Journal of Global Business and Trade

Vol.15 No.1 May 2019

The Journal of Global Business and Trade
IAGBT
International Academy of Global Business and Trade

Journal of Global Business & Trade
Vol.15 No.1 May 2019
IAGBT

ISSN 1946-5130 (Print)
ISSN 2470-4733 (Online)

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Published by
International Academy of Global Business and Trade
The Journal of Global Business and Trade
IAGBT
www.pfw.edu/jgbt

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ISSN 1946-5130 (Print)
ISSN 2470-4733 (Online)

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ISO abbreviation of journal title

The official title of the journal is 'Journal of Global Business and Trade' and the abbreviated title is 'J. Glob. Bus. Trade'

Year of launching (history)

Journal of Global Business and Trade was launched in 2005.

Availability of the full-text in the web

Full text is freely available from: http://www.pfw.edu/jgbt

Fund support

This journal was supported by the International Academy of Global Business and Trade.

Index in database

The articles published in this journal are indexed and/or abstracted in EBSCO, ProQuest, Exribris, and GoogleScholar.

Subscription information

All correspondences regarding membership, subscriptions and changes of address should be sent to the society addressed as below:
International Academy of Global Business and Trade, 2101 E. Coliseum Boulevard, Fort Wayne, IN 46805, U.S.A. (Tel: 1.260.481.6794, Fax: 1.260.481.6879, E-mail: myeonghwan.kim@pfw.edu, Homepage: http://www.pfw.edu/jgbt). The annual subscription fees are free of charge.

Submission

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Peer review under responsibility of International Academy of Global Business and Trade.

Journal of Global Business and Trade Volume 15, Number 1

Published 30 May 2019

Publisher (Editorial office)

International Academy of Global Business and Trade founded in 2005,
2101 E. Coliseum Boulevard, Fort Wayne, IN 46805, U.S.A. (Tel: 1.260.481.6794, Fax: 1.260.481.6879,
E-mail: myeonghwan.kim@pfw.edu, Homepage: http://www.pfw.edu/jgbt).

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The Journal of Global Business and Trade
IAGBT
www.pfw.edu/jgbt

ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2019.15.1.1

The Journal of Global Business and Trade

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https://www.pfw.edu/jgbt

The Heterogenous Effects of Savings and Capital Inflows on Capital Outflows: A Quantile Regression Approach

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Received 5 February 2019, Revised 11 April 2019, Accepted 25 May 2019

ABSTRACT

Purpose – The paper aims to investigate the main driver of gross capital outflows in emerging market economies. Accordingly, it tests the following two hypotheses: first, capital outflows are mostly fueled by capital inflows, rather than by domestic savings, and second, the causal impact of capital inflows is stronger in the upper quantiles of capital outflows.
Design/Methodology/Approach – We estimate the impacts of domestic private savings and gross capital inflows on gross capital outflows in 56 emerging market economies over 1990 - 2014 using Powell's (2015) quantile regression methodology.
Findings – According to the results, the response of capital outflows to capital inflows and domestic savings is similar if capital outflows are below the median. However, if they are above the median, the impact of external loans is stronger than that of savings. Furthermore, a country tends to borrow from foreign countries to purchase debts rather than equities in the short run. This is consistent with several stylized facts, such as pro-cyclical capital inflows and outflows, the high leverage ratio, and high probability of serial default and sudden stops during short-term booms.
Research Implications – The results suggest capital flight is not a market-exiting behavior by domestic agents because they use borrowings rather than savings to increase foreign asset holdings. Therefore, it is unlikely that capital flight significantly decreases domestic agents' domestic asset holdings.

Keywords: capital inflows, capital outflows, private savings, quantile
JEL Classifications: E44, F21, F30, G21, G51

Ⅰ. Introduction

What is the main driver of gross capital outflows in developing countries? Although capital outflows are generally fueled by domestic and external savings, the answer to this suggests different policy implications, especially when domestic agents are purchasing a large amount of foreign assets (capital flight). Capital flight might be harmful, but the reason why is different according to its main source. For example, if domestic agents are saving in foreign countries to avoid expected taxation, a government's tax base erodes and social welfare might be consequently reduced (Dooley & Kletzer, 1994). Conversely, if they borrow from foreign countries to increase leverage, such behaviors might increase the probability of external default and

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sudden stops in the country (Gosh et al., 2016). In either case, different policy responses may be required.

As one answer, we investigate the causal effects of private savings and gross capital inflows on gross capital outflows using panel data that consist of 56 emerging market economies over 1990 - 2014. In particular, we focus on extreme movements of capital flows that may motivate the implementation of macroprudential policies. Recent literature has provided empirical evidence that capital inflows and outflows are both pro-cyclical (e.g., Broner et al., 2013). This might indicate that capital outflows are mainly fueled by external loans rather than by domestic saving, especially during boom times. Accordingly, the paper tests two hypotheses: first, capital outflows are mostly fueled by capital inflows, rather than by domestic savings, and second, the causal impact of capital inflows is stronger than that of domestic savings, especially during capital flight.

Powell's (2015) quantile regression methodology sheds light on the relationship between capital outflows and their two main resources. First, it estimates the quantile treatment effects of gross capital inflows and domestic savings that might vary according to the distribution of gross capital outflows. It is motivated by the procyclical nature of capital flows which, in turn, might indicate varying associations with capital inflows. Moreover, according to Forbes and Warnock (2012a, b), the determinants of capital flight (large foreign asset purchases by domestic agents) and capital retrenchment (small foreign asset purchases) are different. This implies capital flight and retrenchment are different phenomena, and that the causal impacts of capital inflows and private savings might also be different. Ordinary least squares methods estimate the mean effects of the determinants, but do not allow for heterogenous effects at different points in the conditional distribution of the outcome variable. If this is the case for gross capital outflows, OLS models are inappropriate to estimate the impact of two financial resources. On the other hand, quantile regression methodology can provide more robust evidence on the impacts when outflows are far from the mean or median.

A quantile plot (Fig. 1) and the summary (Table 1) of gross capital outflows also support the desirability of the methodology in this circumstance. Across diverse fractions of the data, gross capital outflows range from -15.04% to 50.81%, and even after getting rid of outliers, they range from -2.2% to 12.01%. Therefore, the paper attempts to estimate the impacts of two financial resources across the fraction of gross capital outflows.

Second, we estimate the causal impacts of domestic savings and capital inflows on capital outflows. Addressing causality is important for the study because the association might simply reflect national income accounting in sample countries (i.e., total saving=total investment). In this case, the association between gross capital outflows and two resources may barely vary across the distribution of the former unless there exist large errors and omissions in the data. Powell (2015) adopts Chernozhukov and Hansen's (2005) IV quantile regression methodology, and therefore allows us to estimate not only the association but also causal effects of the determinants.

Fig. 1. Quantile Plot of Gross Capital Outflows (Data source: IMF BOPS and WEO)

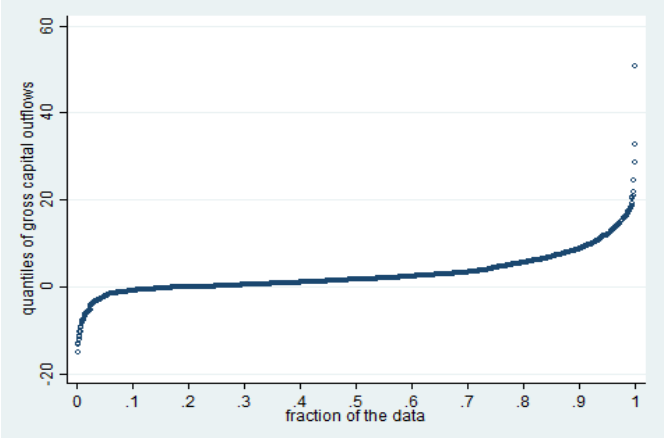


Table 1. The Summary and Quantiles of Gross Capital Outflows (% of GDP)

Obs.	Mean	Std. Dev.	Min	Max
1,298	2.84%	4.81	-15.04%	50.81%
Quantile				
5th	25th	50th	75th	95th
-2.2%	0.17%	1.72%	4.44%	12.01%

Note: Data source is IMF BOPS and WEO, and the data consist of 56 emerging markets and cover the years 1990 – 2014.

According to the results, the marginal effect of external loans on foreign asset purchases is analogous to that of savings when private sectors are purchasing a small amount of foreign assets (e.g., less than the median). However, when asset purchases significantly increase, they switch resources in favor of external loans and reduce the dependency on savings. This suggests capital flight is fueled by borrowing rather than by saving, and it might be a reason why capital inflows are strongly and positively correlated with capital outflows. Furthermore, the impacts of two financial resources on equity outflows and debt outflows are quite different. By showing the past outflows are the best predictor of current equity outflows, the estimates indicate equity outflows are very persistent during capital flight. As a result, although the temporary effect of capital inflows is small, the permanent effect becomes significantly large. On the contrary, debt outflows are less persistent than equity outflows, but the quantile treatment effects of current determinants are larger. This indicates private sectors over borrow to purchase debts rather than equities in the short run, and is consistent with several stylized facts (e.g., high leverage ratio and procyclicality of capital flows and financial systems).

The paper is organized as follows. Section 2 reviews existing literature on the relationship between capital outflows and two financial resources, savings and borrowing. Section 3 explains the data and introduces regression models, and Section 4 reports the results. Section 5 summarizes the paper and concludes it by discussing some policy implications.

Ⅱ. Related Literature

We might be able to surmise the impact of private savings on foreign investment by a well-known stylized fact, "Home equity bias". According to Feldstein and Horioka (1980), empirical evidence indicates savings are mostly spent to purchase domestic capital stock rather than foreign capital stock. Their results suggest a very strong correlation between savings and domestic investment: a one percentage increase in the savings rate increases the investment rate almost one percent. After their study, researchers consistently have attempted to test the "home equity bias", and many have confirmed it.[1] Furthermore, recent empirical literature argues this phenomenon is not restricted to developed countries and equities. Coeurdacier and Rey (2012) showed such bias is stronger and more persistent in emerging markets, and the share of home bonds and bank loans in investor portfolios are also higher. Feldstein (1995) also studied the relationship between capital outflows and domestic investment by investigating how outbound FDI affected domestic capital stock in 24 OECD countries. According to Feldstein, one dollar of spending on outbound FDI is associated with a decrease in domestic investment by almost the same amount, essentially making them substitutes. If such strong correlation between savings and domestic investment holds, we should expect the causal effect of savings on capital outflows to be small. However, this long-term relationship between savings and domestic investment

[1] See e.g., Feldstein (1982), Feldstein and Bacchetta (1991), and Tesar (1991).

does not confirm the causal effect of savings on foreign investment in the short term, which is the main purpose of this paper.

On the other hand, other researchers have focused on simultaneous capital inflows and outflows in Latin America in the 1970s and 1980s, and tried to explain this strong correlation by modeling domestic risks that are unique in emerging markets. For example, Khan and Ul Haque (1985) argued it was because of the "expropriation" risk that cannot be hedged because of political instability and poor infrastructures in the countries. As a result, private sectors prefer to purchase risk-free foreign assets, and governments are forced to borrow from external markets. Similarly, Alesina and Tabelini (1989) pointed out political uncertainty as a reason for the association. They claimed non-cooperative two social groups cause governments' moral hazard in borrowing excessively before the change of the terms. Therefore, individuals who are afraid of an increase in taxes in the future purchase foreign assets as insurance against this. These papers suggest theoretical frameworks as to why large capital inflows are associated with capital flight. Recent studies also provide empirical evidence on a strong positive correlation between capital inflows and outflows. For instance, Broner et al. (2013) showed there was a strong positive correlation between capital inflows and outflows regardless of countries' incomes, and argued that the correlation was becoming stronger. Likewise, Rey (2013) and Miranda-Agrippino and Rey (2015) emphasized a strong correlation between the two flows, and pointed out global common factors, such as global risk aversion and growth as the main drivers of this strong correlation. This might indicate capital inflows are the main drivers of capital outflows. Providing a detailed interpretation on this strong correlation is one of the purposes of this paper.

To our knowledge, this paper is one of few studies employing quantile regression to estimate the impacts of private savings and gross capital inflows on gross capital outflows. The main motivation is to treat capital outflows at different quantiles as different dependent variables. Forbes and Warnock (2012a/2012b) argued the determinants of capital retrenchment and flight were different. They stated that global common factors were the main determinants of capital flight, although domestic specific factors also played a role. This implies that they are indeed different phenomena. If so, the causal effects of private savings and capital inflows on capital outflows may be different according to the amount, and a quantile regression methodology allows us to estimate these. We expect the results could suggest more flexible policy responses according to the amount of capital outflows.

Ⅲ. Data and Estimation Strategy

1. Data

Unbalanced panel data consists of 56 emerging market economies from 1990 to 2014, excluding (1) major oil-exporting countries, (2) bank havens, and (3) low-income groups according to 2008 GNI per capita by the World Bank, considering they might work as strong outliers in the group.[2] All countries have at least a total of 15 years, and 10 consecutive years, of gross capital outflow data (source: IMF BOPS). As it is specified in other papers, IMF data does not clarify whether some missing values in outflows are zero or not available. Following others, (e.g., Forbes and Warnock, 2012a) we replaced these with zero if the surrounding values are zeros, and leave them empty, otherwise.[3] Selected variables for estimation are: gross

[2] The sample countries are: Angola, Armenia, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, Colombia, The Rep. of Congo, Costa Rica, Cote d'Ivore, Dominica, The Dominican Republic, Egypt, El Salvador, Georgia, Grenada, Guatemala, Honduras, India, Indonesia, Jamaica, Jordan, Kazakhstan, Latvia, Lesotho, Lithuania,, Malaysia, Maldives, Mexico, Moldova, Mongolia, Morocco, Namibia, Nigeria, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Russia, Saint Lucia, Seychelles, South Africa, Sri Lanka, Syria, Thailand, Tunisia, Turkey, Ukraine, Uruguay, and Venezuela.

[3] One of the strengths of quantile regression is that estimated QTEs are robust to this kind of censoring.

capital outflows (outflow) for the dependent variable, gross capital inflows (inflow), private savings (prsave), and exchange rate regime (exregime) for the explanatory variables, and real GDP growth (zgdp), capital market openness (kaopen), public savings (pubsave), and domestic credit to the private sector (credit) for the instrumental variables. We also added a lagged dependent variable as an explanatory variable to estimate the permanent effects of other independent variables. The details on data sources and the definition of variables are in Appendix A.[4]

The following is the summary of the selected variables and their correlations. As Table 3 shows, gross capital inflows is the only variable that is strongly correlated with gross capital outflows. On the other hand, the correlation between private savings and gross capital outflows is very small, as the home bias implies, and it gives us a clue that the impact on capital outflows might be insignificant. Private savings and gross capital inflows are negatively correlated, which confirms that savings decrease as people borrow more. Finally, endogenous (gross capital inflows and private savings) and instrumental variables (real GDP growth, capital market openness, public savings, and domestic credit) are strongly correlated, which indicates that the instruments can represent instrumented variables.

2. Estimation Strategy

To estimate the causal effects of the explanatory variables, we use a quantile regression with four instruments (real GDP growth, capital market openness, public savings, and domestic credit) for gross capital inflows and private savings, as these two variables are the main interests. Quantile treatment effects are estimated by a quantile regression methodology across every 5th quantile of gross capital outflows (from 0.05 to 0.9). The model is a linear quantile regression, which is

$$Y_{it} = D_{it}'\beta(\tau) \quad (1)$$

Table 2. The Summary of Selected Variables

	Obs.	Mean	Std. Dev.	Min	Max
Gross Capital Outflows (% of GDP)	1,298	2.84%	4.81	-15.04%	50.81%
Gross Capital Inflows (% of GDP)	1,326	6.45%	8.53	-38.98%	71.01%
Private Savings (% of GDP)	1,061	13.50%	11.48	-69.27%	61.76%
Exchange Rate Regime	1,400	7.36%	4.22	1	15
Real GDP Growth (%)	1,355	3.78%	4.71	-30.90%	25.78%
Capital Market Openness	1,321	0.45	0.33	0	1
Public Savings (% of GDP)	1,073	6.31%	11.68	-55.68%	75.71%
Domestic Credit (% of GDP)	1,302	38.05%	28.83	0%	166.50%

[4] As you can see in Appendix A, the study used Chinn and Ito's (2006) aggregate control index to prevent observations from being reduced only by the index. As the dependent variable is gross capital outflows, the outflow control index will give better information for the estimation, but using it significantly decreases available observations. For example, Fern´andez et al.'s (2016) outflow control index decreases the number of observations from 1,321 to 740.

Table 3. Correlations between Selected Variables

	Outflow	Inflow	Prsave	Exregime	Zgdp	Kaopen	Pubsave	Credit
Outflow	1.0000							
Inflow	0.4000	1.0000						
Prsave	-0.0023	-0.3563	1.0000					
Exregime	-0.0958	-0.1290	0.1726	1.0000				
Zgdp	0.0850	0.1364	-0.0375	-0.0020	1.0000			
Kaopen	-0.0181	0.1669	-0.0362	-0.0032	0.0187	1.0000		
Pubsave	0.1322	0.2276	-0.6753	-0.0977	0.2695	0.0239	1.0000	
Credit	0.0952	0.1500	0.1100	-0.0046	-0.0940	-0.0149	-0.0726	1.0000

Note: outflow: gross capital outflows, inflow: gross capital inflows, prsave: private savings, exregime: exchange rate regime, zgdp: real GDP growth, kaopen: capital market openness, pubsave: public savings, credit: domestic credit.

where Y is the dependent variable (gross capital outflows), D is the set of explanatory

variables (lagged dependent variable, gross capital inflows, private savings, and exchange rate regime) and, $\tau \in \{0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9\}$. For the mean effect, we use two-stage least squares with fixed effect (FE2SLS), and this mean effect and quantile treatment effects by IVQR will be compared with each other.[5]

The model is

$$\text{outflow}_{\text{it}} = \beta_0 + \beta_1 loutflow_{it} + \beta_2 inflow_{it} + \beta_3 prsave_{it} + \beta_4 exregime_{it} + \alpha_i + \gamma_t + \epsilon_{it} \quad (2)$$

where loutflowit is the lagged dependent variable for country i at time t. $\beta 2$ and β_3, which represent the impact of capital inflows and private savings on capital outflows, are our main interests. Note that adopting the dynamic model allows us to estimate the permanent effects of two variables, which are $\beta_2/(1-\beta_1)$ for capital inflows and $\beta_3/(1-\beta_1)$ for savings, respectively.

The corresponding quantile regression (IVQR) can be expressed as

$$\begin{aligned} \text{outflow}_{\text{it}}(\tau) &= q(D_{it}, \tau) \\ &= \beta_0(\tau) + \beta_1(\tau) loutflow_{it} \\ &\quad + \beta_2(\tau) inflow_{it} \\ &\quad + \beta_3(\tau) prsave_{it} \\ &\quad + \beta_4(\tau) exregime_{it} \\ &\quad + \gamma_t(\tau) \end{aligned} \quad (3)$$

where q(Dit, τ) is the τth quantile function of capital outflows. There exists one-to-one mapping of ϵ_{it} to the normalized disturbance term, Uit, so that τth quantile can be interpreted as the τth quantile of Uit.

Additionally, for detailed analysis, we separated gross capital outflows into gross equity outflows (FDIs + portfolio equities) and gross debt outflows (portfolio debts + other investments). Although they are frequently aggregated as gross capital outflows, the characteristics of the two capital flows might be quite different because debt flows are larger and more volatile than equity flows (Forbes and Warnock, 2012b).[6] Therefore, the impacts of private savings and

[5] However, it is worth noting that the results from FE2SLS regression and quantile regression are not one-to-one comparable because their regression strategies are different. Unlike the FE2SLS estimators, Powell's (2015) quantile regression method is the maximum likelihood estimator.

[6] In the data, the mean and standard deviation of equity outflows and debt outflows are 0.62% and 1.61, and 2.24% and 4.3, respectively.

capital inflows on equity outflows and debt outflows might be different. For this reason, we regard the two kinds of capital outflows as different dependent variables, and estimate the effects of the explanatory variables using the same models used for gross capital outflows. To be specific, the models for gross equity outflows and debt outflows are

$$\text{equity}_{\text{it}} = \beta_0 + \beta_1 lequity_{it} + \beta_2 inflow_{it} + \beta_3 prsave_{it} + \beta_4 exregime_{it} + \alpha_i + \gamma_t + \epsilon_{it} \quad (4)$$

$$\text{debt}_{\text{it}} = \beta_0 + \beta_1 ldebt_{it} + \beta_2 inflow_{it} + \beta_3 prsave_{it} + \beta_4 exregime_{it} + \alpha_i + \gamma_t + \epsilon_{it} \quad (5)$$

where $\text{equity}_{\text{it}}$ and debt_{it} are gross equity outflows and gross debt outflows for country i at time t, respectively. Corresponding IVQR models are

$$\begin{aligned}\text{equity}_{\text{it}}(\tau) &= q(D_{it}, \tau)_{equity} \\ &= \beta_0(\tau) + \beta_1(\tau) lequity_{it} \\ &\quad + \beta_2(\tau) inflow_{it} \\ &\quad + \beta_3(\tau) prsave_{it} \\ &\quad + \beta_4(\tau) exregime_{it} \\ &\quad + \gamma_t(\tau)\end{aligned} \quad (6)$$

$$\begin{aligned}\text{deby}_{\text{it}}(\tau) &= q(D_{it}, \tau)_{debt} \\ &= \beta_0(\tau) + \beta_1(\tau) ldebt_{it} + \beta_2(\tau) inflow_{it} \\ &\quad + \beta_3(\tau) prsave_{it} \\ &\quad + \beta_4(\tau) exregime_{it} \\ &\quad + \gamma_t(\tau)\end{aligned} \quad (7)$$

where $q(D_{it}, \tau)_{\text{equity}}$ and $q(D_{it}, \tau)_{\text{debt}}$ are the τ_{th} quantile functions of equity outflows and debt outflows, respectively.

A quantile regression method allows us to test more diverse hypotheses than an OLS regression method. There are three hypotheses to test for the purpose of the study. First, the causal impact of capital inflows on capital outflows is stronger during capital flight: $\beta_2(\tau') \geq \beta_2(\tau)$ if $\tau' > \tau$. Second, the causal impact of capital inflows on outflows is stronger than that of savings: $\beta_2(\tau) \geq \beta_3(\tau)$. Third, the impact of savings on capital outflows is similar to the mean effect during capital flight: $\beta_3(\tau) \approx \beta_3$ for $\tau \in [0.5, 0.9]$. Moreover, the nature of the dynamic model allows us to test the same hypotheses for permanent impacts: (1) $\frac{\beta_2(\tau')}{1-\beta_1(\tau')} \geq \frac{\beta_2(\tau)}{1-\beta_1(\tau)}$ if $\tau' > \tau$, (2) $\frac{\beta_2(\tau)}{1-\beta_1(\tau)} \geq \frac{\beta_3(\tau)}{1-\beta_1(\tau)}$, and (3) $\frac{\beta_3(\tau)}{1-\beta_1(\tau)} \approx \frac{\beta_3}{1-\beta_1}$ for $\tau \in [0.5, 0.9]$.[7] The interpretations of the results in Section 4 will be based on these total six hypotheses.

Ⅳ. Results

1. Gross Capital Outflows

This section estimates the causal effects of explanatory variables by focusing on two-stage least squares and IV quantile regression. The results with gross capital outflows are reported in Table 4 and Fig. 2. First, the impact of previous capital outflows is stronger during capital flight. Second, the impact of capital inflows is large, and they are particularly larger than the mean effect from FE2SLS in the upper quantiles. As a result, a 1% increase in capital inflows at 90th quantile increases capital outflows about 0.75% in the long run. However, when foreign asset purchases are less than the median, the permanent effect is small (e.g., a 0.13% increase in capital outflows permanently at the 0.2th quantile).

