0.0705	-0.0507	0.0139	0.175	0.352**
	-0.181	-0.183	-0.184	-0.181	-0.175
Has a learning system	0.0784	0.104**	0.0725	0.0646	0.0576
	-0.0495	-0.0508	-0.0498	-0.0511	-0.0511
Produces components	0.0234	0.026	0.0111	-0.00555	-0.00514
	-0.0614	-0.0587	-0.0588	-0.06	-0.0624
Produces final products	0.116**	0.154***	0.135***	0.0916 *	0.075
	-0.0523	-0.0492	-0.0507	-0.051	-0.0542
Uses 5S system	0.139***	0.117**	0.108**	0.0576	0.048
	-0.0464	-0.0457	-0.0461	-0.0453	-0.0455
Utilizes a QC circle	-0.0141	-0.00614	0.0228	-0.0208	0.00224
	-0.044	-0.0449	-0.0442	-0.0449	-0.0453
100% Filipino-owned firm	-0.0216	-0.0384	-0.0575	-0.0311	0.0221
	-0.0601	-0.06	-0.0591	-0.0573	-0.057
Top management					
is engineer	-0.0311	-0.00458	-0.0283	-0.0591	-0.0680*
	-0.0384	-0.0383	-0.0376	-0.0373	-0.0371
has MNC experience	-0.00172	0.0283	-0.0241	-0.00429	-0.0447
	-0.0367	-0.0367	-0.0363	-0.0362	-0.0362
is founder or founder's family	-0.0872**	-0.0468	-0.0802**	-0.0787 **	-0.0754**
	-0.0372	-0.037	-0.0372	-0.0361	-0.0371
Firm has an IPR	0.0522	0.0297	0.0459	0.0467	0.0385
	-0.0323	-0.0324	-0.0323	-0.0319	-0.0321
Industrial park location	0.0669	0.0921*	0.0587	0.062	0.0305
	-0.0508	-0.0523	-0.0522	-0.0516	-0.0518
Constant	0.133	0.1	0.153	0.103	-0.0215
	-0.109	-0.11	-0.108	-0.107	-0.107
Observations	855	855	855	855	855
R-squared	0.192	0.178	0.19	0.176	0.113

R&D = research and development; 5S = sort, set, shine, standardize, and sustain; QC = quality control; MNC = multinational corporation; IPR = intellectual property rights
Source: Authors' calculations, *** p<0.01, ** p<0.05, * p<0.10, robust standard errors in parentheses

Table 9. Summary results of the IV regression in process innovation components

Variables	Process Innovation	Procurement	Sales	Accounting	Inventory Control	Logistics
Medium firms	0.00238	0.0437	0.000838	-0.0117	-0.0147	-0.00194
	-0.047	-0.0442	-0.0408	-0.041	-0.0432	-0.0397
Large firms	0.0708	0.0810*	0.00475	0.0398	0.102**	0.0812**
	-0.0454	-0.0434	-0.0402	-0.0409	-0.0435	-0.0387
Age	-0.000332	0.00181	-0.000721	0.00293*	-0.0018	0.00194
	-0.00169	-0.00167	-0.00158	-0.00155	-0.00151	-0.00142
R&D expenditure	0.0859***	0.0694***	0.0471**	0.0474**	0.0361*	0.0746***
	-0.0185	-0.0193	-0.0185	-0.0188	-0.0187	-0.0181
Foreign linkages	0.480**	0.289	0.350**	0.078	0.345*	0.118
	-0.192	-0.196	-0.177	-0.177	-0.192	-0.169
Has a learning system	0.072	0.0454	0.0879**	0.133***	0.0368	0.0902**
	-0.0541	-0.0488	-0.0445	-0.0437	-0.0497	-0.043
Produces components	-0.0362	0.0714	-0.0937	-0.0659	0.0193	-0.0179
	-0.0717	-0.0589	-0.0613	-0.0597	-0.0639	-0.0531
Produces final products	-0.0387	0.0515	-0.111**	-0.0179	0.0437	0.0291
	-0.0646	-0.0539	-0.0556	-0.0554	-0.0572	-0.0489
Uses 5S system	0.0251	0.0376	0.015	0.0167	0.0201	0.0635
	-0.05	-0.0456	-0.0439	-0.0441	-0.0462	-0.0412
Utilizes a QC circle	-0.0384	-0.0171	-0.0676*	-0.042	-0.0318	-0.0749*
	-0.0488	-0.0411	-0.0398	-0.0404	-0.0424	-0.0391
100% Filipino-owned firm	0.159**	0.146**	0.144**	0.0427	0.0867	0.036
	-0.0647	-0.0619	-0.0573	-0.0572	-0.0613	-0.0539
Top management						
is engineer	0.0129	-0.00052	-0.00225	0.0383	0.0327	0.0531
	-0.0404	-0.0379	-0.0357	-0.0354	-0.0375	-0.0341
has MNC experience	-0.02	0.0257	-0.0256	-0.0242	-0.00407	-0.00586
	-0.039	-0.0365	-0.0335	-0.0342	-0.0371	-0.0324
is founder or founder's family	-0.127***	-0.103***	-0.0422	-0.0883***	-0.157***	-0.0858***
	-0.04	-0.0362	-0.034	-0.0342	-0.0361	-0.032
Firm has an IPR	0.018	-0.0503	0.0285	0.00221	0.0438	-0.0510*
	-0.0348	-0.0323	-0.0304	-0.0302	-0.0321	-0.0283
Industrial park location	-0.0980*	-0.025	-0.116**	-0.0344	-0.132**	-0.0986**
	-0.056	-0.0541	-0.051	-0.0494	-0.0536	-0.0483
Constant	0.108	-0.091	0.0454	0.124	0.0738	0.0708
	-0.125	-0.117	-0.111	-0.112	-0.118	-0.103
Observations	855	855	855	855	855	855
R-squared	0.044	0.044	0.011	0.058	0.058	0.093