[7] If the three hypotheses for temporary effects are true, it is sufficient to show that $\beta_1(\tau') \geq \beta_1(\tau)$ and $\beta_1(\tau) \geq \beta_1$ for (1) and (3), respectively. (2) necessarily holds if $\beta_2(\tau) \geq \beta_3(\tau)$.

Table 4. The Impacts of Selected Variables on Gross Capital Outflows: Two-Stage Least Squares and IV Quantile Regression

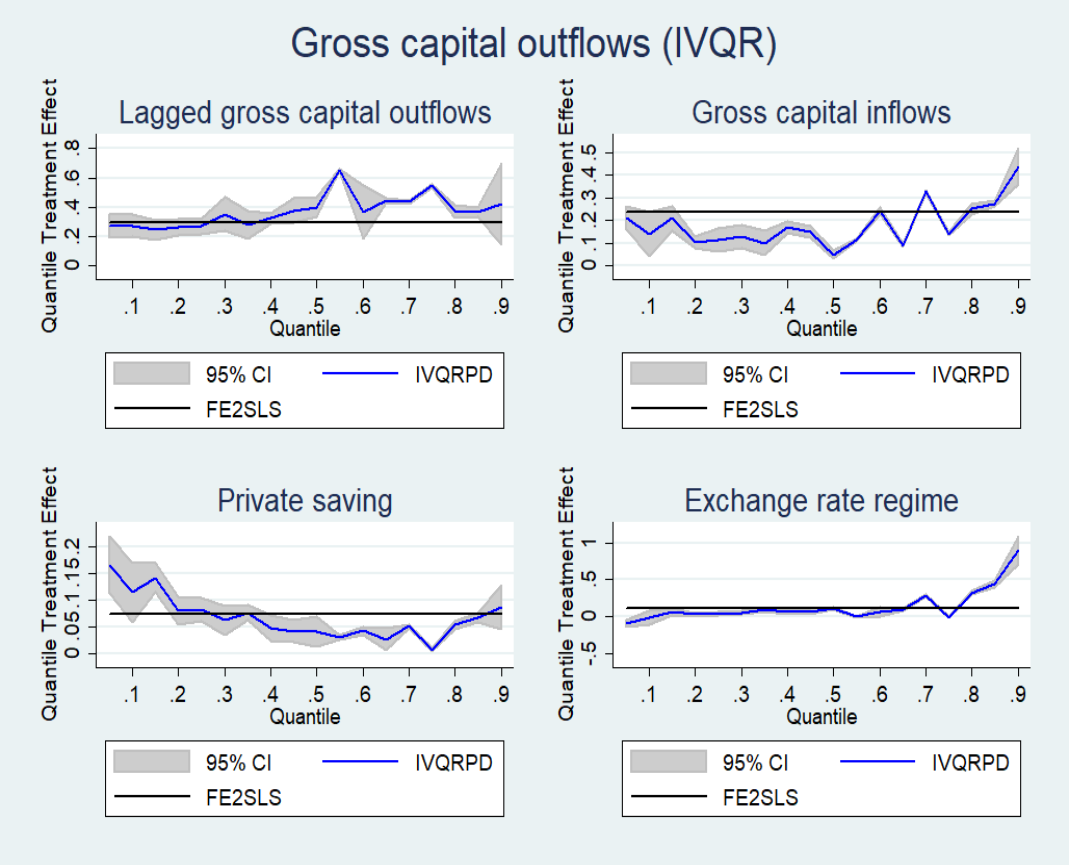
IV Quantile Regression	**FE2SLS**	**0.05**	**0.1**	**0.15**	**0.2**	**0.25**	**0.3**	**0.35**	**0.4**	**0.45**
LOUTFLOW	0.2913***	0.2686***	0.2723***	0.2452***	0.2602***	0.269***	0.353***	0.281***	0.3233***	0.3755***
	(0.0663)	(0.041)	(0.039)	(0.0349)	(0.0287)	(0.0259)	(0.0573)	(0.0486)	(0.0191)	(0.0425)
INFLOW	0.2673***	0.2109***	0.1377***	0.2089***	0.1025***	0.1118***	0.1286***	0.1002***	0.1688***	0.1487***
	(0.0842)	(0.0256)	(0.0501)	(0.0268)	(0.0132)	(0.0259)	(0.026)	(0.0283)	(0.0131)	(0.0122)
SAVE	0.0639*	0.1652***	0.1142***	0.1418***	0.0807***	0.0813***	0.0623***	0.076***	0.0472***	0.042***
	(0.0347)	(0.0269)	(0.0284)	(0.0139)	(0.0133)	(0.0111)	(0.014)	(0.0071)	(0.012)	(0.0103)
EXREGIME	0.1365*	-0.0965***	-0.0134	0.0622***	0.029**	0.0363***	0.0507***	0.0923***	0.0628***	0.0703***
	(0.0598)	(0.025)	(0.0476)	(0.0222)	(0.0138)	(0.0108)	(0.0011)	(0.0103)	(0.0169)	(0.0209)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2/Mean Acceptance Rate	0.3384	0.264	0.252	0.277	0.256	0.249	0.291	0.248	0.344	0.318
Countries	56	56	56	56	56	56	56	56	56	56
Observations	945	989	989	989	989	989	989	989	989	989

IV Quantile Regression	**0.5**	**0.55**	**0.6**	**0.65**	**0.7**	**0.75**	**0.8**	**0.85**	**0.9**
LOUTFLOW	0.4014***	0.652***	0.3644***	0.4439***	0.4349***	0.5464***	0.3702***	0.3653***	0.4215***
	(0.036)	(0.0042)	(0.0937)	(0.007)	(0.0071)	(0.0062)	(0.0226)	(0.0178)	(0.1416)
INFLOW	0.0479***	0.1116***	0.2418***	0.0885***	0.3286***	0.14***	0.2501***	0.2755***	0.4406***
	(0.0086)	(0.0022)	(0.0079)	(0.0037)	(0.0043)	(0.004)	(0.0124)	(0.0071)	(0.0398)
SAVE	0.0411***	0.0302***	0.0423***	0.0268***	0.0514***	0.0069***	0.0539***	0.0669***	0.086***
	(0.0145)	(0.0019)	(0.0042)	(0.01)	(0.0014)	(0.0014)	(0.0039)	(0.0047)	(0.0208)
EXREGIME	0.1167***	-0.0038	0.0695**	0.0969***	0.2844***	-0.0088*	0.321***	0.4466***	0.8939***
	(0.0078)	(0.0046)	(0.0324)	(0.0064)	(0.0054)	(0.0047)	(0.0112)	(0.0253)	(0.0951)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean	0.329	0.333	0.403	0.276	0.370	0.389	0.289	0.312	0.288
Countries	56	56	56	56	56	56	56	56	56
Observations	989	989	989	989	989	989	989	989	989

Notes: 1. The dependent variable is gross capital outflows.

2. The first column is from two-stage least squares, and robust standard errors are in parentheses (under identification test:0.0000 (P-value), Kleinbergen-Paap rk Wald F statistic:10.263, and Hansen J statistic: 0.7338 (P-value)). Quantile regression is from Powell (2015), which uses the adaptive Markov Chain Monte Carlo sampling algorithm, and the point estimates that correspond to the mean of draws and standard errors in the parentheses are derived from variance of draws (total 8,000 draws after burning the first 2,000 draws). R2 for two-stage least squares and mean acceptance rate for quantile regression.
3. *, **, *** for significance at the 10%, 5%, and 1% levels, respectively.

Fig. 2. The Impacts of Selected Variables on Gross Capital Outflows: Two-Stage Least Squares and IV Quantile Regression



Third, the QTEs of savings from IVQR keep decreasing until the 0.65th quantile such that they exhibit a U-shaped curve over quantiles. As a result, although the impact of current private savings is largest at the 0.05th quantile, because of the small QTE of the lagged dependent variable at the same quantile, the long-run impact is not large (0.22%). It is similar to the long-run impact at the 0.9th quantile where the capital outflows are the most persistent (0.15%). In summation, 1) the causal impact of capital inflows is larger during capital flight; 2) it is larger than that of private savings across quantiles; and 3) the causal impact of private savings is similar to the mean effect (except at the 0.05th and 0.1th quantiles). This means private sectors use some savings when they purchase a small amount of foreign assets, but during capital flight, they increase borrowing rather than savings to increase foreign asset purchases. Lastly, the QTEs of the exchange rate regime from IVQR increase in the upper quantiles.

2. Equity and Debt Outflows

Equity outflows become even more persistent with IVQR as the QTEs are larger than 0.8 after the median (Table 5 and Fig. 3).

Table 5. The Impacts of Selected Variables on Gross Equity Outflows: Two-Stage Least Squares and IV Quantile Regression

IV Quantile Regression										
	FE2SLS	**0.05**	**0.1**	**0.15**	**0.2**	**0.25**	**0.3**	**0.35**	**0.4**	**0.45**
LEQTY	0.4485***	0.2259***	0.1854***	0.1748***	0.5097***	0.3042***	0.2889***	0.4555***	0.6588***	0.7398***
	(0.0753)	(0.0194)	(0.0235)	(0.0356)	(0.0331)	(0.1)	(0.0968)	(0.0492)	(0.0061)	(0.0014)
INFLOW	0.0713***	0.0211***	0.017***	0.0103***	0.0092***	0.0152***	0.0136***	0.0087***	0.0033***	0.0055***
	(0.0328)	(0.0035)	(0.0053)	(0.0023)	(0.003)	(0.0049)	(0.0027)	(0.0014)	(0.0005)	(0.0001)
SAVE	0.0149	-0.003	0.0028	0.0004	0.0015	-0.0014	-0.002	-0.0037***	-0.0021***	-0.0029***
	(0.0134)	(0.003)	(0.0021)	(0.0007)	(0.0014)	(0.0018)	(0.0013)	(0.0008)	(0.0002)	(0.0001)
EXREGIME	0.0583**	-0.0407***	-0.0088	-0.0093***	-0.0056	-0.0015	-0.0006	-0.0004	-0.0005	0.0004**
	(0.0227)	(0.0138)	(0.0056)	(0.002)	(0.0012)	(0.0021)	(0.0019)	(0.0008)	(0.0004)	(0.0002)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2/Mean Acceptance Rate	0.2782	0.330	0.280	0.353	0.331	0.300	0.244	0.373	0.403	0.334
Countries	50	50	50	50	50	50	50	50	50	50
Observations	742	777	777	777	777	777	777	777	777	777

IV Quantile Regression									
	0.5	**0.55**	**0.6**	**0.65**	**0.7**	**0.75**	**0.8**	**0.85**	**0.9**
LEQTY	0.8383***	0.8427***	0.8078***	0.8694***	0.8236***	0.8332***	0.9661***	0.9667***	0.8286***
	(0.0085)	(0.0194)	(0.0117)	(0.0066)	(0.0334)	(0.1018)	(0.0055)	(0.0088)	(0.0033)
INFLOW	0.0061***	0.0073***	0.012***	0.0125***	0.0341***	0.0353***	0.0333**	0.0575***	0.0361***
	(0.0009)	(0.0014)	(0.0018)	(0.0012)	(0.0039)	(0.0093)	(0.0147)	(0.0026)	(0.0011)
SAVE	0.0005	-0.001**	0.0039***	-0.00001	0.0028***	0.0061*	0.0015	0.0071***	0.0121***
	(0.0007)	(0.0004)	(0.0009)	(0.001)	(0.0008)	(0.0034)	(0.0021)	(0.0007)	(0.0006)
EXREGIME	0.0013	0.0034***	0.016***	0.0262***	0.0318***	0.0905***	0.0205**	0.0281***	0.0477***
	(0.001)	(0.0011)	(0.0024)	(0.0024)	(0.0033)	(0.0097)	(0.0096)	(0.0039)	(0.005)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean Acceptance Rate	0.315	0.400	0.349	0.358	0.439	0.351	0.275	0.404	0.270
Countries	50	50	50	50	50	50	50	50	50
Observations	777	777	777	777	777	777	777	777	777

Notes: 1. The dependent variable is gross equity outflows (FDI+portfolio equities).

2. The first column is from two-stage least squares, and robust standard errors are in parentheses (under identification test:0.0000 (P-value), Kleinbergen-Paap rk Wald F statistic: 8.508, and Hansen J statistic:0.3029 (P-value)). Quantile regression is from Powell (2015), which uses the adaptive Markov Chain Monte Carlo sampling algorithm, and the point estimates that correspond to the mean of draws and standard errors in the parentheses are derived from variance of draws (total 8,000 draws after burning the first 2,000 draws). R2 for two-stage least squares and mean acceptance rate for quantile regression.

3. *, **, *** for significance at the 10%, 5%, and 1% levels, respectively.

Fig. 3. The Impacts of Selected Variables on Gross Equity Outflows: Two-Stage Least Squares and IV Quantile Regression

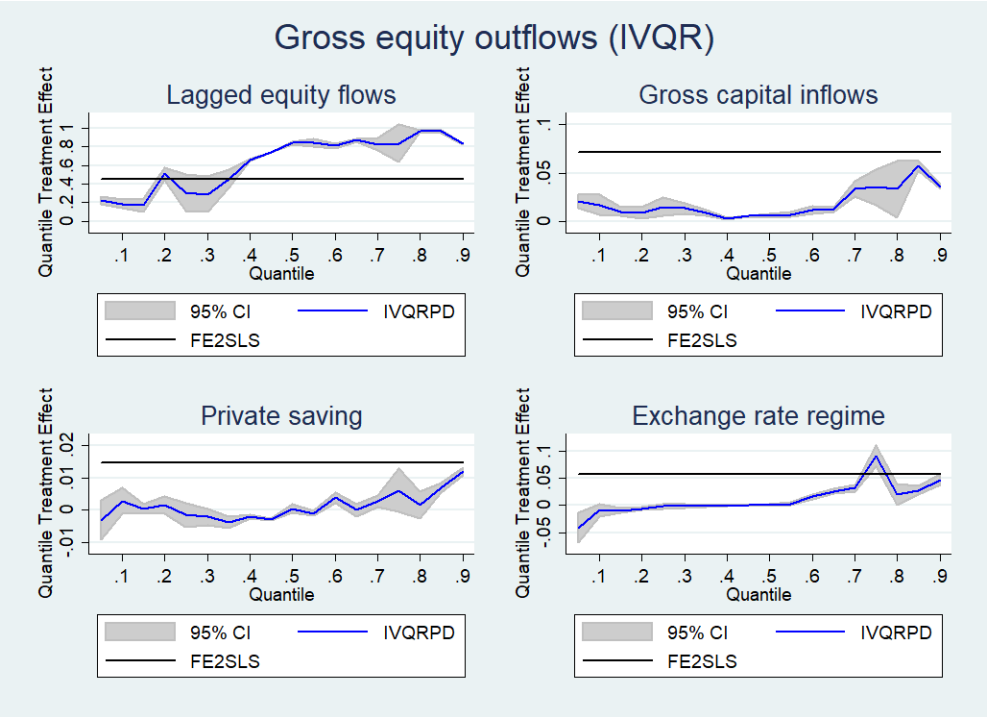


Fig. 4. The Impacts of Selected Variables on Gross Debt Outflows: Two-Stage Least Squares and IV Quantile Regression

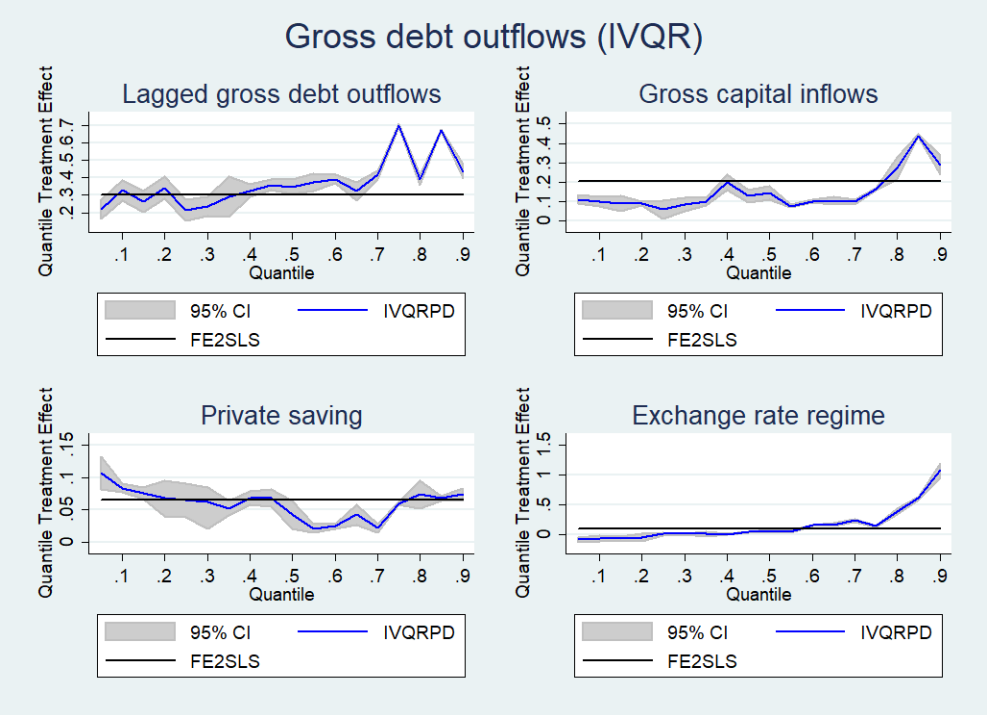


Table 6. The Impacts of Selected Variables on Gross Debt Outflows: Two-Stage Least Squares and IV Quantile Regression

IV Quantile Regression										
	FE2SLS	**0.05**	**0.1**	**0.15**	**0.2**	**0.25**	**0.3**	**0.35**	**0.4**	**0.45**
LDEBT	0.3034***	0.2194***	0.3271***	0.2633***	0.3423***	0.2151***	0.2377***	0.2929***	0.3246***	0.3584***
	(0.0695)	(0.0279)	(0.0295)	(0.0298)	(0.0319)	(0.0312)	(0.0277)	(0.0591)	(0.0184)	(0.0152)
INFLOW	0.2037***	0.1098***	0.0976***	0.0899***	0.0897***	0.059**	0.0825***	0.1***	0.1988***	0.1271***
	(0.073)	(0.0116)	(0.0122)	(0.02)	(0.0049)	(0.0242)	(0.0176)	(0.0092)	(0.0201)	(0.0163)
SAVE	0.0649**	0.1076***	0.0836***	0.0756***	0.0682***	0.065***	0.0525***	0.0528***	0.0682***	0.0684***
	(0.0315)	(0.0127)	(0.0033)	(0.0046)	(0.0139)	(0.0132)	(0.0164)	(0.0059)	(0.0052)	(0.0069)
EXREGIME	0.1011*	-0.0819***	-0.0534**	-0.0636***	-0.0392	0.017	0.0156**	0.019	0.014**	0.0467***
	(0.0517)	(0.0204)	(0.0242)	(0.0174)	(0.0347)	(0.013)	(0.0069)	(0.0193)	(0.006)	(0.0058)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2/Mean Acceptance Rate	0.3041	0.346	0.353	0.343	0.371	0.363	0.348	0.290	0.397	0.351
Countries	56	56	56	56	56	56	56	56	56	56
Observations	965	1,011	1,011	1,011	1,011	1,011	1,011	1,011	1,011	1,011

IV Quantile Regression									
	0.5	**0.55**	**0.6**	**0.65**	**0.7**	**0.75**	**0.8**	**0.85**	**0.9**
LDEBT	0.3478***	0.3748***	0.3902***	0.3227***	0.4149***	0.6972***	0.3873***	0.6695***	0.4363***
	(0.0211)	(0.0257)	(0.0127)	(0.027)	(0.0212)	(0.0045)	(0.0148)	(0.0027)	(0.0219)
INFLOW	0.144***	0.0759***	0.1016***	0.1043***	0.0988***	0.1645***	0.2721***	0.438***	0.2899***
	(0.017)	(0.0035)	(0.0032)	(0.009)	(0.0061)	(0.0029)	(0.0286)	(0.0035)	(0.0251)
SAVE	0.0428***	0.0213***	0.025***	0.0428***	0.0216***	0.06***	0.074***	0.0679***	0.0745***
	(0.0111)	(0.0033)	(0.0018)	(0.0078)	(0.0032)	(0.0009)	(0.011)	(0.0018)	(0.0045)
EXREGIME	0.0546***	0.0577***	0.1627***	0.1743***	0.2407***	0.1445***	0.393***	0.6115***	1.081***
	(0.0123)	(0.0068)	(0.0036)	(0.0155)	(0.0134)	(0.003)	(0.0275)	(0.0097)	(0.0592)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean Acceptance Rate	0.337	0.360	0.310	0.272	0.438	0.378	0.342	0.237	0.338
Countries	56	56	56	56	56	56	56	56	56
Observations	1,011	1,011	1,011	1,011	1,011	1,011	1,011	1,011	1,011

Notes: 1. The dependent variable is gross debt outflows (portfolio debts+other investments).

2. The first column is from two-stage least squares, and robust standard errors are in parentheses (Underidentification test0.0000 (P-value), Kleinbergen-Paap rk Wald F statistic: 10.49, and Hansen J statistic:0.4117 (P-value)). Quantile regression is from Powell (2015), which uses the adaptive Markov Chain Monte Carlo sampling algorithm, and the point estimates that correspond to the mean of draws and standard errors in the parentheses are derived from variance of draws (total 8,000 draws after burning the first 2,000 draws). R2 for two-stage least squares and mean acceptance rate for quantile regression.

3. *, **, *** for significance at the 10%, 5%, and 1% levels, respectively.

On the contrary, the roles of capital inflows and savings are limited. None is larger than the estimates from 2SLS, which indicates that a temporary increase in capital inflows and savings rarely affect equity outflows. This confirms that individuals purchase equities in the long-run aspects. Furthermore, it is noteworthy that because of the strong influence of the lagged equity outflows, the permanent effect of capital inflows is also strong for equity outflows, although temporary effects are small in all quantiles. For example, a permanent increase in capital outflows by a 1% increase in capital inflows is only 0.027% at 0.05th quantile, while it becomes 1.76% at 0.85th quantile (0.21% for private savings). Therefore, the influence of capital inflows is still large for equity outflows, unlike private savings.

The QTEs of the lagged dependent variable on gross debt outflows are larger than the mean effect after 0.4th quantile, and they are the largest at 0.75th and 0.85th quantiles (Table 6 and Fig. 4). Therefore, although less than equity outflows, debt outflows are also persistent in the upper quantiles, and they make permanent effects of capital inflows large as well. Meanwhile, the QTE of capital inflows increases in the upper quantiles, and it is the largest at the 0.85th quantile. As a result, a 1% increase in capital inflows increases only capital outflows about 0.14% at the 0.05th quantile, but it increases about 1.32% at the 0.85 quantile. On the contrary, the influence of private savings is still small in all quantiles. For example, a 1% increase in private savings increases capital outflows by 0.13% permanently at both the 0.05th and 0.9th quantiles. Moreover, at the 0.75th quantile, where capital outflows are the most persistent, the increase in capital outflows by private saving is the largest, but increases only about 0.19%.

Section 4 can be summarized as follows. People are more dependent on external loans than savings when they purchase foreign assets, and this tendency is especially strong during capital flight. On the other hand, the impact of private savings is relatively small, regardless of the amount of assets purchased. This conclusion holds for both gross equity outflows and gross debt outflows in the big picture.

V. Conclusions

The paper has estimated the quantile treatment effects of private savings and gross capital inflows on gross capital outflows using Powell's (2015) quantile regression methodology. The main purpose was to see the impacts of two financial resources on foreign asset purchases according to the conditional distribution of the outcome variable. We specifically focused on capital flight because it might designate the exodus of domestic capital, and thus necessitates proper policy responses to prevent it. The results justifies the quantile regression approach by confirming there are heterogenous effects of explanatory variables according to the conditional distribution of capital outflows. In particular, during capital flight, the impact of gross capital inflows increases, and it is larger than the mean effect estimated by 2SLS. On the other hand, the impact of private savings actually decreases as individuals increase foreign asset purchases. This implies people use external loans rather than their incomes if there is any reason to increase foreign investments substantially. Moreover, the result shows foreign investments are more persistent in the upper quantiles and, because of this persistence, not only the temporary effects but also the permanent effects of explanatory variables have increased in the upper quantiles. Finally, this suggests people prefer a flexible exchange rate regime during capital flight.

Dividing gross capital outflows into gross equity outflows and gross debt outflows provides further information. Unlike gross debt outflows, which followed the characteristics of gross capital outflows, the best predictor for equity outflows is the past. Meanwhile, the QTEs of two financial resources are small, and this was smaller than the mean effect. As a result, although the temporary effect of capital inflows is small, it eventually becomes large in the long run because of the persistence of equity outflows. On the contrary, the long-run effect of private savings for equity outflows is still small, even after considering the persistent nature

of gross equity outflows. Thus, the conclusion is that, for both equities and debts, the impact of external savings on foreign investment is larger than that of domestic savings, especially during capital flight. This is consistent with existing literature.

The results suggest capital flight is not a market-exiting behavior by domestic agents because they use borrowings rather than savings to increase foreign asset holdings. Therefore, it is unlikely that capital flight significantly decreases domestic agents' domestic asset holdings, for the same reason the results show capital flight is associated with capital inflow surges. Existing literature also supports debt-fueled capital outflows because they point out global factors representing external booms are the most important factors causing capital flight. For instance, the global interest rate is usually low during a boom and, as a result, it is easier for domestic firms to increase leverage. In this case, the probability of a domestic crises increases (e.g., see Reinhart and Reinhart, 2008) and, therefore, the government has to implement policies such as capital controls to prevent the economy from facing credit booms.

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Appendix

Table A. Data Sources

Variable	Definition	Source
Gross Capital Outflows (% of GDP)	Net foreign-asset purchase by domestic agents. Foreign assets consist of foreign direct investment, portfolio investment, and other investment	IMF BOPS
Gross Capital Inflows (% of GDP)	Net domestic-asset purchase by foreign agents. Domestic assets consist of foreign direct investment, portfolio investment, and other investment	IMF BOPS
GDP (nominal and real)		IMF WEO
Private Savings	Gross national savings - Gross public savings Gross national saving= (Gross national disposable income) -(Consumption expenditure)	Alfaro et al. (2014)
Exchange Rate Regime	The index ranged from 1 to 16. 16 means the most flexible regime	Ilzetzki, Reignhart and Rogoff (2016)
Real GDP Growth (%)		IMF WEO
Capital Market Openness	The index ranged from 0 to 1. 1 means the most liberalized market	Chinn and Ito (2006)
Public Savings	(Government revenue) - (Government expenditure) + (Grants and other revenue) + (Accumulation of reserves) - (Capital transfer payments abroad)	Alfaro et al. (2014)
Domestic Credit	Financial resources provided to the private sector by financial corporations	WDI

ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2019.15.1.17

The Journal of Global Business and Trade

Journal of Global Business and Trade

https://www.pfw.edu/jgbt

Spatial Market Integration of Regional Fertilizer Markets in the Philippines and Determinants

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Received 14 January 2019, Revised 17 April 2019, Accepted 25 May 2019

ABSTRACT

Purpose – While several studies focusing on the integration of rice markets in order to lower prices have been conducted, little is understood about the market integration of production inputs. Price variation in production inputs, however, is also a strong factor influencing rice prices. Fertilizer is among the major inputs in rice production, implying that any change in fertilizer prices would have implications on rice prices. As fertilizer tends to register high prices and wide disparities in domestic markets, lowering its price is deemed to be effective in increasing its uptake among rice farmers. This paper attempted to answer the following research questions: (1) How closely integrated are the domestic fertilizer markets? (2) Is there price leadership, and correspondingly, are there price followers? (3) Do higher fertilizer prices exist in more segmented markets? (4) What are the determinants of price differences and market integration across regional fertilizer markets?
Design/Methodology/Approach – In order to test for spatial market integration, the correlation coefficient analysis, Granger causality and the Johansen cointegration test were employed. The Johansen cointegration test was performed on 2000-2017 price series data of urea and complete fertilizer of all 16 regions in the Philippines.
Findings – It was found that 95% of regional markets for urea and 81% for complete fertilizer were integrated. Rice-producing regions tended to act as price leaders, whereas regions producing less rice were price followers. Results from OLS regression analysis suggest that lower price differences tended to prevail in integrated markets and infrastructures; distance and output difference are among the determinants of market integration.
Research Implications – Identifying which markets are integrated is extremely crucial in policy development as it allows the government to fast track its interventions. In integrated markets, any price fluctuation in one market is also likely to happen in another integrated market. It therefore signals to the government in which regions to focus the interventions on, especially in its efforts to stabilize the prices of rice. For instance, it could implement centralized policies in integrated fertilizer markets, and decentralized policies in less integrated ones. Having identified the determinants that influence integration should also allow the government to decide what kind of interventions to implement in order to promote the integration of spatially segregated markets.

Keywords: market integration, price leaders, price differential, johansen cointegration test
JEL Classifications: Q13, R32

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I. Introduction

Rice, a staple in many countries, has frequently been subjected to price variability and price shocks. The Philippines, for example, was recently reported to be experiencing a rice crisis. This is a situation where a rice shortage combines with increasing prices. This led the Philippine government to a series of rice importations and the passing of the rice tariffication bill that allows open and free entry of rice into the country. Such actions, however, failed to lower rice prices as the rice sector is still characterized by seasonal and regional price variations. Given that rice shortages are a recurring event in the Philippines, there have been several studies about the market integration of rice output markets, but very few deals with input markets. Price variability of inputs, however, is also a factor that influences the increase in the price of rice. In 2008, during the world rice crisis, fertilizer costs were cited to be a strong factor in the rice price crisis (Pandey et al., n.d.). Fertilizers share 12 percent of rice production costs, implying that any change in the price of fertilizer may also change the price of rice. Another strategy that could stabilize rice prices, aside from importation, is making domestic production competitive. Although not the only solution, countries with increased uptake of fertilizers also have higher agricultural productivity (Morris et al., 2010). However, fertilizer usage of rice farmers in the Philippines remains very low despite increasing demand because of costly fertilizer prices in the domestic market.

As of 2014, the Philippines was consuming an average of 253 kg of fertilizer, where the highest consumption (38%) was made by the rice sector (Bunoan-Olegario, 2011). The Philippines only produces as little as 12% of its fertilizer requirements and imports the rest from neighboring Asian nations, particularly China. International prices, therefore, make up the final price paid for fertilizers by local farmers. The level of fertilizer prices domestically, however, shows wide differences across regions and provinces. Distant regions, including ARMM and Zamboanga Peninsula, tend to have prices that are significantly higher than the national average. Thus, the conducting of this study is warranted to determine the degree of market integration of fertilizer inputs in the domestic markets. Efforts of the government to lower rice prices will not be fully realized unless prices of major production inputs such as fertilizer are also lowered. This is because farmers will not be able to achieve an optimum usage of fertilizers unless they find them affordable.

Spatial integration indicates the interaction within and between areas or markets and how well these markets cooperate. It explains the degree of connectivity and price transmissions across spatially separated markets. Market integration is both an opportunity and a challenge. If three locations, for instance, are highly integrated, it is expected that a decrease in price in location A will also lead to a decrease in prices in the other two locations. However, in the case of global price shocks, price fluctuations will be felt more by integrated markets than by those less integrated. Thus, examining market integration is primarily important in development planning. Market integration studies identify the group of integrated markets and allow the government to avoid duplication of its interventions. This signals the government as to where to focus interventions, especially in efforts to stabilize the prices of rice. It should be noted that gains from rice tariffication or rice import liberalization will not be fully realized unless markets are integrated because the lower prices of one market will not be correctly transmitted to another market.

The story does not end in identifying which markets are integrated and which are not. It is equally important to understand the factors that explain the spatial integration of markets in order to craft policies and projects that facilitate the integration of markets and make price transmissions effective, hence the conducting of this study. This paper particularly answers the following research questions: (1) How closely integrated are the domestic fertilizer markets? (2) Is there price leadership in the domestic fertilizer markets? (3) Do high fertilizer prices happen in more segmented markets? (4) What are the determinants of price differences and market integration across regional input markets?

II. Review of Related Literature 7

1. Why Market Integration?

The concept of market integration is closely related with market efficiency as they both deal with lowering commodity prices in the markets. Although often used interchangeably, these two are conceptually different, but are closely related. Market efficiency pertains to the extent to which markets limit costs and match supply with demand, whereas market integration describes how prices in different markets move together (Barrett, 1996; Rashid et al., 2010). In order for markets to be efficient, prices should be effectively transmitted to various markets to allow traders to take advantage of the differing prices of commodities. When price signals immediately reach producers/ traders and they take advantage of this arbitrage, prices then return to equilibrium (Rufino, 2008). Market integration has two typologies defined by the types of the markets being compared. First is vertical market integration that refers to the relationship of prices at different channels in the supply chain, such as prices in the wholesale markets vis-a-vis in retail markets. On the other hand, spatial market integration, which is the focus of this research, refers to how prices of a same commodity move closely together across spatially different locations (Barrett, 1996; Rashid et al., 2010). In spatially integrated markets, a decrease or increase in commodity prices in one market would immediately be transmitted to other markets (Barrett, 1996).

Variation in the prices of fertilizer inputs and of any commodity is inevitable. Price differences actually are not really considered bad as this allows the market players to engage in trade. As Rashid et al. (2010) have pointed out, what is alarming is the excessive variability or no to little variability in prices. Excessive variability in prices implies that there is no integration in markets, which could result in ineffective price transmissions and market failures.

What makes market integration a critical topic? Rashid et al. (2010) and Familow and Benson (1990) emphasized that understanding the degree of market integration is essential in solving problems in commodity markets. Less integrated markets may reveal problems, including a lack of market information, trade barriers, credit constraints, poor road quality, or imperfect competition. Weak integration also implies that markets and producers are blind to commodities that are highly appreciated on the world market (Varela et al., 2012). When there is no market integration, provinces with an output/input surplus of a commodity may be unable to transfer them to areas that are output/input deficit as price signals are not readily transmitted. Baulch (1997) also pointed out that unstable prices and unrealized trade gains, as possible outcomes, result from little to non-integration of markets.

Identifying integrated markets is critical in government development planning and policy-making as this reduces duplication in government interventions. In integrated markets, any intervention introduced in one market would be passed on to other markets. This makes integrated markets cheaper to finance compared to less integrated markets (Digal et al., 2010; Galang, 2014). In policy-making, the government could decide to implement decentralized policies in less integrated provinces and centralized policies in integrated provinces (Fackler & Goodwin, 2001). Less integrated or segmented markets are also more susceptible to monopolies, which often lead to overly expensive prices for consumers (Barrett, 1996).

2. Market Integration Approaches and Empirical Studies

Approaches to measure market integration have evolved from price correlations in the 1970s and early 1980s to regression methods in the late 1980s and 1990s, and on to cointegration methods in the 1990s. Early measures of market integration utilized correlation of price series (Jones, 1968, 1972; Farruk, 1970; Lele, 1972; Hossain & Verbeke, 2010; Stigler & Sherwin, 1985). Using this method, significant correlation coefficients imply that the markets being compared are integrated. Higher coefficients signify

stronger linear association in the prices (Ghoshray, 2011). This test of market integration, however, received a number of criticisms as it fails to consider other factors, including general price inflation and seasonality, and population growth (Abdulai, 2006; Blyn,1973; Harris, 1979; Heytens, 1986; Ravallion, 1986; Sexton et al., 1991; Timmer, 1974). Correlation coefficient is only a measure of linear association among stationary processes. It fails to acknowledge the fact that the marketing system is rather dynamic and not stationary. Non-stationary variables produce spurious regression analysis that often gives misleading results, showing a relationship even if none exists.

Regression-based approaches to measuring market integration were tested after the criticisms received on the correlation coefficients approach. This approach, however, was again criticized for its assumption of instantaneous price transmission from one market to another. Price changes may take time and therefore include lags. This was noted by Ravallion (1986), indicating that the dynamic behavior of markets can be captured when lagged values are included in the model (as cited in Ghoshray, 2011). Mundlak and Larson (1992) were among the researchers who employed this technique when they examined the co-movement of international food prices to domestic

prices in 58 countries. Still, the lagged regression method fails to capture the non-stationarity of prices.

It was in the 1990s when cointegration methods were introduced. The cointegration approach answered the gaps observed from the former approaches, taking into account the non-stationarity of prices. It also measures the long-run relationship between prices (Rashid, Minot, Lemma, & Behute, 2010). Two of the tests that capture non-stationarity of prices include the Engle-Granger and Johansen tests of integration.

A wide number of studies examine market integration among output markets, especially IN food markets. Among theSE studies include market integration in wheat and teff markets in Northern Ethiopia (Jaleta & Gebremedhin, 2012), world shrimp markets in Europe, Japan, and USA (Vinuya, 2006), livestock markets (Diakosavvas, 1994; Fafchamps & Gavian, 1996; Goodwin & Schroeder, 1990), corn markets in China (Rozelle et al., 1997), and rice markets in Vietnam (Goleti et al., 1996, Nga & Lantican, 2009), China (Rozelle et al., 1997), India (Jha et al., 2008), and the Philippines (Rufino, 2008). Very few studies were done internationally and locally, examining the integration of input markets, including fertilizer markets. In the Philippines, only two studies focusing on fertilizer markets were found. Briones (2016) studied the integration of domestic fertilizer markets with the world market by applying the Johansen cointegration test. Results from the Vector Autoregressive (VAR) model and Granger causality indicate short-run relationship between domestic price and foreign price. Exchange rate, on the other hand, has no causal relationship with the domestic fertilizer price in the short-run. The Vector Error Correction (VEC) model using the Johansen maximum likelihood reveals long-run relationships between foreign fertilizer prices and the peso-dollar exchange rate with domestic fertilizer prices that will prevail.

Galang (2014) evaluated the spatial integration of regional fertilizer markets, particularly urea, in the Philippines using 24-year time series data from 1990-2013. As emphasized by Rufino (2008), who used a 13-year period in the integration analysis of rice markets, this period is enough to measure price relationships in the long-run in each paired regions. Likewise, Galang (2014) employed the Johansen cointegration technique to measure spatial integration. High market integration on regional fertilizer markets was found among the 16 regions, wherein only one pair, CALABARZON-CAR, out of the 120 paired regions, was not integrated. Using the Granger causality test, Galang (2014) also identified the existence of price leaders and followers as well as a feedback relationship between regional fertilizer markets. A causality test revealed the direction of price transmissions that happened between regions. Her results suggested that Cagayan Valley, Central Luzon, and Western Visayas which were the top rice

producers, are price leaders whereas Central Visayas, CALABARZON, Davao, CAR, CARAGA, and ARMM were price followers. Also, 55% of the regional pairwise were observed to exhibit feedback or two-way direction of causality.

3. Determinants of Market Integration

There was some literature reviewed on the common determinants that were significant in market integration. Goodwin and Schroeder (1991) examined the integration between cattle

markets in the US from 1980 to 1987 using cointegration tests of price series across regions. The study used four determinants: distance between markets, which includes the costs and risks associated between markets; industry concentration ratios; market volume; and market types, or whether it was a terminal market or not. It was found that these variables had significant influences on the integration between cattle markets. Distance between markets decreased the degree of market integration. On the other hand, industry concentration had a positive effect on market integration. When a market was more integrated, the lack of information about market outlets for cattle were lessened across regions, and it may facilitate price behavior coordination between markets across regions.

Goletti, Ahmed, and Farid (1995) evaluated the integration between rice markets among 64 districts in Bangladesh from 1989 to 1992 by measuring correlation coefficients, co-integration coefficients, dynamic multipliers, and speed adjustment, and examining its indicators. They found that integration among rice markets in Bangladesh was moderate. Determinants were classified into three dimensions: market infrastructure, volatility of policy, and dissimilarity of production. Market infrastructure included: distance between markets, density of paved roads, railway infrastructure, number of strikes in the areas, telephones per individual, and number of banks. Volatility of policy referred to the variation in the coefficient of the stocks of government agencies in each district every month. Dissimilarity of production, on the other hand, was computed via the absolute value of the percentage difference in the production per capita. These indicators responded differently. Distance between markets, telephone density, and number of labor strikes negatively affected market integration. Differences in production per capita and road density increased the degree of integration. Given these results, several implications were suggested,

such as a need to solve labor-related conflicts to reduce the incidence of labor strikes, and to develop existing roads in order to strengthen integration between markets.

Ismet, Barkley, and Llewelyn (1998) studied the effects of government intervention on rice market integration across regions in Indonesia from 1982 to 1993 by measuring market integration and tracing its determinants. Degree of market integration was measured using the Johansen approach in testing the co-integration of the price series across regions and dynamics of price transmission. Determinants used were volumes of purchases and sales of rice by ‘bulog’ in each market; infrastructure by measuring road densities; and market development through income per capita of the region. Only the volume of purchases of rice had a significant effect on the market integration for the whole period of 1982-1993. For the self-sufficiency period, the volume of sales of rice and income per capita had significant positive effects.

Varela, Carroll, and Iacovone (2012) analyzed price differentials, market integration, and their determinants for the five major commodities across provinces in Indonesia using the Johansen cointegration approach. The commodities included rice, soybeans, corn, sugar, and cooking oil. It was reported that the degree of market integration varied for the five commodities. There were smaller price differences across provinces for the rice and sugar markets. These markets had a high degree of market integration, in contrast to the soybean, cooking oil, and corn markets. Determinants used were distance, remoteness, infrastructure, population, income per capita, output

per capita, productivity, trace statistic, price difference, and price of commodity. Remoteness, interaction between remoteness and quality of infrastructure, output per capita, and land productivity were found to be significantly correlated to price differentials for the five commodities. On the other hand, income per capita had only significantly affected rice markets where quality differences, such as different varieties, were important. Lastly, remoteness and infrastructure were the only determinants that had significant effects on market integration for the five commodities.

One of the gaps identified in these reviews was the failure to identify determinants of price differentials and market integration. This study, therefore, is an effort to fill in this gap as it also determined the factors that may explain the wide disparities in prices among regions that influence the integration of input markets, particularly fertilizer, which is the primary material input in rice production.

III. Methodology

1. The Data Set

Monthly price series data from the years 2000-2017 (18-year period) were used to examine the extent of market integration in domestic fertilizer markets. The dealer's prices of fertilizers were used due mainly to availability. Dealers were considered because they are also the closest channel to farmers as source of fertilizer (Briones, 2016). Moreover, only urea and complete (14-14-14) fertilizer were taken into account in the analysis as these are the primary fertilizer types utilized by farmers year-round, compared to ammophos and ammosul. The datasets were obtained from the Philippine Statistics Authority.

2. Determining Spatial Market Integration

As cited by Rufino (2008), two regional markets of a homogeneous commodity, such as fertilizers, are said to be spatially integrated if trade occurs between them, and/or the nominal price at the receiving market, equals the nominal price at the exporting market plus the transportation and other incidental costs required to move the product between the two markets. Spatially separated markets that are integrated imply that there is an easy or free flow of information and goods, and that prices between markets are linked.

In order to test for spatial market integration, correlation coefficient analysis, Granger causality, and the Johansen cointegration test were employed. All these and their related procedures were implemented using the STATA 15 statistical package. In particular, the pairwise correlation test was performed to have a sense of the degree of market integration. Using this method, significant correlation coefficients indicate that markets being compared are integrated. Higher correlation coefficients imply a stronger linear association in the markets' prices. However, as this approach only measures linear association among stationary time series data and does not acknowledge the seasonality of prices, the Johansen cointegration test was later utilized. Before employing the Johansen test, a stationarity test in time series data was performed since non-stationary data series would result in spurious regression coefficients, which later on will be used for forecasting or prediction. To do this, the Augmented Dickey-Fuller (ADF) test was done under the null hypothesis (Ho) of non-stationarity being rejected if the resulting trace statistic is higher than the 5% critical value. The non-stationary series must be differenced d times before it becomes stationary, and thus is said to be integrated of order d (I(d)) (Engle & Granger, 1987). In general, most economic time series data achieve stationarity after first differencing, meaning data are integrated of order 1 (I(1)).

The Granger causality test was used to describe whether causal relationships between variables exist, and whether the histories of one variable could predict behavioral patterns of another variable. This approach works by estimating the Vector Autoregressive model prior to testing the Granger causality test (Fackler & Goodwin, 2001 as cited in Galang, 2014). For each

regional pairwise, the optimal number of lags was identified using the Akaike Information Criterion (AIC). The number of lags indicated in the AIC is also a requirement in running the Johansen cointegration test. Note that VAR was performed using the natural log (ln) of prices, and not using its first difference. The null hypothesis of no Granger causality was rejected when the probability value of chi2 statistic was less than a 5% level of significance.

Furthermore, the Johansen cointegration test took the Ho of no cointegration, which was rejected when the resulting trace statistic or max statistic was higher than the critical value. Ho implies that there is at least one cointegration relationship and that the two regional fertilizer markets are integrated in the long-run. Using the Johansen test, a higher trace statistic for a pair of regional fertilizer markets suggested a stronger degree of integration. The resulting values of trace statistic were used as dependent variable to measure the determinants of spatial integration between domestic fertilizer markets. A Johansen cointegration test was performed in all pairwise combinations of 16 regions using monthly fertilizer prices in each region. In total, there were 120 cointegration tests performed for this analysis.

3. Identifying Determinants of Price Differentials and Spatial Market Integration

Understanding the extent of market integration between markets is essential in knowing how price transmission/signals happen between regions, but it is more ideal for understanding what drives market integration as well as price differences. Output per capita, productivity, income per capita, distance, infrastructure, and exposure to shocks as drivers for market integration and price differentials were considered as depicted in the equation for transmission signal (TS) between markets i and j:

$$TS = \beta_0 + \beta_1 OutputPC_i + \beta_2 OutputPC_j + \beta_3 SqOutputPC_i + \beta_4 SqOutputPC_j + \beta_5 Yield_i + \beta_6 Yield_j + \beta_7 PCI_i + \beta_8 PCI_j + \beta_9 Dist_i + \beta_{10} Dist_j + \beta_{11} Infra_i + \beta_{12} Infra_j + \beta_{13} ShockDiff_i + \beta_{14} ShockDiff_j + \beta_{15} ShockDiff_j + \varepsilon_{ij}$$

Price differential used a similar regression function, except that it included values of trace statistics, or the measure of market integration, as one of its determinants. This allowed the determination of whether the price difference was higher or lower in integrated markets.

IV. Results and Discussion

The utilization of fertilizer for paddies in the Philippines remained constant from 2006-2012 (Table 1) with 67% and 58% of farmers using urea and complete, respectively. Fertilizer usage on a kilogram basis also remained constant from 2003 to 2014 (Fig. 1). The lowest uptake of fertilizer was observed in Eastern Visayas, where only 21% of farmers used urea and 36% used complete. This low adoption could be associated with the prevailing high prices of fertilizers in the region. As of 2017, Eastern Visayas registered the highest price. Declining fertilizer usage among farmers was also observed in distant regions including SOCCSKSARGEN, CARAGA, and ARMM, especially for urea.

Fig. 1 shows that in 2014, the top producing regions were also the top users of fertilizers, led by Central Luzon, the Ilocos region, CAR, and the Cagayan Valley, which applied roughly 350, 325, 292, and 283 kg of fertilizers, respectively. These were also regions with lower prices for fertilizers. On the other hand, Eastern Visayas and ARMM, regions with the highest price across all years, utilized only about 114 and 120 kg of fertilizers, respectively.