R&D = research and development; 5S = sort, set, shine, standardize, and sustain; QC = quality control; MNC = multinational corporation; IPR = intellectual property rights
Source: Authors' calculations, *** p<0.01, ** p<0.05, * p<0.10, robust standard errors in parentheses

Finally, having foreign linkages is positively related to process innovations particularly in sales and inventory control activities. In general, foreign linkages were estimated to increase by 48.0 percent the likelihood to conduct process innovation. This result is as expected as process innovation resulting from foreign linkages would usually come from customers and thus would affect sales and inventory control. The study of del Prado and Rosellon (2017b) provides some evidence of this in their analysis of fruit juices. They found that foreign linkages were used to expand the market (improve sales) of the firm.

SUMMARY, CONCLUSION, AND POLICY RECOMMENDATIONS

The probit regression has indicated that having foreign linkages is positively associated with being a process innovator but does not present the same significant effect to product innovation activities. This is consistent with the findings of Machikita and Ueki (2011) wherein firms with foreign linkages have more propensity to find new markets as compared to their propensity to develop new products. Moreover, foreign linkages develop and expand the degree of embeddedness that a firm has with them, thus, allowing for process innovations to develop. Likewise, having foreign linkages can increase the probability of a firm to conduct significant improvements in sales and inventory processes.

Meanwhile, by controlling for sources of endogeneity, it was shown that foreign linkages have a positive and significant impact on the probability that a firm will undertake product innovation that involves the development of a new product using technology new to the firm by 35.2 percent. The observed relationships in the probit model for process innovation also remains true with an overall effect of 48.0 percent. It should be noted then that internal resources to the firm are also important determinants of both product and process innovation. Being in an industrial zone has been associated positively with foreign linkages.

Policy recommendations

It is important to review current policies related to strengthening foreign linkages of firms in the Philippines. Two chapters in the *Philippine Development Plan (PDP) 2017-2022* emphasize the importance of linkages to the Philippine domestic economy. Chapter 15 in the PDP that focuses on ensuring a strong macroeconomic performance of the local identified the following strategies: expanding market access particularly for MSMEs, increasing the competitiveness of Philippine exports through the adoption of best practices, and supporting innovation in key industries and facilitate trade through stronger linkages and connectivity.

The PDP's Chapter 9 on expanding economic opportunities in industry and services through 'Trabaho at Negosyo' highlights the goal of the government to be able to develop globally competitive businesses particularly for MSMEs through the full implementation of the Comprehensive National Industrial Strategy (CNIS). The PDP promotes interfirm cooperation as a means of increasing the competitiveness, innovativeness, and resilience of industries and services.

The full implementation of the CNIS is central to the development of the industrial sector in the country. However, given the rapidly changing global landscape in terms of innovation, the Department of Trade and Industry has launched its new industrialization strategy coined as i^3S (inclusive innovation industrial strategy). The overall goal is the creation of globally competitive and innovative industries through the following channels: growth-oriented action to upgrade industries and move them up the value chain, removal of obstacles to growth and subsequently attract more investments, and deepening the participation in regional and global value chains by domestic firms. Key points under the i^3S include the building of new industries, clusters, and agglomeration together

with the empowerment of MSMEs notwithstanding the need to ease the conduct of doing business and the investment environment.

With these policies in place and given the findings of this study, the policy recommendations include the following:

(1) Promote stronger regional and/or global linkages to sustain manufacturing growth in the region. It is important to be wary of policies that might be detrimental to the formation of linkages.

(2) Support trainings on the 5S system through government institutions such as the Technical Education and Skills Development Authority programs on Trainee Performance Space (TPS), 5S, or kaizen, together with efforts coming from state universities and colleges in the Visayas region teaching TPS and 5S.

(3) Support the development of R&D capability of firms. For instance, the PDP 2017-2022 highlights four strategies to develop science, technology, and innovation in the Philippines (Chapter 4) that can help encourage innovation. The i^3S is an example of a policy that can move this support forward.

(4) Highlight the role of innovation intermediaries. Expanding relational chains and linkages both domestically and internationally helps to facilitate the degree of embeddedness of firms. This knowledge dissemination dynamic allows for reducing the inefficiencies of innovation's trial-and-error nature. The role of intermediaries, such as PEZA, is also important as institutions like this can provide an environment conducive for innovation.

(5) Recognize the value of establishment-level data on the innovation activities of firms. Particularly, there can be a measure of where the firm is innovating across the global value chain. There is a possibility that the effects of innovation can be differently assessed in different nodes across the chain although this would require a more detailed questionnaire catered to this inquiry.

Areas for further research related to this study's findings include distinguishing between forward and backward linkages in the model. Future researches can explore how each type of linkage can contribute to strengthening industries in the Philippines. Other variables that can be included in the model relate to identifying how information is being transmitted from foreign partners to the domestic firm through data on the exchange of high-skilled personnel. Apart from these, exploring innovation activities based on technological capacity-building levels (Ariffin and Figueiredo 2006) and of external linkages' degree of activity (Patra and Krishna 2015) will shed light as to where Philippine firms' innovation efforts are concentrated or directed.

Exploring the relationship of market power with innovation activity can also be interesting although it would require the use of another dataset. The rationale for investigating market power is that its relationship with the innovation activities of firms is ambiguous, that is, innovation may be pursued to increase market power or market power may induce more innovation.

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