Table 1. Percentage of Farmers UsingFertilizers by Grade and Region, Philippines, 2006-2012

	UREA				COMPLETE			
Region	Jul-Dec 2006	Jan-Jun 2007	Jul-Dec 2011	Jan-Jun 2012	Jul-Dec 2006	Jan-Jun 2007	Jul-Dec 2011	Jan-Jun 2012
PHILIPPINES	67.0	56.0	68.0	67.0	54.0	41.0	55.0	58.0
CAR								
Ilocos Region	78.5	45.5	76.5	97.0	68.5	39.0	65.5	80.5
Cagayan Valley	61.5	87.5	88.5	88.0	41.5	38.0	39.0	42.5
Central Luzon	73.4	55.0	70.4	67.2	67.4	49.0	70.6	73.8
CALABARZON	61.0	66.0	22.5	52.0	43.0	40.5	48.0	53.5
MIMAROPA	86.0	78.5	86.0	89.0	65.5	65.0	73.0	75.5
Bicol Region	59.5	74.0	72.0	72.0	52.0	48.5	66.5	68.0
Western Visayas	80.0	31.0	85.0	90.0	42.0	19.0	45.0	52.0
Eastern Visayas	49.5	45.5	12.5	21.0	26.5	26.5	26.5	35.5
Zamboanga Peninsula	34.0	23.3	39.7	39.7	51.3	33.7	47.3	54.7
Northern Mindanao	60.0	33.0	74.0	78.0	53.0	21.0	46.0	48.0
Davao Region	63.3	72.5	69.0	70.8	48.8	47.8	56.5	58.0
SOCCKSARGEN	86.7	54.7	84.7	74.0	27.7	22.3	40.0	39.7
CARAGA	28.5	34.0	26.5	24.0	50.0	48.0	44.0	46.0
ARMM	43.0	39.0	95.0	91.0	70.0	14.0	22.0	53.0

Source: PalayStat System, https://dbmp.philrice.gov.ph/palaystat/statistics

The major types of fertilizer in the country are urea (46-0-0), ammonium sulfate (21-0-0), ammonium phosphate (16-20-0), and complete NPK (nitrogen, phosphorus, and potassium (14-14-14)). Application of these fertilizers ranged between 230 to 250 kilograms (kg) per hectare from 2003 to 2014. A significant decrease in fertilizer usage can be observed in 2008 due to a fertilizer price increase (Fig. 2). The largest share of usage was found for urea, which accounted for about half of the quantity of fertilizers applied by the farmers. Ammophos and ammosul fertilizers were the least applied in production at 22 to 23 percent, respectively.

Retail or dealer's prices of urea and complete fertilizer were on a relatively gradual downward trend from 2005 to 2017 (Fig. 2). A major price hike in both fertilizer types was noted in 2008, with both almost doubling their prices. It should be noted that oil prices also increased significantly during this period. Afterwards, fertilizer prices generally decreased, and this could have been brought about by trade liberalization, among all other reasons.

The average dealer's price for urea from 2005 to 2017 was PhP1,073, while it was PhP1,119 for complete fertilizer. The regions of ARMM, Eastern Visayas, and CALABARZON had the highest dealer's prices for urea (PhP1,226, PhP1,059, and PhP988 per bag, respectively) and complete (PhP1,311, PhP1,242, and PhP1,190). Both the ARMM and CARAGA regions are distantly located from city ports with estimated distances of 433 and 352 kilometers (km), respectively. The long distance from the port increases the transport costs, hence increasing retail prices. CALABARZON also had high prices because there are only 6 licensed fertilizer dealers and 90 licensed fertilizer and pesticide dealers in this region, the lowest among regions, thus affecting supply. SOCCKSARGEN had the lowest price for both fertilizer types, which could be attributed to its relatively shorter distance from the city port (78 km away) and the presence of quality roads (63%).

Fig. 1. Fertilizer Use for PaddIES in the Philippines by Year, Region and Grade (Bags of 50 kg)

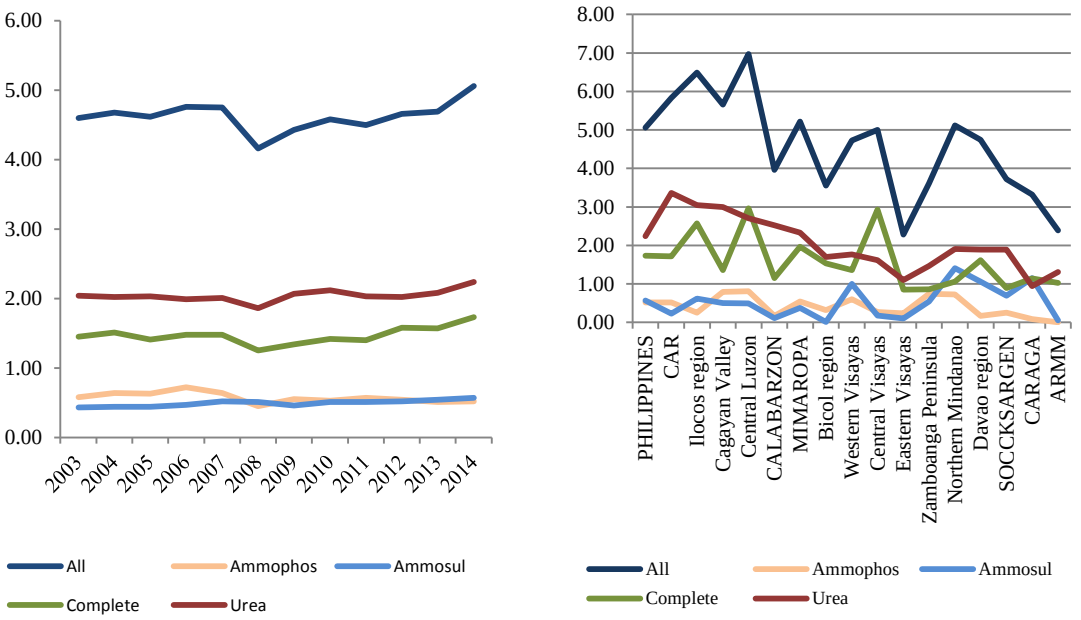
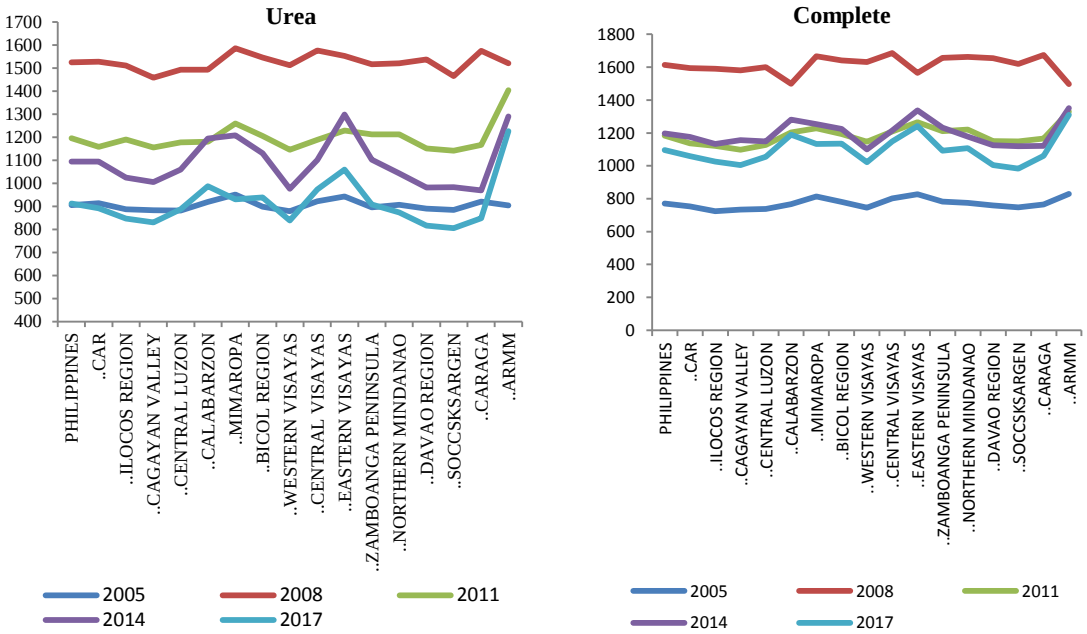


Fig. 2. Dealers' Fertilizer Prices in the Philippines by Region and Year (Pesos per Sack of 50 kg)



The ARMM, Eastern Visayas, and SOCCKSARGEN were the regions with the highest price deviations from the national average of dealer's prices of urea and complete, in absolute value, in 2017. For urea, the price differences between the Philippines' average retail price and that of the aforementioned regions amounted to PhP313, PhP146, and PhP108, respectively. On the other hand, the price differences for complete fertilizer were PhP214, PhP146, and PhP114, respectively.

The factors used as determinants of market integration and price difference were: distance to major city ports in km, percentage of paved roads (asphalt or concrete), population, output per capita, productivity, per capita Gross Domestic Product (GDP) in 2000 prices, and experiences of climate shocks (Table 2). The data used were averaged from 2000 to 2017. As discussed above, the longer the distance of the region from major city ports will entail higher transport costs, leading to higher retail prices, ceteris paribus. The Bicol region was the farthest from major city ports at 503 km, while the Davao region was the nearest, being only 51 km away. However, transport cost can also be affected by the percentage of paved roads since a higher percentage of paved roads will result in faster transportation of inputs and commodities, though a higher cost may also be incurred due to toll fees. CALABARZON had the highest percentage of paved roads (91%), population (11.2 million), and per capita GDP (PhP87,240), but it had the lowest output per capita (0.04 MT per person). On the other hand, CAR had the lowest percent of paved roads (37%) and population (1.6 million). Cagayan Valley had the highest output per capita, reaching 0.62 MT per person.

Productivity in this study was measured as the ratio between total harvest and area planted with rice (in metric tons per hectare). Central Luzon, the country's rice granary, attained the highest productivity with 4.46 MT per hectare. This can be explained by the existence of the Philippine Rice Research Institute (PhilRice) in the region, providing farmers with easier access to modern technologies that substantially increase overall production. As of 2017, Central Luzon's productivity (4.5 MT/ha) is much higher than the national average yield of 3.5 MT/ha. ARMM had approximately 2.7 tons per hectare-yield, the lowest among the regions. This region also had the lowest per capita GDP at only PhP14,100 at constant 2000 prices. It can then be inferred that rice producing regions, such as Central Luzon, tend to have cheaper fertilizer prices, whereas those who are producing less, such as ARMM, have higher prices for fertilizers.

Cagayan Valley experienced the biggest area (131,500 hectares) affected by flashfloods, typhoons, drought, pests and diseases, and other causes, while Northern Mindanao was the least affected (1,500 hectares).

1. Market Integration

Pairwise correlation tests resulted in values of no lower than 93% in urea and 97% in complete fertilizer markets, all significant at 5%, indicating a stronger integration in the latter than in the urea markets. However, this cannot be a compelling evidence of market integration as the price time series involves non-stationary data. This should therefore be supported by cointegration tests that recognize the dynamics of price series and markets.

Just by examining the two-way line graph of price data series (Fig. 3), it can be inferred that unit roots or stochastic trends with random walk are present in the data series thereby, implying non-stationary data. The ADF test of stationarity (Table 3) confirms the observation in the graph. The null hypothesis of non-stationarity cannot be rejected since all the test statistics for all regions were less than the critical value (-3.435).

Table 2. Mean Values of Market Integration Determinants by Region, Philippines, 2000-2017

Region	Dis-tance (km)	Paved Roads (%)	Population	Output PC	Productivity	Per Capita GDP	Shock–Affected Area
CAR	217.3	37.3	1,641,848.5	0.239	3.550	74,796.0	12,166.9
Ilocos Region	117.8	89.6	5,050,892.0	0.308	4.008	43,866.2	29,737.7
Cagayan Valley	368.2	63.5	3,382,701.3	0.621	3.939	36,117.9	131,549.7
Central Luzon	155.5	88.0	9,865,845.2	0.291	4.459	60,171.5	83,507.8
CALABARZON	84.9	90.9	11,207,650.7	0.036	3.433	87,239.9	9,641.7
MIMAROPA	321.3	58.1	2,764,722.8	0.334	3.457	38,964.4	12,494.2
Bicol Region	502.5	75.2	5,635,515.5	0.182	3.260	24,158.8	32,979.3
Western Visayas	129.8	76.4	7,468,502.9	0.263	3.214	37,370.9	30,726.3
Central Visayas	112.9	90.4	6,862,362.6	0.039	2.758	60,869.5	3,033.3
Eastern Visayas	352.3	78.9	4,341,294.8	0.198	3.306	35,535.7	12,798.6
Zamboanga Peninsula	285.3	67.8	3,404,649.7	0.168	3.662	38,885.2	3,492.0
Northern Mindanao	116.1	79.1	4,215,461.3	0.139	3.977	56,931.1	1,514.9
Davao Region	50.9	60.2	4,420,426.0	0.100	4.213	57,632.8	3,182.0
SOCCSKSARGEN	78.6	62.5	3,874,518.0	0.310	3.585	42,148.3	8,922.3
CARAGA	310.0	58.8	2,519,587.6	0.170	3.085	32,678.5	4,951.0
ARMM	432.8	50.1	3,370,540.1	0.159	2.697	14,122.0	1,694.5

Note: *Distance, in kilometers, is measured as the average of the distance of the region's provinces to the nearest regional ports. Distance considered here is only the averages for current year. Paved roads% is calculated as the ratio of length of asphalt or concrete road to total road length, and shock affected area accounts for the area affected by all types of shocks: flood, drought, pests/diseases, and other causes.

Fig. 3. Two-Way Line Graph of ln Price Data, January 2000-December 2017 Price Time Series for 16 Regions

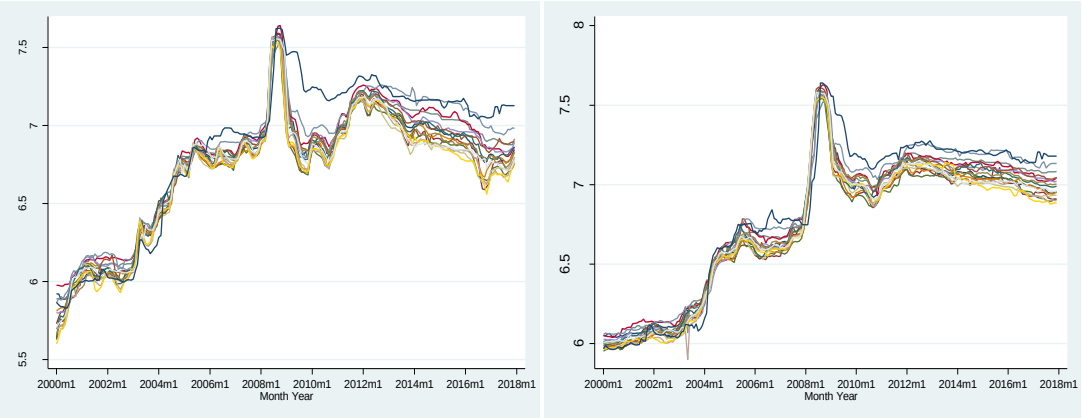


Table 3. Stationarity Test Results Using the Augmented Dickey-Fuller Test for the Monthly Fertilizer Price Series, Philippines, January 2000-December 2017

Region	UREA				COMPLETE			
	Natural Log		First Difference (dln)		Natural Log		First Difference (dln)	
	Test Statistic	P-value	Test Statistic	P-value	Test Statistic	P-value	Test Statistic	P-value
CAR	2.175	0.504	-6.261	0.000	-1.918	0.645	-4.831	0.000
Ilocos Region	-2.775	0.206	-7.754	0.000	-2.275	0.448	-5.647	0.000
Cagayan Valley	-2.338	0.413	-6.767	0.000	-2.181	0.500	-5.647	0.000
Central Luzon	-2.849	0.179	-7.417	0.000	-2.453	0.352	-6.289	0.000
CALABARZON	-2.361	0.401	-6.066	0.000	-1.293	0.890	-4.582	0.000
MIMAROPA	-2.244	0.465	-7.473	0.000	-2.109	0.541	-5.509	0.000
Bicol region	-2.490	0.333	-7.255	0.000	-2.040	0.580	-5.179	0.000
Western Visayas	-2.656	0.255	-7.897	0.000	-2.815	0.192	-5.694	0.000
Central Visayas	-2.165	0.510	-7.657	0.000	-1.841	0.685	-5.224	0.000
Eastern Visayas	-1.911	0.649	-7.758	0.000	-1.151	0.920	-6.911	0.000
Zamboanga Peninsula	-2.193	0.494	-7.587	0.000	-2.016	0.593	-4.809	0.001
Northern Mindanao	-2.109	0.541	-7.996	0.000	-2.104	0.544	-4.887	0.000
Davao region	-2.618	0.272	-8.801	0.000	-1.336	0.879	-6.079	0.000
SOCCSKSARGEN	-2.624	0.269	-8.795	0.000	-2.089	0.553	-4.719	0.001
CARAGA	-2.257	0.458	-7.957	0.000	-2.336	0.414	-5.529	0.000
ARMM	-1.407	0.859	-7.018	0.000	-1.469	0.840	-6.880	0.000

Note: Critical value = -3.435.

When the ADF test was performed in the first difference of price data, stationarity was achieved, implying integration of order 1 (I(1)). It is only when the data is stationary in its first difference that cointegration tests can be employed.

1.1. Presence of Price Leaders in Domestic Fertilizer Markets

The existence of price leaders was determined using the Granger causality test. The Granger causality describes whether causal relationships exist between the regional fertilizer markets, and whether price behavior in one region can predict behavioral patterns in another region. Results from the Granger causality test show that about 51% of the urea markets and 68% of complete fertilizer markets have a bidirectional/ feedback causal relationship, indicating that those paired regions (Table 4) depended on the available information of each market when forming therespective prices for fertilizers.

The unidirectional patterns, on the other hand, specify the regions that are price leaders and price followers. The causality test confirms that price leaders are present in domestic fertilizer markets when forming the input prices in the region. Regions that produce more rice, including Central Luzon, Cagayan Valley, Ilocos Region, and Bicol Region in Luzon, Western Visayas in Visayas, and Zamboanga Peninsula and SOCCSKSARGEN in Mindanao, tended to dictate the fertilizer prices in other regions. Regions producing less rice, such as Eastern Visayas, Davao Region, CAR, CARAGA, ARMM, Central Luzon, CALABARZON, and MIMAROPA, are price followers. This supports the observation of Galang (2014) when she studied fertilizer market integration using a 1990-2013 price series. Although this pattern is also observed in complete fertilizer markets, it is more apparent in urea markets.

Table 4. Directions of Price Transmissions between Regional Market Pairs (Urea) Based on Granger Causality Test, Philippines, January 2000-December 2017

	Y/X	r2	r3	r4	r5	r6	r7	r8	r9	r10	r11	r12	r13	r14	r15	r16
1	CAR	<	<	<=>	<=>	<=>	<=>	<	<=>	>	<	<=>	<=>	<	<=>	>
2	Ilocos Region		<=>	>	<=>	>	>	<=>	<=>	>	<=>	<=>	<=>	<=>	<=>	<=>
3	Cagayan Valley			>	>	>	>	<=>	>	>	<=>	>	>	<=>	>	<=>
4	Central Luzon				<=>	<=>	>	<	<=>	>	<	>	>	<=>	>	<=>
5	CALABARZON					<=>	<=>	<=>	<=>	<=>	<	<=>	<	<	<=>	>
6	MIMAROPA						<=>	<	<=>	>	<=>	<=>	<=>	<	<=>	>
7	Bicol region							<=>	<=>	>	<	<	<	<	<=>	<=>
8	Western Visayas								>	>	<=>	<=>	>	>	<=>	>
9	Central Visayas									>	<	<=>	<=>	<=>	<=>	<=>
10	Eastern Visayas										<	<	<	<	<	<=>
11	Zamboanga Peninsula											>	>	<=>	>	<=>
12	Northern Mindanao												<=>	<	<=>	<=>
13	Davao region													<=>	>	>
14	SOCCSKSARGEN														>	<=>
15	CARAGA															<=>

Table 5. Directions of Price Transmissions between Regional Market Pairs (Complete Fertilizer) Based on Granger Causality Test, Philippines, January 2000-December 2017

	Y/X	r2	r3	r4	r5	r6	r7	r8	r9	r10	r11	r12	r13	r14	r15	r16
1	CAR	<=>	<	<	>	<=>	<=>	<	<=>	>	<	<=>	<=>	<	<=>	<=>
2	Ilocos Region		<=>	>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	>
3	Cagayan Valley			<=>	<=>	<=>	>	<=>	<=>	<=>	<	<=>	<=>	<=>	<=>	<=>
4	Central Luzon				<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	<=>	>
5	CALABARZON					<=>	<=>	<=>	<=>	<=>	<	<	<	<	<=>	>
6	MIMAROPA						<=>	<=>	<=>	<=>	<	<=>	<=>	<	<=>	<=>
7	Bicol region							<	<=>	<=>	<	<=>	<=>	<	<	<=>
8	Western Visayas								>	<=>	<=>	>	>	<=>	>	<=>
9	Central Visayas									<=>	<	<=>	<=>	<	<=>	<=>
10	Eastern Visayas										<=>	<	<=>	<	<	<=>
11	Zamboanga Peninsula											>	>	<=>	>	<=>
12	Northern Mindanao												<=>	<=>	<=>	<=>
13	Davao region													<	<=>	>
14	SOCCSKSARGEN														>	<=>
15	CARAGA															<=>

1.2. Spatial Integration of Regional Fertilizer Markets

Johansen cointegration tests were performed on 120 regional pairwise combinations using the 2000-2017 price series data of urea and complete fertilizer. Of these combinations using urea prices, 95% of the regional markets were found to be spatially integrated. Only six market pairs were segregated, or non-integrated, and these are: the CALABARZON link with Davao and CARAGA, Bicol with Northern Mindanao, Davao and CARAGA, and Zamboanga Peninsula with SOCCSKSARGEN (Appendices Table A). Meanwhile, when the cointegration test was performed in complete markets, 23 market pairs were non-integrated (highlighted in red in Appendices Table B). All non-integrated markets observed in urea markets were also observed in complete fertilizer markets, except the Bicol-CARAGA market pair. The Johansen test suggests that markets for urea are more likely to be integrated than markets for complete fertilizer. This refutes the results from the correlation coefficients, which suggested that complete fertilizer markets are more integrated. Higher market integration of urea is possibly explained by the higher demand of rice farmers for urea relative to complete fertilizer. Roughly 67% of farmers are using urea, and only 58% use complete fertilizer (Table 1).

Results of the study showed that 95% of the urea market and 81% of the market for complete were spatially integrated, which is an indication of high intercorrelation of prices across regional markets. Price differences across integrated markets were relatively lower compared to less integrated markets.

2. Determinants of Market Integration and Price Differences

Tables 6 and 7 show the factors affecting the integration among fertilizer markets for urea and complete fertilizer across regions in the Philippines from 2000 to 2017. The following were examined: distance, output per capita, yield, infrastructure, per

capita income, and exposure to shocks as determinants for market integration and price differentials. Distance was measured as the minimum distance in kilometers between a province and the main ports within the same island group: Luzon, Visayas, and Mindanao. Yield is the total volume of rice production in metric tons (MT) over the total land area (hectares) cultivated for rice production in the region. Output per capita is production (metric tons) over the total population. Infrastructure was captured by the percentage of paved roads out of the total length of national roads. Per capita income was the annual income over the total number of the inhabitants, and exposure to shock was represented as area (ha) affected by flashfloods, typhoons, droughts, pests and diseases, among others.

Among the variables tested using a pairwise correlation test, output per capita, yield, per capita income, and infrastructure had significant influence on integration among fertilizer markets for both urea and complete fertilizer at a 10% level of significance. All significant determinants positively affected the integration among markets for urea.

Table 6. Determinants of Market Integration and Price Differentials, Urea Fertilizer Markets, Philippines, January 2000-December 2017

Variable	UREA							
	Correlation Coefficient		Johansen Trace Statistic		Price Difference (Model 1)		Price Difference (Model 2)	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Trace Statistic							-1.505	-2.60***
Output Per Capita_i	-0.012	-0.33	38.932	1.72*	93.170	0.67	151.772	1.11
Output Per Capita_j	0.090	1.90*	2.923	0.10	-24.032	-0.13	-19.632	-0.11
Sq. Output Per Capita_i	0.009	0.19	-60.400	-2.18**	-79.822	-0.47	-170.739	-1.01
Sq. Output Per Capita_j	-0.095	-1.20	-7.127	-0.15	-34.412	-0.12	-45.140	-0.16
Yield_i	0.003	0.76	0.560	0.23	-13.653	-0.91	-12.810	-0.88
Yield_j	0.007	1.93*	4.021	1.86*	-25.848	-1.95*	-19.795	-1.51
Per Capita Income_i	0.000	0.21	0.000	-0.35	0.000	-0.24	0.000	-0.34
Per Capita Income_j	0.000	1.99**	0.000	-0.48	0.000	-0.27	0.000	-0.40
Distance_i	0.000	0.36	-0.031	-3.34***	0.008	0.14	-0.039	-0.67
Distance_j	0.000	0.87	0.005	0.54	0.040	0.67	0.048	0.82
Road_i	-0.001	-0.10	-8.812	-1.38	18.626	0.48	5.362	0.14
Road_j	0.032	2.28**	22.257	2.57***	-94.520	-1.78*	-61.018	-1.15
Difference in Area Affected by Shocks	0.000	-0.22	0.000	1.62	0.000	-0.18	0.000	0.22
Constant	0.893	40.24***	7.038	0.52	248.325	2.98***	258.919	3.18***
Number of Observations	120		120		120		120	
Prob>F	0.000	***	0.000	***	0.000	***	0.000	***
R-squared	0.467		0.349		0.300		0.343	

Note: ***Significant at 1%, ** at 5%, * at 10%.

Results of the estimation show that output per capita is a significant factor of market integration in both fertilizer markets using both the correlation coefficients and Johansen test. One interesting result is the difference in the signs of the coefficients of Outputi and Outputj. Outputi captures supply conditions, whereas Outputj is the receiving market. Significant contradicting signs of output per capita imply that the degree of difference in production per capita between markets could explain higher integration. As

emphasized by Goletti, Ahmed, and Farrid (1995), the more dissimilar the markets, the greater the likelihood that trade can occur between them. This factor does not seem to have an effect on the price differential. Likewise, yield differences were also found to increase market integration and lower price differences. This indicates that there is a higher likelihood that trade may occur between a surplus and deficit region than when both regions have a surplus or deficit.

Table 7. Determinants of Market Integration and Price Differentials, Complete Fertilizer Markets, Philippines, January 2000-December 2017

Variable	COMPLETE							
	Correlation Coefficient		Johansen Trace Statistic		Price Difference (Model 1)		Price Difference (Model 2)	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Trace Statistic							0.616114	1.62
Output Per Capita_i	0.007	0.42	29.104	1.08	94.763	0.89	76.83166	0.72
Output Per Capita_j	0.043	1.94*	-65.496	-1.89*	28.097	0.21	68.44962	0.5
Sq. Output Per Capita_i	-0.013	-0.63	-67.859	-2.05**	-75.651	-0.58	-33.842	-0.26
Sq. Output Per Capita_j	-0.046	-1.27	79.392	1.38	-120.280	-0.53	-169.194	-0.74
Yield_i	0.001	0.46	-0.618	-0.21	-8.966	-0.78	-8.58465	-0.75
Yield_j	0.003	1.69*	3.868	1.50	-19.620	-1.93*	-22.0031	-2.16**
Per Capita Income_i	0.000	0.05	0.000	-2.54**	0.000	-0.23	5.96E-05	0.16
Per Capita Income_j	0.000	1.79*	0.000	-1.84*	0.000	0.41	0.000466	0.69
Distance_i	0.000	0.19	-0.029	-2.66***	-0.013	-0.29	0.005194	0.12
Distance_j	0.000	0.63	0.023	1.96	0.065	1.40	0.050988	1.09
Road_i	0.000	0.02	-5.246	-0.69	19.576	0.65	22.80846	0.76
Road_j	0.015	2.31**	28.989	2.81***	-56.821	-1.39	-74.6814	-1.78*
Difference in Area Affected by Shocks	0.000	-0.24	0.000	1.37	0.000	0.19	-3.60E-06	-0.02
Constant	0.954	92.90***	29.353	1.81*	137.400	2.14**	119.3148	1.85*
Number of Observations	120		120		120		120	
Prob>F	0.000	***	0.000	***	0.003	***	0.002	***
R-squared	0.441		0.404		0.245		0.263	

Note: ***Significant at 1%, ** at 5%, * at 10%.

Contrasting results from the correlation coefficient test and Johansen test were noted for per capita income. For the Johansen test in complete fertilizer markets, per capita income lessened integration, but using the correlation coefficient, per capita income increased market integration. Higher per capita income signifies that there are higher economic activities, such as trading, in the area. Markets with higher per capita income are more capable in setting up interventions, such as improved road infrastructure, to aid the trading process.

On the other hand, distance had a negative effect on market integration since a longer distance between markets entails higher transportation costs; thus, there

is lesser opportunity for trade to take place. Market integration is achieved when arbitrage conditions occur, or when the nominal price in the exporting market plus the transport and incidental costs are less than the nominal price in the importing market. When it becomes greater as a result of a high transport cost, there is an absence of integration. Markets that are farther apart would add to the trader's cost of transporting and selling urea and complete fertilizers to other markets, thus lowering the trading activities.

Infrastructure is represented by the presence of quality roads, i.e. asphalt or concrete, and is positively associated with market integration. High quality roads make it easier for trading to occur between spatially separated markets, thus the strong positive relationship to market integration. Road quality or the presence of good infrastructure is also a strong determinant that lowers prices. The coefficient for roads implies that road as proxy to infrastructure is the strongest determinant that would increase the integration of markets and lower input prices.

When it comes to price differentials, yield and road were found to have significant negative effects on the price difference. The higher the yield or productivity in the area which leads to higher supply, the lower the differences between prices because there is enough fertilizer supply in the area. Likewise, with road condition, a higher number of paved roads will encourage trading activities, thus decreasing the chance of monopolizing the prices of fertilizer (urea) within an area and avoiding higher price differences between markets.

V. Conclusion and Policy Implications

Based on the present analysis, high fertilizer prices seem to discourage farmers from using fertilizer, as evidenced by the fact that regions with the highest fertilizer prices were also found to have the lowest fertilizer uptake. Additionally, price differences appear lower in fertilizer markets that are integrated since spatial integration of domestic fertilizer markets ensures effective price transmission between markets. Findings likewise suggested that infrastructure development that eases transport costs is a strong determinant of market integration. Distance lessens market integration, but is compensated by the presence of quality roads. Similarly, output per capita is a significant factor of market integration in both fertilizer markets using both the correlation coefficients and Johansen test.

The Philippines is far from achieving rice self-sufficiency, but has great potential in making its rice production competitive with the adoption of improved appropriate technologies and access to affordable production inputs. This is important because, given the soaring prices of production inputs for rice cultivation, particularly fertilizer, it has been difficult for farmers, especially for those living in distant regions where input prices are high, to compete with cheap imported rice. However, with integrated markets, fertilizers and other important production inputs could become affordable to farmers. This could aid in encouraging local farmers to continue producing rice because it is still profitable.

Rice tariffication can benefit rice consumers through the influx of cheap imported rice, but the welfare of the local farmers is being compromised. This is crucial since rice production is still deemed necessary despite economists saying that the country is losing its comparative advantage in rice. One of the main reasons is that the global rice supply is becoming unstable. Rice remains a thinly exported commodity in the world market, where only 6% of global rice production is sold worldwide. Population increases are also a problem in rice exporting countries ,which pushes them to occasionally ban exports to protect the local supply (IBON Foundation, 2019).

Meanwhile, identifying which markets are integrated is extremely crucial in policy development as it allows the government to fast track interventions. In integrated markets, any price fluctuation in one market is also likely to happen in another integrated market . It therefore signals to the government where or in which regions to focus interventions, especially in

efforts to stabilize the prices of rice. For instance, it could implement centralized policies in integrated fertilizer markets, and decentralized policies in those less integrated. Having identified the determinants that influence integration should also allow the government to decide what kind of interventions it would implement in order to promote the integration of spatially segregated markets. The higher likelihood that trade and therefore integration would occur between a surplus and deficit region implies a need for the government to link these regions via cost-reducing transportation infrastructures, both physical and policy-wise. For instance, when it comes to the prioritization of road and bridge construction, regions that are not yet integrated but found to have high potential for market integration, as indicated by their respective outputs per capita, should be among those on top of the list.

In addition, as this study failed to capture market power due to the unavailability of relevant data, future research that will look at the influence of market power on market integration as deemed necessary.

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Appendices

Table A. Trace Statistic Matrix for Urea Fertilizer Prices in Each Regional Market Pair, Results from Johansen Cointegration Test

	Region	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	CAR																
2	Ilocos Region	41.227															
3	Cagayan Valley	34.390	39.790														
4	Central Luzon	54.209	29.099	31.422													
5	CALABARZON	20.318	29.758	30.193	41.197												
6	MIMAROPA	20.760	39.541	33.822	37.888	26.514											
7	Bicol region	27.536	36.806	26.897	41.846	24.029	35.228										
8	Western Visayas	48.173	30.290	24.564	25.782	24.398	28.459	25.639									
9	Central Visayas	37.093	34.890	27.551	41.882	26.520	28.262	27.361	32.255								
10	Eastern Visayas	20.642	29.997	26.607	30.014	44.903	25.686	30.817	23.643	18.840							
11	Zamboanga Peninsula	46.527	48.880	31.504	43.198	33.904	37.886	29.464	26.364	43.624	30.853						
12	Northern Mindanao	37.198	37.615	26.276	32.636	16.577	26.171	14.037*	35.954	25.452	17.209	28.300					
13	Davao region	33.308	37.320	30.598	27.585	12.471*	20.707	13.781*	41.044	25.049	19.066	19.970	45.736				
14	SOCCSKSARGEN	33.203	33.520	36.267	29.630	18.980	24.440	15.997	27.297	24.330	20.932	15.103*	24.916	31.138			
15	CARAGA	29.681	31.194	18.276	23.037	14.546*	22.879	11.195*	45.261	18.843	15.554	28.304	24.758	33.771	26.090		
16	ARMM	24.903	26.849	22.446	27.516	24.409	17.839	26.703	25.748	27.090	17.800	24.260	24.754	21.354	22.077	23.078	

Table B. Trace Statistic Matrix for Complete Fertilizer Prices in Each Regional Market Pair, Results from Johansen Cointegration Test

	Region	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	CAR																
2	Ilocos Region	30.637															
3	Cagayan Valley	29.943	39.524														
4	Central Luzon	25.307	24.402	19.757													
5	CALABARZON	11.669*	17.304	15.685	19.029												
6	MIMAROPA	22.521	34.849	22.147	30.645	15.601											
7	Bicol region	16.574	41.780	24.642	44.342	11.790*	43.765										
8	Western Visayas	30.821	22.270	11.125*	17.162	10.559*	23.549	28.036									
9	Central Visayas	21.308	36.489	22.939	42.590	17.090	32.750	29.248	28.321								
10	Eastern Visayas	15.648	31.631	32.789	40.013	38.903	33.974	36.080	40.879	27.014							
11	Zamboanga Peninsula	26.182	46.209	26.367	30.107	15.261*	33.583	22.083	21.971	34.738	29.955						
12	Northern Mindanao	17.491	27.480	15.736	26.260	8.847*	34.642	13.243*	28.670	36.030	34.706	20.530					
13	Davao region	31.390	29.181	14.611*	14.923*	8.842*	24.707	15.089*	34.742	15.933	17.795	17.869	18.877				
14	SOCCSKSARGEN	11.898*	14.051*	12.213*	9.235*	5.439*	11.236*	8.804*	23.707	11.771*	15.557	14.367*	7.739*	34.861			
15	CARAGA	26.568	21.555	17.597	19.839	10.342*	25.487	17.573	38.884	38.118	34.909	21.790	26.746	33.259	9.604*		
16	ARMM	23.122	29.861	30.832	65.946	29.149	24.885	23.979	35.250	28.690	22.655	17.252	36.761	28.107	23.038	57.101	

ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2019.15.1.39

Journal of Global Business and Trade

https://www.pfw.edu/jgbt

The Impacts of Minimum Trading Units and Tick Size Changes on Bid-ask Spread, Depth, and Trading Volume: Evidence from the Indonesia Stock Exchange

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Received 22 January 2019, Revised 22 April 2019, Accepted 25 May 2019

ABSTRACT

Purpose – This research aims to analyze the differences in the bid-ask spread, depth, and trading volume after a new tick size and minimum trading unit policy were imposed by the Indonesian Stock Exchange (IDX) on January the 6th, 2014.

Design/Methodology/Approach – This research is exercised on the three variables of liquidity, i.e. the bid-ask spread, the depth, and the trading volume. This research used a paired difference test to measure the impact before and after the policy was imposed.

Findings – The results showed that the smaller the tick size, the greater the average decrease of the bid-ask spread, ask depth, and bid depth, but the trading volume did not show a significant average difference.

Research Implications – The tick size reduction was consistent and supported the previous research from different countries. The bid-ask spread, ask depth, and bid depth significantly decreased, and the trading volume had a tendency to increase as well, although it was not significant. Results are aimed at the IDX and Bapepam as additional information related to the changes that occurred as a result of the implementation of the new policy in stock trading. Investors can use the information from this study to make investment decisions.

Keywords: bid-ask spread, depth, tick size, volume
JEL Classifications: G11, G12, G14, G18

Ⅰ. Introduction

1. Research Background

The liquidity of the stock market in Indonesia has long been considered to be below its maximum. There are still too many stocks that are not actively traded or not moving, which are often referred to as inactive stocks, or illiquid stocks. Since 2006, the Indonesian Stock Exchange (IDX) has delisted 26 companies (Jatmiko, 2013). This liquidity problem has still not been resolved, and in 2015, Indonesia will face the start of the ASEAN Economic Community (AEC). Therefore, Asosiasi Emiten Indonesia (AEI) predicts that the AEC plan will increase difficulties for local

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issuers. Foreign issuers that are better rated can cause local issuers to be uncompetetive, so there will be many more inactive stocks. (Supriadin, 2012).

The entire capital market has a tick size that determines the multiple bargaining changes in stock prices; for example, stocks at a price of Rp. 100 can only be changed by a multiple of Rp. 1 into Rp. 101 or Rp. 99 for stock trading on the stock exchange. To be able to be traded, there is also a requirement for a minimum number of the shares to be in the stock bargaining process, called round lots. Investors can buy or sell at least one lot of shares with the price changed by the amount of the tick size in effect on those stocks (Husnan, 2005, h.33).

In order to increase market liquidity, the IDX should encourage growth in the numbers of investors. The IDX considered that the amount of traded units and the tick size were components of the market's microstructure which had an important role in the liquidity of shares, so that the amount of round lots and the tick size were deemed to be necessary for adjustment to improve the market's capitalization and competitiveness. In stock trading, it has long been established that one lot consisted of 500 sheets. However, on November 8th, 2013, the Board of Directors of PT. Bursa Efek Indonesia issued a decree (Kep-00071/BEI/11-2013) concerning changes in the tick size and trading unit that came into force on January 6th, 2014 (Bursa Efek Indonesia, 2013).

Table 1. Change in Tick Size and MTU

Change in Minimum Trading Units (lot)					
Old			**New**		
1 lot = 500 stocks			**1 lot = 100 stocks**		
Maximum volume order in regular market and cash market	10,000 lots		Maximum volume order in regular market and cash market	50,000 lots	
Change in Tick Size					
Old			**New**		
Price Groups	**Tick Size**	**Max Daily Change**	**Price Groups**	**Tick Size**	**Max Daily Change**
< Rp. 200	Rp. 1	Rp. 10	< Rp. 500	Rp. 1	Rp. 20
Rp. 200 up to < Rp. 500	Rp. 5	Rp. 50			
Rp. 500 up to < Rp. 2,000	Rp. 10	Rp. 100	Rp. 500 up to < Rp. 5,000	Rp. 5	Rp. 100
Rp. 2,000 up to < Rp. 5,000	Rp. 25	Rp. 250			
≥ Rp. 5,000	Rp. 50	Rp. 500	≥ Rp. 5,000	Rp. 25	Rp. 500

Source: Secondary data processed from the IDX (2013).

In research into the Japanese stock market, Amihud et al. (1999) studied the decrease in the Minimum Trading Unit (MTU). The MTU is the equivalent of the round lot, which is the minimum number of sheets that can be traded. The MTU's reduction was carried out by 66 companies listed on the Tokyo Stock Exchange. Amihud et al. found that the average decline in the MTU increased stock values

by more than 5%. Increasing the value correlated positively and significantly with the addition of shareholder numbers (investors). These findings supported a discovery by Merton (1987) on the relationship between the value of the shares and the number of investors. According to Merton, when more investors own shares, stocks become more well known and reduce the problem of the availability of information, thus reducing the capital costs and affecting the value of the shares. Therefore, an increase in liquidity due to an increase in the number of investors also added to the value of the shares.

The results of changing the tick size are still being debated. Some researchers, such as Hart (1993), found a decrease in the tick size made liquidity increase for small investors, and smaller spreads would increase the trading volume. Ricker (1998) found that a smaller tick size was more profitable for traders who used market orders, thus reducing the utilization of limit orders. Grossman and Miller (1988) argued that the tick size should be high enough to sustain competitive supply. Harris (1997) found that despite a change in tick size being more favorable to liquidity demanders, it could be detrimental to liquidity providers because it could increase costs, thus lowering the intention to provide liquidity.

Adjustments to the trading unit and the new tick size are also intended to accommodate retail investors who do not have sufficient funds to buy high-priced stocks. These changes are expected to result in an increase in stock liquidity (as measured by the variables bid-ask spread, depth, and trading volume), thereby increasing market capitalization. For investors, the information is an important requirement for the decision making process, as the announcement of changes to the tick size and trading unit is considered meaningful information to investors.

Fig. 1. Graph of Trading Volume around the Announcement of the New Trading Unit and Tick Size Policy, January 6th, 2014.

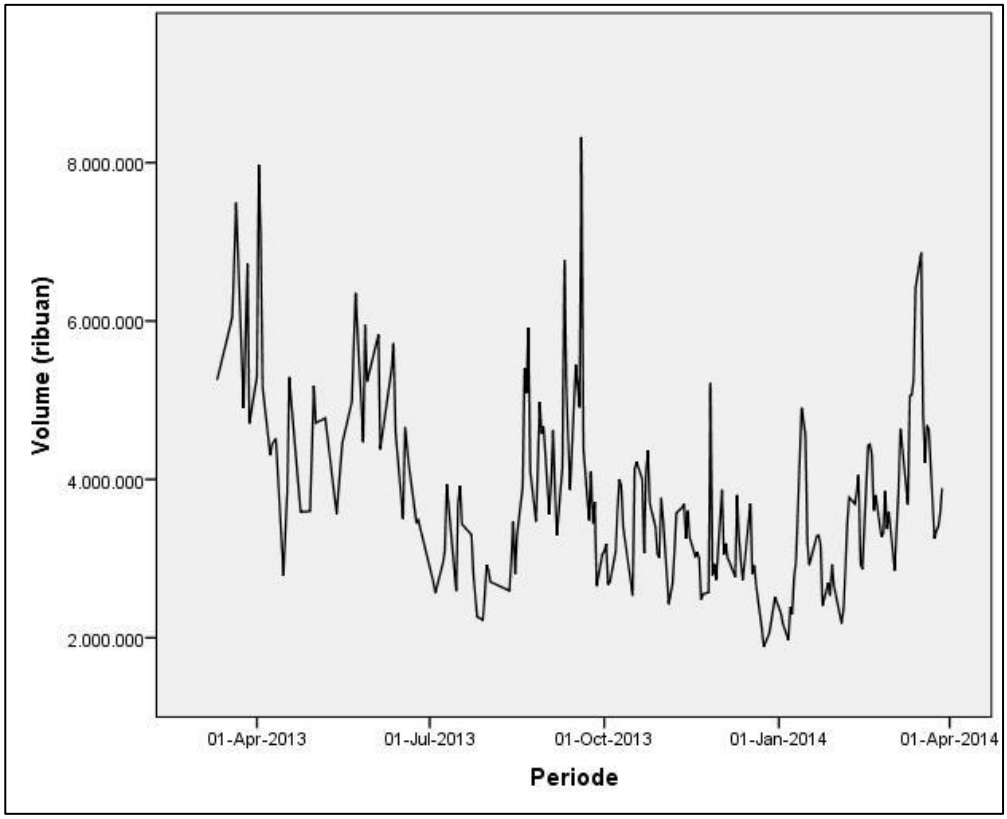


Fig. 1 shows the trading volume for one year from March 2013 to March 2014. It appears that the volume of stocks traded in the regular market experienced a downward trend (bearish), and then back upward (bullish) after the introduction of the new system for the trading unit and tick size. It cannot be known with any certainty if the changes in volume were caused by the changes to the system. This event provides a unique opportunity to empirically evaluate the effect, or the impact, on the stock market's liquidity, of the changes to the tick size and trading unit that were applied simultaneously, as this has never happened before.

This study tries to analyze the differences in all tick sizes (Rp. 1, Rp. 5, and Rp. 25) on the bid-ask spread, depth, and trading volume before and after the implementation of the new tick size, and the MTU policy on the IDX. The amount of the bid-ask spread determines the trade execution costs faced by investors, and is often used to compare the quality between different stock markets. Depth change is important to more thoroughly evaluate changes in liquidity. While the change in the trading volume is an important performance indicator for a stock market because it is directly related to revenue, the liquidity of a stock market is indicated by the smaller size of the bid-ask spread, the higher amount of depth, and the higher trading volume (Harris, 1997).

This study also attempts to analyze differences in the MTU (1 lot = 100 sheets) on the trading volume before and after the implementation of the new policies. Amihud et al. (1999) found an increase in individual investors who provided positive abnormal returns since the announcement of the policy to reduce the MTU, up until the time the policy was imposed. Hauser and Lauterbach (2003) also found that there was a positive stock return. This can be explained by research into the number of investors conducted by Merton (1987). Research into the MTU's reduction will focus on the trading volume, which is the dimension of liquidity.

2. Research Purpose

The BEI has made several changes to the tick size since 2000. A single tick size system was imposed until 2000, then a system with three tick sizes ran until the beginning of 2005. BEI then added one additional tick size, making for four tick sizes in total, which were used until the beginning of 2007. Then, a system of five tick sizes operated from 2007 to early 2014. The changes were aimed at improving the liquidity of the shares represented by the variable depth, spread, and trading volume.

Goldstein and Kavajecz (2000), in a study on the New York Stock Exchange, found the spread and depth both decreased. Purwoto and Tandelilin (2004), in a study on the Jakarta Stock Exchange, stated that spreads declined, decreasing the depth, but trading activity rose for low-priced stocks, though declining for high-priced stocks. Satiari (2009) found the spread decreased, but the depth and volume of trade had increased. While on the MTU, Amihud et al. (1999), Ahn et al. (2005), and Hauser and Lauterbach (2003) consistently found a positive stock return that supported research into the number of investors conducted by Merton (1987).

Discrepancies in the research results on the tick size created a gap in the research on this topic; the effect of the application of the new tick size and new trading unit policy are also interesting research subjects for study. This study is expected to obtain results that are able to explain the phenomenon of the change in the tick size system (i.e. tick sizes of Rp. 1, Rp. 5, and Rp. 25) and the MTU (1 lot into 100 sheets) on the bid-ask spread, depth, and trading volume in the IDX.

Based on the formulation of the problem, research questions analyzed are: (1) is there a difference in the average bid-ask spread on tick sizes of Rp. 1, Rp. 5, and Rp. 25 after the new policy was imposed by the IDX? (2) Is there a difference in the average depth on the tick sizes of Rp. 1, Rp. 5, and Rp. 25 after the new policy was imposed by the IDX? (3) Is there a

difference in the average trading volume on tick sizes of Rp. 1, Rp. 5, and Rp. 25 after the new policy was imposed by the IDX?

This research is expected to be able to provide a variety of benefits to a number of parties, including: (1) the IDX and Bapepam, as additional information related to the changes that occured as a result of the implementation of the new policy in stock trading; (2) investors and potential investors, who can use the information from this study to make investment decisions in the event of a change in the tick size and the MTU in the future; (3) students and researchers, as this study will enrich their knowledge on the impact of changes in the tick size and the MTU in the Indonesian market.

This research is exercised on the three variables of liquidity, i.e. (1) the bid-ask spread, (2) the depth, and (3) trading volume, which all focus the research and prevent it from becoming blurred. This research used a paired difference test to measure the impact before and after the new tick size and MTU policy were imposed. The data analysis was also limited to stock quotes that could be downloaded from IDX's official website.

Ⅱ. Literature Review and Hypothesis Formulation

The stock prices that form the focus of this research are the market prices, or the price of the shares traded on the IDX. Fluctuations in stock prices are reflected by the rise and fall of stock prices due to changes in the strength of the demand and supply of the stocks on the stock market. The stock price is influenced by internal and external factors. Internal factors that affect stock prices are related to the specific nature of the stock (performance of the company and the industry in which it operates). In addition, they are also influenced by external factors, the macro, which includes macroeconomic conditions or the technical condition of the market, social and political conditions, and rumors (Brigham & Houston, 2004, h.26). Regulatory changes are also external factors, including any new policies, such as new tick sizes and new MTUs.

Liquidity is a concept that is very old and has many definitions. According to Keynes, an asset is more liquid than others if it can be realized in a short period of time without loss. The key words here are short time and without loss. Liquid assets are more profitable, because they do not reduce in value when traded. According Brunnermeier and Pedersen (2009), liquidity is the ease of an asset to be traded, while according to Ross et al. (2012, h.23), liquidity is the speed and ease of converting assets into cash.

Four dimensions are often associated with liquidity in market microstructure literature, namely width, depth, immediacy, and resiliency. According to Harris (1990), width refers to the spread of the amount of a particular stock, depth refers to the number of shares that can be traded at the last price (quotation), and resiliency refers to how quickly the price can revert back to a previous level when there is a change due to imbalanced demand from market participants who do not have relevant information. Overall, a market is liquid if the market's participants can quickly buy or sell large volumes of shares whenever they want at low transaction costs.

According to attachment Kep-00071/BEI/11-2013, regulation number II-A on equity securities trading, tick size is the unit price change used while performing an offer to sell, or a demand to buy, a stock. For example, stock prices are expressed in multiples of Rp. 25 (called a point, a general term for a multiple of the price scale is referred to as the tick size). If the stock price goes up by 5 points, it means the stock price rose by Rp. 125 (Husnan, 2005, h.33).

One of the most important protocols in the securities market is the magnitude of the multiples of the minimum price. If the magnitude of the minimum

price multiple is too high, then supply and demand becomes more difficult, and could result in failure to complete the transaction. If the magnitude of the minimum price multiple is too small, this can reduce the depth of the market and increase negotiation costs. The maximum price change is the magnitude of change in orders to buy or sell, based on the quotation or the last transaction price. Tick size and maximum price changes are valid for one day only, so stocks that pass through the new price group will have a change in tick size and maximum price the next day.

The ask price is the offer price for the sell order, and the bid price is the demand price for the buy order. The spread is the difference between the (the quoted) bid and ask prices (Huang & Stoll, 1997). The fundamental issue in a trade is the asynchronous arrival of the sellers and buyers, as it creates uncertainty on the time required to bring the two parties together, as well as whether the market price will change when the sellers and buyers meet.

This uncertainty will be mitigated by the presence of the liquidity providers, who will require compensation for the costs involved, namely their costs of processing, holding, and the cost of adverse selection. Dealers recover costs by buying at a low bid price and selling at a high ask price. The bid and ask prices are prices quoted by the dealer, and the differences between both prices is the bid-ask spread or the quoted spread, which is a measure of the trade costs (Bessembinder & Venkataraman, 2009).

Conclusions resulting from previous studies state that the bid-ask spread is a function of the transaction cost that causes investors to hold financial assets that have higher transaction costs for longer. Transaction costs include the costs of commissions, the costs of implementation, and opportunity costs that can be grouped into the components of fixed costs and variable costs. The most common way used to measure the spread is by calculating the difference between the best bid and best ask to obtain the rupiah spread, and divide it by the median value of the stock quote. The decline in the tick size will tend to lower spreads and increase the trading volume because trading becomes cheaper (Purwoto & Tandelilin, 2004).

The quantity supplied by the dealer at the quoted price is called the quoted depth, which consists of the bid depth and the ask depth. Depth is the quantity available for trading at the best bid and best ask prices. Depth represents the liquidity offered and requested by the market. Previous studies found that high volatility had a correlation with low liquidity, in the form of a low depth at the best quotes (Baker & Kiymaz, 2013, pp.1968). Standard depth measurements are by calculating the ask depth (the number of shares at the best ask price) and the bid depth (the number of shares at the best bid price). Depth is measured separately because the depth change may be asymmetric between the ask depth and bid depth (Purwoto & Tandelilin, 2004).

In stock trading on the IDX, there is also a minimum unit of shares in stock trade bargaining, called a round lot, and investors can buy or sell at least one lot of shares at the price the tick size changes in effect at that time have on the stock's price (Husnan, 2005, pp. 33). The MTU has an influence on the volume of stocks traded, because the smaller the MTU is, then an investor will be able to make transactions using less funds, so that they could buy even small amounts of the more expensive shares.

Amihud et al. (1999) found that the average decline in the MTU increased a stock's price by more than 5%. This value increase correlated positively and significantly with the addition of shareholders (investors). These findings supported the Merton (1987) findings on the relationship between the stock value and the number of investors. According to Merton, when more investors own stock, the stock become better known and reduces the problem of information availability, thus reducing capital costs and affecting stock value. The increase in liquidity due to the increase in the number of investors also adds to the value of the shares.

The trading volume is the number of shares traded by the owners of capital or the investors in stocks. The greater the numbers of investors investing capital in a stock makes the stock trade in a more liquid manner. According to Chordia et al. (2000), trading volume, trading frequency, volatility, and price were all components of individual stock liquidity. A high trade volume is a sign that there is more opportunity to sell and buy stocks related to the liquidity aspect, i.e. immediacy, which means how fast a stock can be successfully traded at a certain price.

Technical words in this case refer to the analysis of the market itself, not the analysis of external factors that are reflected in it. Technical analysis is the actual historical records (including the price movements and volume of transactions) of individual stocks or groups, and is used to deduce future trends of the market (Levy, 1996). Technical analysis is basically an effort to understand when to buy or sell shares utilizing technical indicators, or by using graphical analysis (Husnan 2005, pp.358). This study is a technical analysis that compares the changes in the bid-ask spread, depth, and trading volume.

Studies of previous research were conducted for comparison and reference material that could be used to clarify the discussion. Studies of the effect of tick size have generally been concerned with changes in the liquidity dimension of the stock market, i.e. the bid-ask spread, depth, trading activity and trading volume. Studies on the effect of the MTU have generally been concerned with the dimensions of the stock price, such as the price noisiness and abnormal returns, as well as the dimensions of liquidity that have an impact on the share price, such as trading volume and number of shareholders. Such previous research can be seen in Table 2.

Hart (1993) argued that a decrease in tick size will increase liquidity for small investors, and smaller tick sizes would increase trading volumes. Ricker (1998) stated that a smaller tick size may benefit liquidity demanders and decrease utilization of the limit order. Grossman and Miller (1988) argued that tick size should be high enough to maintain a competitive supply. Harris (1997) founds that a reduced tick size, although of benefit for some liquidity demanders, harmed some liquidity providers, and thus reduced the desire to provide liquidity.

There are various differences between previous studies related to the research results; the depth variable, for example, recorded mixed results. Ahn et al. (1996) stated it was unaffected, Purwoto and Tandelilin (2004) stated it decreased, whereas Satiari (2009) stated it increased. Differences in the previous studies make this research topic increasingly attractive, and the MTU's reduction policy also raises the question of whether it is the correct policy to increase the liquidity of the capital markets.

Increased liquidity is measured by spread, depth, and trading volume. If the spread is decreased, depth increased, and trading volume increased, liquidity can clearly be understood to have increased as a result of the new IDX tick size and MTU policy. In this research, what we are trying to observe is whether the new system that is applied by the IDX makes a difference in the bid-ask spread, depth, and trading volume.

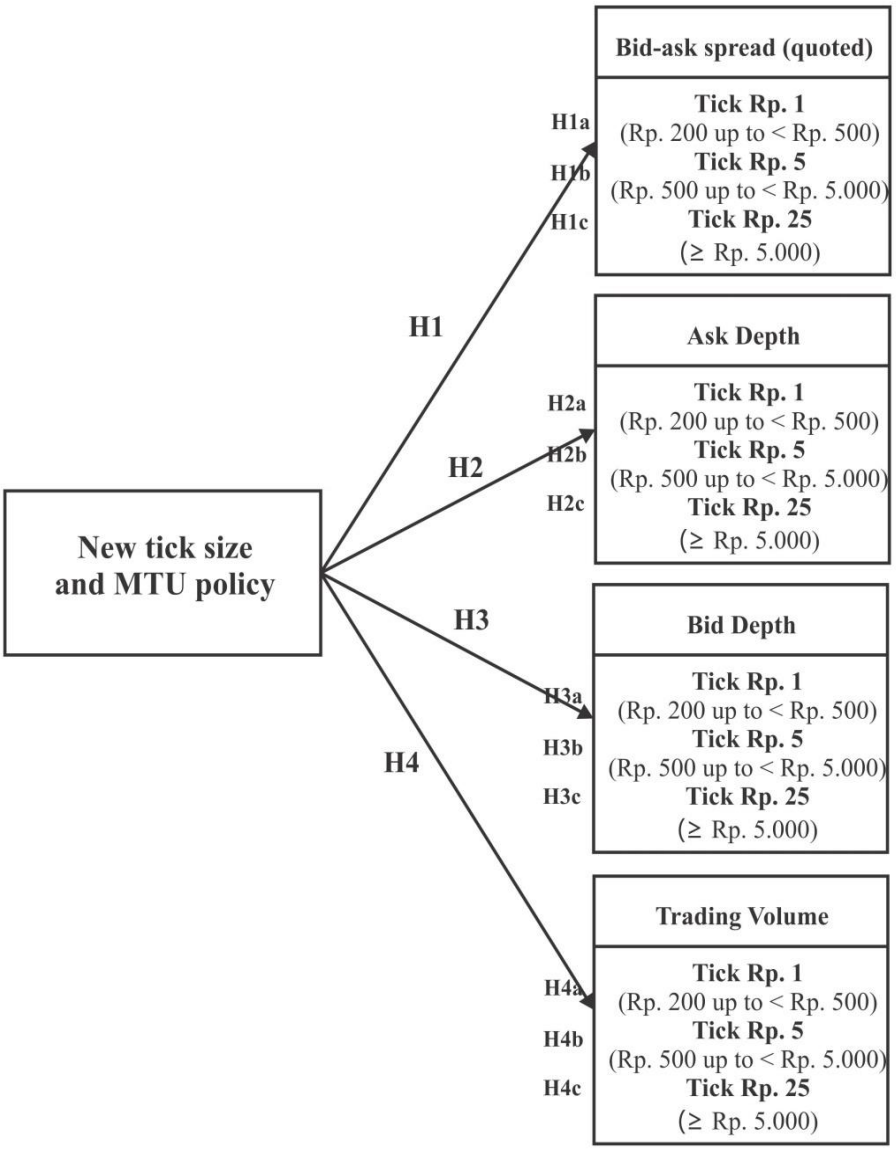
This analysis was conducted after the new policy was announced, so the result may well differ from the conclusions drawn from previous analyses when older systems were in use. Most research into the reduced tick size in the world found that the spread decreased, depth decreased, and trading volume increased. Therefore, the hypothesis model can be arranged as in Fig. 2. The hypothesis outline is arranged into several hypotheses based on the tick size of the different price groups because there may be different results for each price group.

Table 2. List of Previous Studies

Researchers (Year)	Title	Variables	Results
Ahn et al. (1996)	Tick Size, Spread, and Volume	Quoted spread, effective spread, volume, depth	Quoted spread and effective spread decrease, volume and depth unaffected
Amihud et al. (1999)	Number of Shareholders and Stock Prices: Evidence from Japan	Stock price, number of shareholders	Stock price and the niumber of shareholders increase
Bessembinder (2000)	Tick Size, Spreads, and Liquidity: An Analysis of Nasdaq Securities Trading near Ten Dollars	Quoted spread and effective spread	Quoted spread and effective spread decrease
Goldstein and Kavajecz (2000)	Eighths, Sixteenths, and Market Depth: Changes in Tick Size and Liquidity Provision on the NYSE	Quoted spread, depth	Quoted spread and depth decrease
Hauser and Lauterbach (2003)	The Impact of Minimum Trading Units on Stock Value and Price Volatily	Volume, stock price, price noisiness	Volume and price noisiness increase
Purwoto and Tandelilin (2004)	The Impact of the Tick Size Reduction on Liquidity: Empirical Evidence from the Jakarta Stock Exchange	Bid-ask spread, market depth, trading activity	Spread and depth decrease, trading activity increase for low priced stocks, but decrease for high priced stocks
Nugroho (2006)	Perbedaan fraksi harga saham terhadap variabel bid-ask spread, depth, dan volume perdagangan	Bid-ask spread, depth, and trading volume	Bid-ask spread can distinguish change in tick size,depth and trading volume can not distinguish change in tick size
Ekaputra and Ahmad (2007)	The Impact of Tick Size Reduction on Liquidity and Order Strategy: Evidence from the Jakarta Stock Exchange (JSX)	Spread, depth,depth-to-spread ratio	Spread and depth decrease, depth-to-spread ratio change is not significant
Alampieski and Lepone (2009)	Impact of a Tick Size Reduction on Liquidity: Evidence from the Sydney Futures Exchange	Bid-ask spread and quoted depth	Bid-ask spread and quoted depth decrease
Satiari (2009)	Analisis perbedaan sistem fraksi harga saham terhadap variabel bid ask spread, depth, dan volume perdagangan	Bid ask spread, depth, and trading volume	Bid ask spread decrease, depth and volume increase

Source: From various journals.

Fig. 2. Hypotheses Model



Based on the literature review above, the hypotheses proposed are as follows:

H1: There was a smaller average bid-ask spread in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed.

H1-a: There was a smaller average bid-ask spread in stocks with a tick size of Rp. 1 after the new policy was imposed.

H1-b: There was a smaller average bid-ask spread in stocks with a tick size of Rp. 5 after the new policy was imposed.

H1-c: There was a smaller average bid-ask spread in stocks with a tick size of Rp. 25 after the new policy was imposed.

H2: There was a smaller average ask-depth in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed.

H2-a: There was a smaller average ask-depth in stocks with a tick size of Rp. 1 after the new policy was imposed.

H2-b: There was a smaller average ask-depth in stocks with a tick size of Rp. 5 after the new policy was imposed.

H2-c: There was a smaller average ask-depth in stocks with a tick size of Rp. 25 after the new policy was imposed.

H3: There was a smaller average bid-depth in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed.

H3-a: There was a smaller average bid-depth in stocks with a tick size of Rp. 1 after the new policy was imposed.

H3-b: There was a smaller average bid-depth in stocks with a tick size of Rp. 5 after the new policy was imposed.

H3-c: There was a smaller average bid-depth in stocks with a tick size of Rp. 25 after the new policy was imposed.

H4: There was a greater average trading volume in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed.

H4-a: There was a greater average trading volume in stocks with a tick size of Rp. 1 after the new policy was imposed.

H4-b: There was a greater average trading volume in stocks with a tick size of Rp. 5 after the new policy was imposed.

H4-c: There was a greater average trading volume in stocks with a tick size of Rp. 25 after the new policy was imposed.

Ⅲ. Research Method

1. Research Design

This study is empirical research with a quantitative approach to determine the change in the variables' bid-ask spreads, depths, and trading volumes using a paired difference test analysis for the pre-event period of November 8th, 2013 until January 3rd, 2014, and the post-event period of the implementation of the new tick size and the MTU of January 7th, 2014 until February 28th, 2014. According to Cooper and Schindler (2011, pp. 70), empiricism is a theory that says knowledge comes only or primarily from sensory experience and/or is derived from experience by the inductive logic method, which includes mathematics and statistics. Researchers use this approach to describe, explain, and make predictions based on information obtained from observations.

According to Creswell (2003, p. 18), a quantitative approach is when researchers mainly use postpositivist claims to develop knowledge (such as cause and effect thinking, reduction of specific variables, questions, hypotheses, measurements, observations, and testing of the theory) using experimental strategies and surveys, then collect data to generate statistical data. Using the quantitative method, we expected to be able to obtain accurate results regarding the change of the variables' bid-ask spreads, depths, and trading volumes before and after the application of new tick sizes and the MTU.

2. Operational Definitions and Variables

2.1. Bid-Ask Spread

The most common way used to measure the spread is by calculating the difference between the best bid and the best ask price to obtain a rupiah spread, and divide this by the median value of the stock quote (Purwoto & Tandelilin, 2004).

Bid-ask spread (rupiah) = Aj,t – Bj,t

$$\text{Bid-ask spread (percent)} = \frac{A_{j,t} - B_{j,t}}{(A_{j,t} + B_{j,t})/2} \times 100\% \quad \ldots 1$$

Aj,t = Best ask price for stock j on day t

Bj,t = Best bid price for stock j on day t

2.2. Depth

The standard depth measurement is found by calculating the ask-depth (the volume of stocks at the best ask price) and the bid-depth (the volume of stocks at the best bid price). Depth is measured separately because depth changes may be asymmetric between the ask-depth and bid-depth (Purwoto and Tandelilin, 2004).

Ask depth (sheets) = The volume of stock at Aj,t

Ask depth (percent) =

$$\frac{\text{The volume of stock at } A_{j,t}}{\text{The volume of listed stock j on day t}} \times 100\% \quad \ldots 2$$

Bid depth (sheets) = The volume of stock at Bj,t

Bid depth (percent) =

$$\frac{\text{The volume of stock at } B_{j,t}}{\text{The volume of listed stock j on day t}} \times 100\% \quad \ldots 3$$

Aj,t = Best ask price for stock j on day t

Bj,t = Best bid price for stock j on day t

2.3. Trading Volume

The trading volume is the volume of stocks traded by investors or capital owners in the stock market.

Trading volume (sheets) = The volume of stock j traded on day t

Trading volume (percent) =

$$\frac{\text{The volume of stock j traded on day t}}{\text{The volume of listed stock j on day t}} \times 100\% \quad \ldots 4$$

The imposition of new tick sizes and the MTU on the stock exchange is a variable that affects all three variables, namely the bid-ask spread, depth, and trading volume. Measurement of the pre-event period was recorded from the 8th of November, 2013, to January 3rd, 2014, and the post-event period was recorded from January 7th, 2014 until February 28th, 2014. There was an adjustment so that the number of days before and after the event were the same in order to obtain 37 days before the event, 37 days after the event, and the day of the event.

Table 3. Dependent Variable Measurement Methods

No.	Dependent Variables	Measurement Method
1	Bid-Ask Spread (percent)	$\frac{A_{j,t} - B_{j,t}}{(A_{j,t} + B_{j,t})/2} \times 100\%$
2	Ask Depth (percent)	$\frac{\text{The volume of stock at } A_{j,t}}{\text{The volume of listed stock j on day t}} \times 100\%$
3	Bid Depth (percent)	$\frac{\text{The volume of stock at } B_{j,t}}{\text{The volume of listed stock j on day t}} \times 100\%$
4	Volume (percent)	$\frac{\text{The volume of stock j traded on day t}}{\text{The volume of listed stock j on day t}} \times 100\%$

3. Sample

The sample is a part of the population (Boedijoewono, 2007, pp.130). The samples in each tick size group used a purposive sampling method to meet certain criteria. The criteria used are: (1) stocks were not delisted or had an IPO during the sample period. (2) Companies did not conduct corporate actions (cash dividends, stock dividends, mixed dividends, rights issues, stock splits, mergers, or acquisitions) during the sample period. (3) Stocks must have had a minimum of one quote and one trading frequency during the sample period.(4) There are no changes in the average stock price between the two periods that can lead to a tick group difference. (5) The stock's price average is equal to or more than Rp. 200 during the sample period.

A total of 355 stocks were removed from the total population of 493 stocks during the event period, with details as follows:

Trading frequency < 1 (274 stocks).

Bid ask quote < 1 (5 stocks).

IPO (9 stocks).

Delisting (1 stock).

Dividend (24 stocks), rights issue (7 stocks), stock split (5 stocks).

Price < Rp 200, (24 stocks).

Different tick group (6 stocks).

Therefore, based on the criteria that have been mentioned, we obtained a sample of 138 stocks, which are presented in Table 4.

Table 4. Sample Distribution

Tick Group	Number of Samples	Stock Code
Tick Rp. 1 (Rp 200, up to < Rp. 500)	44	ADMG, AMAG, APLN, ASSA, BCIP, BEST, BHIT, BJTM, BRMS, BRPT, BUMI, CENT, CFIN, CNKO, COWL, CPGT, DILD, DYAN, EKAD, ELSA, GIAA, INTA, JAWA, JTPE, KIJA, KRAS, KREN, LCGP, LMPI, META, MLPL, MTLA, NIRO, PANR, PWON, SDMU, SMBR, SRIL, SUGI, TBLA, TMPI, TRIS, VIVA, WEHA
Tick Rp. 5 (Rp500, up to < Rp. 5000)	78	ACES, ADES, ADHI, AISA, AKRA, ALDO, ANTM, APEX, APIC, ARII, ARNA, ASGR, AUTO, BBMD, BBNI, BBTN, BDMN, BISI, BJBR, BMTR, BNGA, BSDE, BTEK, CLPI, CMNP, CPIN, CTRA, CTRP, CTRS, DNET, DSNG, ECII, ERAA, EXCL, FASW, GJTL, HEXA, HRUM, INCO, INDY, INKP, INVS, ISAT, JPFA, KAEF, KKGI, KLBF, LSIP, MAYA, MBSS, MEDC, MPMX, MPPA, NOBU, NRCA, PADI, PGAS, PLAS, PNBN, PTPP, PTRO, RALS, SAME, SGRO, SIMP, SMCB, SMRA, SSIA, TAXI, TELE, TINS, TLKM, TOTL, TRAM, ULTJ, WIIM, WIKA, YPAS
Tick Rp. 25 (≥ Rp. 5000)	16	AALI, ASII, BBRI, BMRI, GGRM, ICBP, INDF, INTP, ITMG, LPPF, MAPI, PTBA, SMGR, SMMT, TBIG, UNTR

Source: Secondary data processed from the IDX, 2014.

The data collection method used in this research was secondary data. The data was processed statistically using secondary data obtained from the IDX data center, which can be downloaded from http://www.idx.co.id.

4. Analysis Method

In conducting a statistical test, there are certain steps that must be followed.

4.1. Normality and Homogeneity Test

One of the hypothesis tests used was the parametric paired t-test. Several groups of researchers have argued that if the t-test does not meet certain assumptions, the results are not robust. Testing via the parametric paired t-test was based on the assumption that the average difference of the data sets had a normal distribution, and the variance were homogeneous (Field and Miles, 2009, pp.273; Morgan et al, 2011, pp.148; Munich and Hilbe, 2010, pp.478; Mitchell and Jolley, 2012, pp.407). The data are normally distributed if:

Z Skewness and Z Kurtosis $\leq |1.96|$

Kolmogorov-Smirnov is not significant (≥ 0.05)

Shapiro-Wilk is not significant (≥ 0.05) (Field, 2013, pp.184-185; Ho, 2013, pp.57).

The variance is homogenous if Levene is not significant (≥ 0.05) (Field, 2013, pp.193-194).

4.2. Data Transformation

Data transformation is a mathematical operation to change each value of a data set into a new data set. Transformation is used to normalize data and eliminate the influence of the data outliers. To determine the appropriate transformation technique, researchers first need to know the shape of the histogram and the values of Z Skewness and Z Kurtosis. For data sets that experienced a moderate positive skew, a logarithmic transformation can be used (Sheskin, 2003, pp.406). In order for the data set not to experience a large reduction in its resolution, then the natural logarithm (ln) transformation is used.

Philosophically, outlier data is maintained if it represents the population; therefore, this study retained samples that had been collected previously. The treatment used to minimize the influence of the data outliers of this study was the ln transformation, which was described in the previous paragraph. The ln transformation is better than removing/winsorizing the extreme data that would make the research biased.

4.3. Hypotheses Testing

A parametric paired t-test was used to investigate the change in the mean value. A non-parametric Wilcoxon sign test was used to amplify the t-test (in the group that did not pass the test for normality or homogeneity) and to examine the proportion of the shares that changed (Purwoto and Tandelilin, 2004). The non-parametric test was not intended to accept or reject the hypotheses, but only to reinforce the results of the t-test that had been carried out in advance so that if there were no significant results from the parametric test, but significant results from the non-parametric test, the results used to accept or reject the hypotheses were still the results of the parametric test. The confidence interval used was 95% and α of 0.05.

Ⅳ. Results

1. Descriptive Statistics

Before discussing hypotheses testing, we will first review the data distribution condition of each variable. Descriptive statistics provide a picture, or a description, of the data that is visible from the average value (mean), standard deviation, maximum, and minimum.

Table 5 shows that the only feasible data to use to perform the hypotheses testing is the bid-ask spread data set because the standard deviation value is much smaller than the mean value. For the data sets of ask-depth, bid-depth, and volume, the standard deviation is very large, which means that there is an extreme value in the data that is not feasible for further processing

when not employing transformation, or elimination of extreme values. In Tick Rp. 25, the data set is still eligible to be processed statistically, but it will still be transformed for uniformity.

The data transformation will be performed on ask-depth, bid-depth, and volume for each tick group. Only the bid-ask spread data set is not transformed because the distribution of that data is quite good. Therefore, because there were no negative values, then the logarithmic transformation can be used to normalize the data.

Table 5. Descriptive Statistics

No.	Tick Group	Variables	Minimum	Maximum	Mean	Std. Deviation
1	All Samples	Spread	0.34026%	2.53509%	0.95424%	0.41191%
2		Ask Depth	0.00037%	0.04678%	0.00926%	0.00861%
3		Bid Depth	0.00042%	0.23941%	0.01193%	0.02301%
4		Volume	0.00176%	1.91482%	0.20281%	0.31247%
5	Tick Rp. 1	Spread	0.71843%	2.53509%	1.19763%	0.39860%
6		Ask Depth	0.00134%	0.04678%	0.01247%	0.01003%
7		Bid Depth	0.00102%	0.06521%	0.01382%	0.01342%
8		Volume	0.00503%	1.91482%	0.25554%	0.40207%
9	Tick Rp. 5	Spread	0.37710%	2.42167%	0.88900%	0.37710%
10		Ask Depth	0.00037%	0.03934%	0.00846%	0.00793%
11		Bid Depth	0.00042%	0.23941%	0.01262%	0.02870%
12		Volume	0.00176%	1.63973%	0.19421%	0.28181%
13	Tick Rp. 25	Spread	0.34026%	1.08027%	0.60294%	0.19152%
14		Ask Depth	0.00144%	0.00955%	0.00430%	0.00241%
15		Bid Depth	0.00143%	0.00581%	0.00332%	0.00126%
16		Volume	0.05021%	0.15353%	0.09969%	0.02762%

Source: Secondary data processed from the IDX, 2014.

2. Hypothesis Test of the Bid-Ask Spread Variable

First, the average time series data for the bid-ask spread was calculated in the pre-event period and the post-event period for each stock code. Two statistical tests were performed, namely the parametric paired t-test and the non-parametric Wilcoxon sign test. These tests were performed using the IBM SPSS v20 program, and the following are the test results.

The results of the hypotheses testing for all categories were very convincing, rejecting the null hypotheses and accepting the alternative hypotheses with p-values significant at the 0.01 level. Table 6 also shows that the smaller the tick size, the greater the decline in spreads. Overall results of the hypothesis testing in this section are as follows:

Hypothesis 1 (H1) was accepted.
Hypothesis 1a (H1a) was accepted.
Hypothesis 1b (H1b) was accepted.
Hypothesis 1c (H1c) was accepted.

Table 6. Paired t-Test and Wilcoxon Sign Test Results for Bid-Ask Spread

	Paired t-Test				Wilcoxon Sign Test	
Tick Group	**Before**	**After**	**Diff**	**t-Statistic**	**% Stock Decrease**	**z-Statistic**
All Samples	1.316%	0.598%	-0.718%	19.374***	97.83%	-10.100***
Tick Rp. 1	1.782%	0.622%	-1.160%	23.092***	100.00%	-5.777***
Tick Rp. 5	1.171%	0.612%	-0.559%	16.293***	96.15%	-7.548***
Tick Rp. 25	0.742%	0.465%	-0.277%	6.641***	100.00%	-3.516***

*Significant at the 0,10 level (one tailed)

**Significant at the 0,05 level (one tailed)

***Significant at the 0,01 level (one tailed)

3. Hypothesis Test of the Ask-Depth Variable

First, the average time series data for the ask-depth was calculated in the pre-event and post-event period for each stock code. Then, the ln transformation and two statistical tests were performed, namely the parametric paired t-test and the non-parametric Wilcoxon sign test. These tests were performed using the IBM SPSS v20 program, and the results of the calculation are shown in Table 7. The results of hypothesis testing showed all categories decreased, but the tick size of Rp. 25 was only significant at the 0.10 level, and therefore cannot reject the null hypotheses. In the category of all samples, te tick size Rp. 1 and tick size Rp. 5 convincingly rejected the null hypotheses and accepted the alternative hypotheses with a p-value significant at the 0.01 level.

Table 7. Paired t-Test and Wilcoxon Sign Test Results for Ask Depth

	Paired t-Test				Wilcoxon Sign Test	
Tick Group	**Before**	**After**	**Diff**	**t-Statistic**	**% Stock Decrease**	**z-Statistic**
All Sample	0.008%	0.004%	-0.004%	9.410***	79.71%	-7.610***
Tick Rp. 1	0.014%	0.004%	-0.010%	13.582***	97.73%	-5.753***
Tick Rp. 5	0.006%	0.004%	-0.002%	4.559***	73.08%	-4.216***
Tick Rp. 25	0.004%	0.003%	-0.001%	1.575*	62.50%	-1.448*

*Significant at the 0,10 level (one tailed)

**Significant at the 0,05 level (one tailed)

***Significant at the 0,01 level (one tailed)

At tick size Rp. 25, ask-depth did not decline significantly, and it showed increases during the last days of the period. Table 7 also shows that the smaller the tick size, the greater the decline in the ask-depth. The overall results of the hypothesis testing in this section are as follows:

Hypothesis 2 (H2) was confirmed.
Hypothesis 2a (H2a) was confirmed.
Hypothesis 2b (H2b) was confirmed.
Hypothesis 2c (H2c) was rejected.

4. Hypothesis Test of the Bid-Depth Variable

First, the average time series data for bid-depth was calculated in the pre-event and post-event periods for each stock code. Then, the ln transformation and two statistical tests were performed: namely, the parametric paired t-test and the non-parametric Wilcoxon sign test. The tests were performed using the IBM SPSS v20 program, and the results of the calculations are shown in Table 8.

The results of the hypothesis testing in all categories very convincingly rejected the null hypotheses and accepted the alternative hypotheses with a p-value significant at the 0.01 level. Table 8 also shows that the smaller the tick size, the greater the decrease in the bid-depth. Overall results of the hypothesis testing in this section are as follows:

Hypothesis 3 (H3) was accepted.
Hypothesis 3a (H3a) was accepted.
Hypothesis 3b (H3b) was accepted.
Hypothesis 3c (H3c) was accepted.

Table 8. Paired t-Test and Wilcoxon Sign Test Results for Bid Depth

	Paired t-Test				Wilcoxon Sign Test	
Tick Group	**Before**	**After**	**Diff**	**t-Statistic**	**% Stock Decrease**	**z-Statistic**
All Sample	0.008%	0.004%	-0.004%	10.984***	80.43%	-8.400***
Tick Rp. 1	0.014%	0.003%	-0.011%	13.534***	95.45%	-5.742***
Tick Rp. 5	0.007%	0.004%	-0.002%	5.802***	71.79%	-4.973***
Tick Rp. 25	0.004%	0.002%	-0.001%	3.369***	81.25%	-2.430***

*Significant at the 0,10 level (one tailed)

**Significant at the 0,05 level (one tailed)

***Significant at the 0,01 level (one tailed)

5. Hypothesis Test of the Trading Volume Variable

First, the average time series data for the trading volume was calculated in the pre-event and post-event periods for each stock code. Then, the ln transformation and two statistical tests were performed: namely, the parametric paired t-test and the non-parametric Wilcoxon sign test. The tests were performed using the IBM SPSS v20 program, and the results of the calculations are shown in Table 9. The hypothesis test results indicated that there were different outcomes associated with the predicted direction, and there were no significant results at the level of 0.05 in the t-test,

only the fraction of Rp. 1 and Rp. 5 were significant at the 0.10 level, and therefore cannot reject the null hypotheses.

The above results showed that the increase in the volume of the post-event period was not significant, even with a decrease in volume which occurred at a tick size of Rp 1. The best results were obtained at tick size Rp 5, wherein the volume increased after a period of significant events at the level of 0.1, but it did not make the alternative hypotheses acceptable. The overall results of hypothesis testing in this section are as follows:

Hypothesis 4 (H4) was rejected.
Hypothesis 4a (H4a) was rejected.
Hypothesis 4b (H4b) was rejected.
Hypothesis 4c (H4c) was rejected.

Table 9. Paired t-Test and Wilcoxon Sign Test Results for Trading Volume

	Paired t-Test				Wilcoxon Sign Test	
Tick Group	**Before**	**After**	**Diff**	**t-Statistic**	**% Stock Increase**	**z-Statistic**
All Sample	0.087%	0.090%	0.003%	-0.664	59.42%	-1.329*
Tick Rp. 1	0.102%	0.088%	-0.014%	1.497*	45.45%	-1.132
Tick Rp. 5	0.079%	0.090%	0.010%	-1.583*	64.10%	-1.880**
Tick Rp. 25	0.089%	0.100%	0.012%	-1.210	75.00%	-2.017**

*Significant at the 0,10 level (one tailed)

**Significant at the 0,05 level (one tailed)

***Significant at the 0,01 level (one tailed)

V. Discussion and Conclusion

1. Discussion

When the spread decreases, depth increases, and volume increases; the increase in the liquidity can be clearly understood to be a result of the new tick size policy of the IDX. The results of this study revealed that the spread and depth decreases, while the volume did not differ significantly, so we cannot be sure that an increase in liquidity occured. The decline in the spread and depth confirmed the research of Ahn et al. (1996), Bessembinder (2000), Goldstein and Kavajecz (2000), Purwoto and Tandelilin (2004), Ekaputra and Ahmad (2007), and Alampieski and Lepone (2009). Because both variables (spread and depth) decreased, the effect of a change or reduction in the tick size became ambiguous. Reduction of the spread is clearly beneficial to small investors who trade on best quotes, whereas for large investors, the spread reduction does not mean that trading costs become cheaper. Harris (1994) revealed that a decrease in the spread does not mean that liquidity is increased.

Purwoto and Tandelilin (2004) and Ekaputra and Ahmad (2007) used trading activity to measure liquidity. The use of trading activity was not suitable

for use in this study because, in addition to changes in tick size, the IDX also changed the MTU. To achieve a 500 sheet transaction under the old policy, investors only had the choice of a one-time transaction, while with the new policy, an investor can perform five transactions to reach 500 sheets. This makes the use of trading activity biased, and it has a tendency to increase without there being any change in trading volume. Therefore, researchers used a trading volume variable to measure liquidity.

Spread and depth were reduced, making the results of this study ambiguous, especially when coupled with the trading volume difference, which was not significant; therefore, we needed a mechanism to calculate the overall effects of the spread and depth. Purwoto and Tandelilin (2004) calculated the ratio of the depth-to-spread before and after the event using the average of the ask-depth and bid-depth, then dividing by the spread; these results are presented in Table 10.

Table 10. Paired t-Test and Wilcoxon Sign Test Results for the Depth-to-Spread Ratio

	Paired t-Test				Wilcoxon Sign Test	
Tick Group	**Before**	**After**	**Diff**	**t-Statistic**	**% Stock Increase**	**z-Statistic**
Whole Sample	0.690%	0.795%	0.104%	-2.319**	59.42%	-2.209**
Tick Rp. 1	0.871%	0.729%	-0.142%	1.869**	38.64%	-1.809**
Tick Rp. 5	0.634%	0.859%	0.226%	-3.600***	69.23%	-3.579***
Tick Rp. 25	0.554%	0.688%	0.133%	-1.960**	68.75%	-1.706**

*Significant at the 0,10 level (one tailed)

**Significant at the 0,05 level (one tailed)

***Significant at the 0,01 level (one tailed)

The depth-to-spread ratio calculation results were consistent with the results from the trading volume hypothesis test, where tick size Rp. 1 had a different direction compared to other tick size groups. For all samples, tick size Rp. 5 and tick size Rp. 25 had calculated results that showed that the average depth-to-spread ratio in the post-event period was greater than in the pre-event period. This meant that the tick size and the MTU policy from the IDX increased the stock liquidity of tick size Rp. 5 and tick size Rp. 25, but decreased the liquidity of the stock of tick size Rp. 1. However, the overall liquidity of all stocks in the sample increased. The increased liquidity of the stocks of tick sizes Rp. 5 and Rp. 25 was also supported by the results of the sign test that presented a high proportion of the sample that experienced an increase in its trading volume and depth-to-spread ratio.

The reason behind the liquidity decrease for Rp. 1 can be explained by Grossman and Miller (1988), who argued that the tick size should be high enough to maintain a competitive supply. Harris (1997) found that a reduced tick size, although of benefit to some liquidity demanders, harmed some liquidity providers, thus reducing their desire to provide liquidity. Transaction cost is the reason why liquidity providers lost the desire, because if we assume that the selling

cost was at 0.35%, and they would only recoup 0.50%, their profit would only be 0.15%, which makes them tend to hold assets for a longer period in hopes of recouping more later. The increased liquidity of tick sizes Rp. 5 and Rp. 25 can be understood not only because of the tick size reduction but also because of the MTU reduction. The MTU has an impact on the trading volume because a smaller MTU enables investors to make transactions using fewer funds so that they can buy the more expensive stocks, although only in small quantities.

Policy changes to tick size and the MTU are proven to increase the liquidity of all stocks in the sample as a whole, although they have a negative impact on the tick size of Rp. 1, but a positive impact on the other groups. This result of tick size reduction is also consistent with previous research, in which the bid-ask spread, ask depth, and bid depth decreased significantly, and the trading volume increased as well, although not significantly. The results of this study cannot be separated from the limitations of the study. Firstly, this study only focused on three variables of liquidity of bid-ask spread, depth, and trading volume. Secondly, this study consisted of a 75 day observation period, from November 8th, 2013 to February 28th, 2014. Thirdly, this study did not take into account macroeconomic indicators such as interest rates, exchange rates, inflation, and other factors that may have an effect, especially on the trading volume variable. Fourthly, the results of this study could only predict the direction and ratio, but were unable to answer whether the new policy would be likely to increase or decrease the liquidity, and which group would experience a greater impact.

2. Conclusion

Based on the test results and discussion, the conclusions are as follows:

Hypothesis 1 (H1) was accepted. There was a smaller bid-ask spread average in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed. All parts of the hypothesis (H1a, H1b, and H1c) were also accepted.

Hypothesis 2 (H2) was accepted. There was a smaller ask depth average in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed. Only one part of the hypothesis (H2c) was rejected because the result was not significant.

Hypothesis 3 (H3) was accepted. There was a smaller bid depth average in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed. All parts of the hypothesis (H3a, H3b, and H3c) were also accepted.

Hypothesis 4 (H4) was rejected. There was a greater trading volume average in all sample stocks (stocks with tick sizes of Rp. 1, Rp. 5, and Rp. 25) after the new policy was imposed, but the result was not significant. All parts of the hypothesis (H4a, H4b, and H4c) were also rejected. H4b and H4c were rejected because the result was not significant, and H4a was rejected mainly because the volume average decreased in the post event period.

Based on the depth-to-spread ratio, there was a tendency to increase the liquidity for all sample stocks and tick groups Rp. 5 and Rp. 25. There was a tendency to decrease the liquidity for tick group Rp. 1.

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ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2019.15.1.61

Journal of Global Business and Trade

https://www.pfw.edu/jgbt

Feed Supply Sourcing Practices and Strategies of Commercial Swine Farms in the Philippines: Trade Insights and Implications

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Received 25 January 2019, Revised 18 April 2019, Accepted 25 May 2019

ABSTRACT

Purpose – Feeds comprise the majority of swine production expenses, and it has been the goal of livestock farmers to acquire feeds with the best value. This paper identified and analyzed the feed supply sourcing practices and strategies of commercial swine farms in a major hog-producing municipality in Bulacan, a province in the northern Philippines.
Design/Methodology/Approach – Small, medium, and large commercial swine farms from Sta. Maria municipality in Bulacan province, 34 in all, were the study subjects. A descriptive method of inquiry/investigation was employed in the study using questionnaires in data gathering. Data was analyzed through mean, mode, frequency counts, and cross tabulation while a Chi-square Test of Independence and Cramer's V were also used to scrutinize relationships between significant data results.
Findings – Four feed supply sourcing strategies were identified in the study, namely (1) self-production of feeds (64.7% of the farms), (2) buying unbranded feeds (23.5%), (3) buying branded feeds only for piglets' pre-starter and booster feeds while self-producing the rest (23.5%), and lastly, (4) buying feeds from commercial feed mills (11.8%). As the scale of an operation increases, self-production of feeds becomes more prominent due to its overall lower cost, while for farms with a smaller scale of operation, buying unbranded feeds is the more dominant practice due to its lower capital requirement and the relatively lower cost of unbranded feeds compared to those branded. Balance (quality and price) is the decision criterion mostly used by swine farms when choosing feed suppliers. Scale of operation, type of ownership, and years in operation are significant variables associated with the feed sourcing strategy used by commercial swine farms.
Research Implications – Few studies focus on the feed supply sourcing of swine farms. Many of the recent studies focus on production, success factors, profitability, technologies, and new farming systems. This study addresses the feed supply sourcing research gap by focusing on the different practices and strategies pertaining to the feed supply sourcing of commercial swine farms. Such insights have crucial and strategic trade implications on the part of feed ingredient and feed suppliers in the country, and it defines specific opportunities for government support as well.

Keywords: feed supply, Philippines, swine farms, trade
JEL Classifications: L23, L69, Q13

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I. Introduction

The swine industry is a major player in the Philippine agriculture sector as it ranks next to rice in terms of agricultural contribution (PCAARRD, 2016). Globally, the Philippines ranks 8th among top swine producers according to the Department of Agriculture - Foreign Agricultural Service (USDA-FAS) (2017). There is no doubt that due to the continuous increase in pork consumption worldwide, the demand and the consequent attention given to the swine industry, not just locally, but worldwide, shall not cease. The shift of the basic human diet to meat consumption and the continuous growth of the population rationalize this increase in pork demand.

The challenges in the local swine industry right now are brought about by continuous increases in input prices such as feeds and medications, stricter policies, pork importation, pork smuggling, and the weakening of trade barriers within Southeast Asian Countries, among other factors, which pose a significant threat to the growth and competitiveness of the industry. Although it was observed that significant academic attention was already given to the industry as studies and research regarding different aspects of the industry give the industry greater potential and possible growth, there are still many aspects of swine production and the industry which researchers still need to shed light on: most specifically, on the feed sourcing aspect.

Feed comprises roughly 60% of the overall cost in swine production (PCAARRD-DOST, 2017). In other literature, it is estimated that this value could increase up to 80% of the total cost of swine production, depending on various factors. However, the prices of feeds, along with other commodities, have increased rapidly in the previous years. This brought significant pressure to the industry as it was already established that feeds account for the majority of the costs in swine production. In line with these facts, it is undeniable that the feed industry plays a major role in the determination of the performance of the swine industry.

Despite this significant relationship between the two, there are few studies focusing on the different aspects of feed supply sourcing of swine farms. Many of the recent studies focus on production, success factors, profitability, technologies and new farming systems. Thus, this study attempts to address the feed supply sourcing research gap by focusing on the other aspects and strategies of feed supply sourcing of swine farms.

This study answered this general research question; "What are the different aspects and factors in feed supply sourcing of commercial swine farms in Sta. Maria, Bulacan?" Specifically, the study addressed the following questions:

a. What are the profiles of the farms, and who are the feed purchasing decision-makers of commercial swine farms in Sta. Maria, Bulacan, Philippines?
b. What are the characteristics of commercial swine farms in the area in terms of production systems and scale of operation?
c. What are the current supply sourcing practices and strategies of commercial swine farms?
d. What factors are considered in feed supply sourcing by the farms in the area?
e. What recommendations can be offered in terms of strategies and/or approaches to the problems and opportunities found in the feed supply sourcing of swine farms in the area?

The general purpose of this study was to analyze the different aspects in feed supply sourcing and usage of commercial swine farms in Sta. Maria, Bulacan. Specifically, the study aimed to:

a. present the profiles of the farm and feed purchase decision makers of commercial swine farms in Sta. Maria, Bulacan;
b. characterize the commercial swine farms in the area in terms of production systems adopted and scale of operation;
c. evaluate the current supply sourcing practices and strategies of the commercial swine farms;
d. discuss the factors considered in feed supply sourcing by the farms in the area;

e. and recommend strategies and/or approaches to the problems and opportunities found in the feed supply sourcing of swine farms in the area.

II. Overview of the Industry

1. Swine Industry

The Philippine swine industry is the second biggest contributor to Philippine agriculture, next to rice (PCAARRD-DOST, 2016). The industry amounts 18.28% of the total value of the country's total agricultural production. Moreover, the Philippines ranks 8th in global hog production, with a total production of 1,585,000 metric tons (MT) in 2017, according to the United States Department of Agriculture - Foreign Agricultural Service (USDA-FAS) (2017). These facts prove the irrefutable significance that the industry plays in Philippine agriculture.

In terms of production, the Central Luzon region holds the largest inventory of swine, at an 18.10% share in the overall swine inventory in the country according to the Philippine Statistics Authority (PSA, 2017). This is followed by the Calabarzon region which holds 12.69%, followed by the regions of Northern Mindanao, Bicol, and Davao, which hold 7.43, 7.35, and 7.02 percent of the total Philippine swine inventory, respectively (PSA, 2017). Furthermore, these five regions account for more than 50% of the country's total swine inventory, while 37.83% of the overall commercial swine farm inventory is situated in Central Luzon only (PSA, 2017). Bulacan is the top swine producing province in the whole country. It is located in the Central Luzon region, which holds a major part (18%) of the Philippine swine inventory.

2. Feedmilling Industry

For almost the entire livestock industry, particularly the swine and poultry industry, feeds are one of the most critical inputs. Moreover, feeds comprise a big portion of the costs of production in swine and poultry; roughly 60 percent of the total cost of producing eggs, pork, and poultry comes from feeds. This fact is the basis of the growth of the feedmilling industry, is a multi-billion-peso industry in the Philippines, as it also plays the same vital role in various animal and fish industries. Notably, the swine and poultry industries, which account for more or less of 80% of industry output, are its biggest clients. Thus, the feedmilling industry is one of the biggest and most organized support industries in the country (PCAARRD-DOST (2017).

III. Review of Related Literature

1. Supply Sourcing

According to Burke, Carrillo, and Vakharia (2006), effective supply sourcing is vital for a firm to properly manage its supply chain, and for the firm to retain its market value. Supply sourcing plays a vital role in maintaining a firm's productivity, profitability and competitiveness.The significance of supply sourcing, together with factors involved in swine farming, is undeniable as it was established already that up to 80% of costs in swine farming comes from feeds. A study done by Burke et al. (2006) involved supply sourcing factors (supplier-related) such as product prices, supplier costs, supplier capacities, historical supplier reliabilities, and firm-specific inventory costs. Some of these factors were included in this study.

2. Feed-Related Studies on Related Industries

In a study done by Britz (2012) on small-scale broiler farmers in South Africa, there were seven identified significant factors that influenced the purchase behavior of farmers relative to feeds. The seven supplier and product-based factors were enumerated as: value for money and opportunity; perceived brand value; customer support and service; consensus on available quality; brand loyalty; feed

price at the reseller; and bag size. Among the given factors, the study concluded that quality and price had score values of 83.6% and 76%, respectively, which meant that these two factors were very important for farmers, while size of packaging (66.6%), services (73%), promotion (64.60%), place (73%), and economics (62.80%) were rated by farmers as important. Brand category (59.2%), climate (46.40%), and special event (39.80%), on the other hand, were rated by farmers as not very important.

Another study done by Borchers et al. (2012) have shown that for crop expendable products, four buying behavior segments were found. The four segments were enumerated by the authors as: (1) convenience, (2) price, (3) performance, and (4) balance. On the other hand, for the livestock producers, three (3) segments were found: namely, (1) balance, (2) price, and (3) performance. For the balance segment, the factors were enumerated as convenience, customer service, price, performance, and support services were weighed by the farmers as they decided on buying feeds for their farms. The study has shown that almost 60% of the farmers exhibited the "balance segment", while 21.7% and 19.9% displayed the performance (quality) and price segments, respectively.

The product and supplier-based factors enumerated by Borchers et al. (2012), such as convenience, customer service, price, performance, and support services, were considered in this study as some of these factors appear to be applicable in the Philippine context.

IV. Methodology

A descriptive method of inquiry/investigation was used in this research. Complete enumeration of a total of 34 commercial swine farms in Sta. Maria, Bulacan, Philippines was involved in the study. The decision-maker or part of the deciding body in relation to the process of supply sourcing of feeds of each respective farm served as the respondent and/or the farm owner.

The list of all commercial swine farms in Sta. Maria was acquired through the Bureau of Permit and Licensing Office (BPLO) in the Municipal Hall of Sta. Maria in Bulacan province, Philippines. Primary data of the commercial swine farms in Sta. Maria, Bulacan, Philippines were gathered through the use of semi-structured questionnaires were administered either face-to-face or via phone call interviews with chosen respondents. A complete enumeration of the population of commercial swine farms was used in the study.

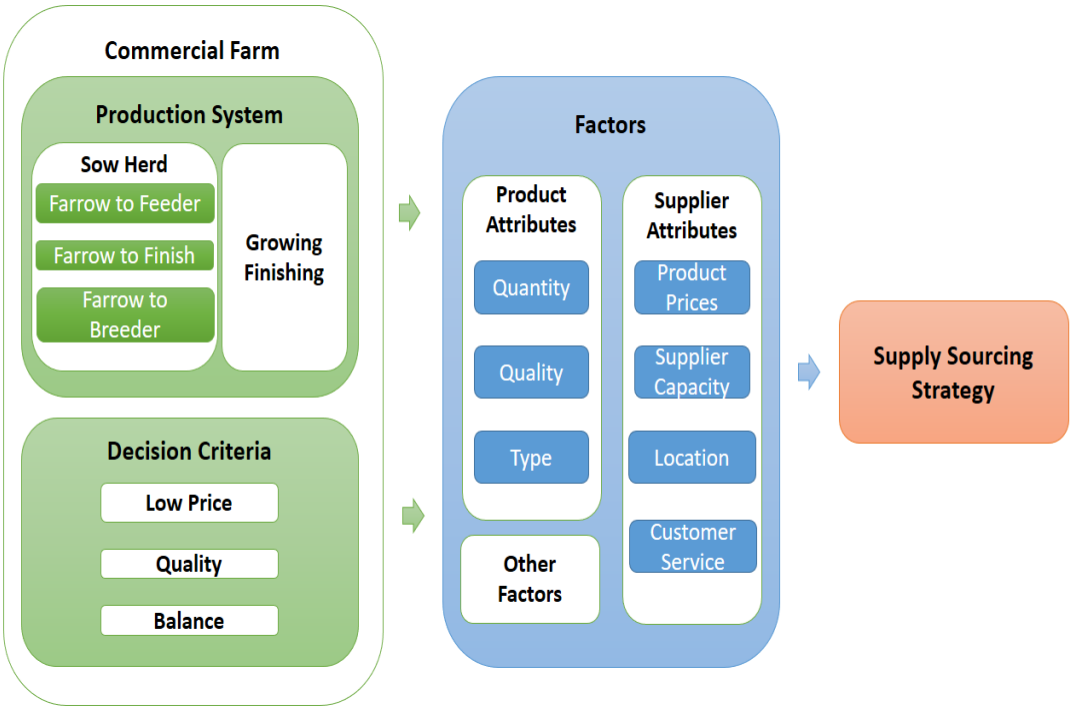
Descriptive statistical tools such as mean, mode, frequency counts, and percent distributions were used. Other statistical tools such as the Chi-square Test of Independence and Cramer's V were also used to scrutinize relationships between significant data results, especially on the profile-to-strategy relationships, while cross tabulation was also applied in data analysis.

The conceptual framework (Fig. 1) shows that the type of production system adopted by small commercial farms (growing-finishing and sow herd production system: farrow-to-feeder, farrow-to-breeder, and farrow-to-finish operations), which differ in requirements in terms of labor, capital, facility, and feed requirements, among others, contribute to the determination of the factors and the extent to which these factors affect the farmers on how they source feed supplies.

Price, quality, and balance were three segments/ criteria identified by Borchers et al. (2012) in livestock feed sourcing. This means that in terms of buying/ sourcing feeds, there are three types of farmers who prioritize each attribute accordingly. Price segments prioritize price most, performance or quality segments prioritize performance or quality most, while the balance segment balances both price and quality/ performance in making decisions regarding the sourcing of feeds. The priority or segment of the farmer determines the feed and supplier attributes that affect the farmer's decisions when it comes to supply sourcing.

This study also identified other factors specific to the Philippine setting which might not have been looked upon or identified by the studies of Borchers et al. (2012) in the USA, and Britz (2012) in South Africa.

Fig. 1. Conceptual Framework



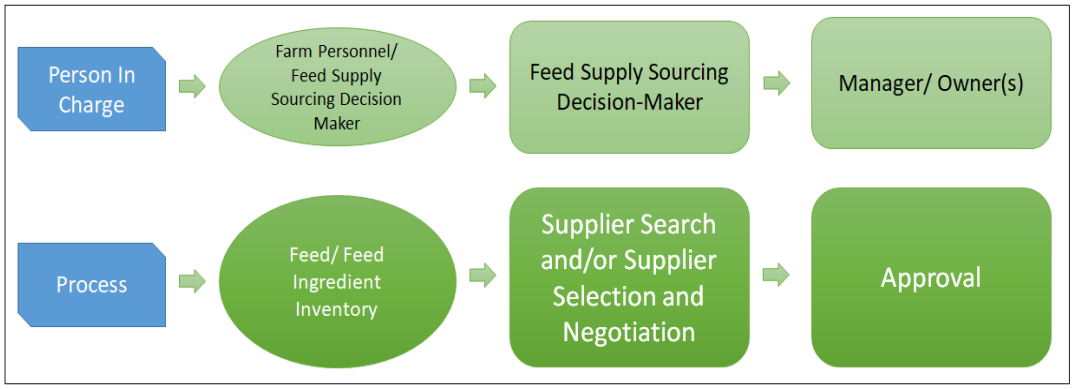
Sources: Adapted from Borchers et al. (2012), Britz (2012) and Aspile, Manipol, Depositario, and Aquino (2016).

V. Results and Discussion

1. Feed Supply Sourcing Decision-Making

The decision-making process usually starts with an inherent need for a feed supply for commercial swine farms. With this need, a supplier is chosen among the current pool of suppliers of feeds or feed ingredients, which could either be current suppliers or new entrants. This decision-making process varies from farm to farm, but usually, upon recognizing the need for a feed supply, the individual (this could be a farm personnel who is responsible in the feedmilling process) that keeps inventory of the level of stock/supply of either feeds or feed ingredients available on the farm gives notice to the feed supply sourcing decision-maker. The decision-maker then contacts his/her respective supplier and negotiates for the quantity and price, and then pays when the supplies arrive, or according to the terms of credit (if payment is through credit). The approval of a manager or owner(s) is required, especially when the supplier is a newly selected supplier (Fig. 2).

Fig. 2. Decision Making Process of Commercial Swine Farms in Feed Supply Sourcing



2. Feed Supply Sourcing Practices and Strategies (FSSPS)

The commercial swine farms in the area, in terms of feed supply sourcing, could either be farms which are (1) buyers of feeds, or "BF's", and (2) producers of their own feeds, or "PF's".

Out of 34 commercial swine farms, 12, or 35.2%, buy feed supplies, while 22 out of 34 (64.7%) of the farms produce their own feeds (S1) (see Fig. 3). This shows that the strategy of producing their own feeds, which is undoubtedly more profitable, was adhered to by the majority of the commercial swine farms. Despite this factor, other farms were still resorting to sourcing feeds from different suppliers. A majority of those who buy feeds are small commercial farms, while medium commercial swine farms comprise the majority of those who produce their own supply of feeds. Among the small commercial farms, only 5 out of 13, or 38.5%, were able to produce their own feeds, while among the medium-scale commercial swine farms, 16 out of 21, or 61.9%, were able to produce their own feeds. The only large commercial farm produces its own feeds.

Among the 12 farms (35.2% of all the farms) who buy their supply of feeds, only 4 (33.3% of BF farms, or 11.8% of all the farms) were currently buying commercial or branded feeds (S4), while 8 farms (66.7% of BF farms, or 23.5% of all the commercial swine farms) buy unbranded feeds (S2). It is clear that the majority of those who buy feed supplies were currently buying unbranded feeds from other farms, cooperatives, and unbranded feedmilling companies. This could be attributed to the relatively cheaper cost of unbranded feeds given its justifiable quality proven or discovered by the commercial swine farm through long experience in the industry. However, for those farms buying commercial feeds, certain feed brands were prominent. It was common among commercial swine farms buying commercial feeds to have well-established long-time partnerships or close relationships with the aforementioned feed mills. Half of those who adhere to this strategy are small-scale commercial firms, while the other half are medium-scale commercial swine farms.

It was also discovered in the study that 8, or 23.5%, of all commercial swine farms adhere to a strategy of buying commercial feeds for their pre-starter and booster feeds (S3), which are the very first rations fed to piglets, while producing the rest of their feed requirements. These farms are usually medium-scale commercial farms with linkages to well-known feed brands. The rationale behind this strategy is the assurance of safety and reduced digestive complications that commercial feeds bring to the piglets, unlike uncooked, unbranded feeds.

It was likewise observed that some commercial swine farms were able to sell the feeds that they produce to other swine farms. Usually, these farms are proximate, small, and/or backyard farms which house

about 1-41 heads of pigs. Still, some commercial farms were also buying feeds from farms able to produce their own feeds.

The prominent strategies being adhered to by the commercial swine farms in the area can be summarized into four groups:

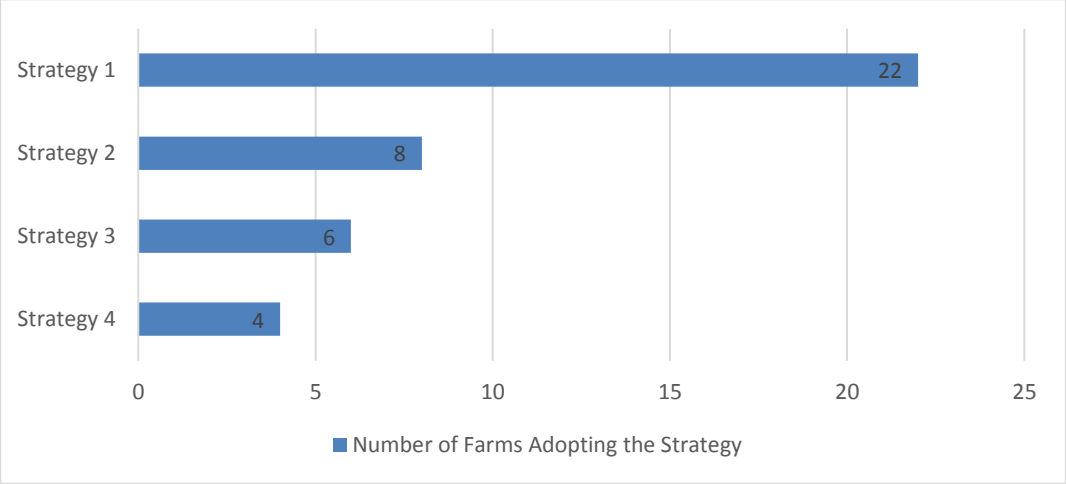
Self-production of feeds (64.7%) (NOTE: 41.2% solely used this strategy)

Buying of unbranded feeds (23.5%)

Buying commercial feeds only for piglets', pre-starter and booster feeds, while self-producing the remainer of feeds (23.5%)

Buying branded feeds (11.8%)

Fig. 3. Strategy Adopted by Commercial Swine Farms



3. Advantages and Disadvantages of Each Feed Supply Sourcing Strategy

For Strategy 1 (S1- self-production of feeds), the most valuable advantage according to respondents is its overall lower cost. Since feeds are the major expense in swine farming, there is therefore an undisputable importance in reducing this expense. Another advantage of S1 is the knowledge and assurance possessed by the farm with regards to the price, quality, and quantity of their feeds since they produce it themselves. This knowledge reduces, to some extent, specific uncertainties (e.g. supply, demand, quality and price) which could have been present if the feeds were bought. All these advantages are at the expense of greater capital requirements and greater management stress or effort since supplies of different input materials would have to be managed by the farm itself.

For Strategy 2 (S2- buying of unbranded feeds), the relatively lower cost of unbranded feeds (as compared to branded ones), less capital requirement, and less management stress or effort required are the most pronounced advantages. All of these advantages are at the expense of disadvantages such as the perceived lower quality of unbranded feeds (as compared to branded feeds) and additional effort in establishing or searching for a quality supplier of unbranded feeds.

Strategy 3 (S3- buying branded feeds for pre-starter and booster feeds only while self-producing the rest), brings advantages to the farm such as (1) the assurance of high quality pre-starter and booster feeds which will (2) reduce digestive problems which commonly strike piglets when fed with uncooked feeds, (3) savings due to the production of the rest of the feeds, and (4) additional perks being offered by commercial brands, such as free vacations at the expense of disadvantages such as (1) additional effort

in branded pre-starter and booster feed procurement, (2) greater capital requirement in establishing the feedmilling facility, and (3) relatively expensive branded pre-starter and booster feeds.

The advantages brought about by Strategy 4 (S4-buying of branded feeds) are (1) the assurance of high-quality feeds, (2) high bargaining power with a long-time partner commercial feedmill, (3) an established "fit" between a long-time partner commercial feedmill, which makes transactions more efficient between the two parties, and (4) less management effort. The disadvantage is the high cost of branded feeds.

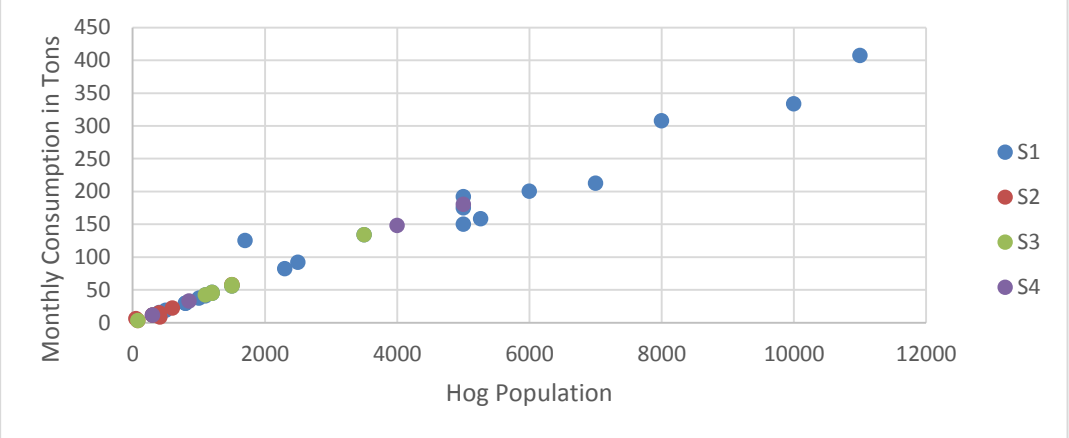
4. Population and Volume Utilization of Feeds in Relation to Feed Supply Sourcing Strategy

The volume utilization of feeds was derived through the responses of those who were able to compute their monthly and/or yearly feed utilization. As it can be observed in the graph (Fig. 4), swine farms with higher populations, naturally, are also the farms with greater feed usage. Farms which adhere to Strategy 1 are the farms with high populations and high feed consumption (as shown by the blue dots in the upper right part of the graph). Farms with more than 5,000 population and/or 180 tons of feed consumption per month are most likely swine farms applying Strategy 1. Still, some of those who apply Strategy 1 are present within the middle and the lower left part of the graph, which means that some of the small-scale and medium-scale commercial swine farms with less than 5,000 heads and 180 tons of feed consumptionwere still able to adhere to Strategy 1.

Commercial swine farms that adhere to Strategies 2 and 3 are usually found within the lower left parts of the graph, which means, that relative to farms who apply Strategy 1, these farms have a lower population and feed usage. Farms that apply Strategy 3 do not exceed a population of 3,500 and monthly feed consumption of 134 tons. On the other hand, farms that apply Strategy 4 are farms present in the lower left and middle part of the graph, which shows that some farms with relatively small populations (small commercial swine farms), and some with relatively high populations (medium-scale commercial swine farms), are applying Strategy 4.

Generally, as commercial swine farm hog population and feed consumption increase, commercial swine farms tend to adhere to self-production of feeds, while as when farm hog population and feed consumption are reduced, farms tend to adhere to the "buying feeds" strategy.

Fig. 4. Scatter Plot of Commercial Swine Farms According to Monthly Feed Consumption, Population, and Strategy Adopted



5. Summary of Feed Supply Sourcing of BF Farms

The feeds supplied to BF farms that apply Strategy 2 (buying of unbranded feeds) usually come from cooperatives, other farms which adhere to Strategy 1 (self-production of feeds), and unbranded feed milling companies. For those that apply Strategy 4 (buying of branded feeds) and/or Strategy 3 (buying of branded pre-starter and booster feeds), feed supplies come from commercial feedmills.

Although the pick-up type of mode of acquisition is present among farms that buy from cooperatives (these are the smallest among the commercial swine farms), the majority of the commercial swine farms get feeds delivered by their respective suppliers via the use of delivery trucks. The majority pay for feeds through credit with terms such as a 5% or 2% discount if paid within 30 or 60 days, and since the majority of the BF farms are small-scale commercial swine farms, the feeds are usually delivered every two weeks. Weekly delivery is prominent among medium-scale commercial swine farms under the BF category since they feed more hogs, and thus deplete their feed supply more quickly, while the daily acquisition schedule is done by those who pick up feeds from cooperatives, usually through the use of motorcycles. Upon reaching the swine farm, the feeds are then stored and/or prepared for the swine feeding schedules.

6. Summary of Feed Supply Sourcing of PF Farms

For those who apply Strategy 1 and Strategy 3, macro ingredients such as corn, wheat, and soya usually reach commercial swine farms through middlemen or a middle entity. In contrast to the common notions on middlemen as "evil", these middle entities actually play a significant and beneficial role from the perspective of commercial swine farms.

For corn, the supplies usually come from Ilocos, Isabela, Tuguegarao, Pangasinan, Cagayan, Bocaue (all in northern Philippines), and Bukidnon (in southern Philippines). Ilocos, Isabela, and Tuguegarao were the most frequent sources of corn supplies according to commercial swine farms in Sta. Maria, Bulacan. The corn supplies from these provinces are usually gathered by agents for the majority, although specific enterprises were also able to supply corn to some farms in the area.

When it comes to soya, the majority of supplies come from the USA, although some farms have stated that the middlemen were also able to get soya from Argentina. Soya coming from the USA is perceived to be of superior quality as compared to soya from other countries. Among the enterprises which serve as importers of soya, a large integrator was able to cater to a majority of farms in the area. Still, other enterprises were able to supply soya to some farms in the area.

Wheat, which is usually a substitute for corn whenever corn prices or supply fluctuate, usually comes from Ukraine, Australia, and Russia. The same enterprises supply this commodity, and a large integrator dominates in the area as well.

When it comes to micro-ingredients, a number of enterprises supply commercial swine farms in the area. Middlemen are not present when it comes to micro-ingredients, and this could be attributed to the fact that these manufacturing companies were able to transact directly with commercial swine farms, and their locations are not far from the area.

Macro-ingredients are usually delivered by middlemen to a farm, while micro ingredients are usually picked up by the farm directly from the company store. When it comes to payment, macro-ingredients are paid for in cash by the majority of the farms, while micro ingredients are paid through credit with terms by a majority of the farms.

The schedule of feed acquisition of a majority of the farms is either based on a (1) re-order point (a method where supplies are ordered upon reaching a specific supply level threshold), (2) a reorder point and factor dependent, and (3) every two or three weeks. Still, some of the farms were solely factor dependent.

7. Priority Decision Criterion

Commercial swine farms were almost unanimous in ranking the decision criteria which they consider in feed supply sourcing. About 94.1% ranked balance of price and quality as the best description of their decision criteria in feed supply sourcing, while 88.2% ranked quality as the second-most priority among the decision criteria. Furthermore, price was ranked by 88.2% as third among the three choices.

8. Priority Supplier Characteristics and Services

The modes (Strongly Agree) of the priority supplier characters and services show that (1) the offering of delivery services, (2) building of good relationship and trust, and (3) acceptance of credit with terms of payment method were commercial swine farms' most prioritized supplier characteristic and services (see Table 1).

The suppliers' capacity to supply the amount of needed products, provide the highest quality products, offer promos and discounts, and provide adequate technical guidance fell in the "agree" category, which states that these factors are indeed a basic yet necessary priority in commercial swine farm supplier selection.

When it comes to lowest product prices as a priority supplier attribute, the mode of the answers of the respondents fell in the "slightly agree" (SLA) category. This response of "agree" became the mode of "highest quality product", and justifies the previous results which state that the best decision criteria that applies to swine farms were the "balance of price and quality", and that "quality" by itself is second, and "price" by itself is only third. Farmers slightly agreed that they still prioritize suppliers who provide the lowest product prices, but with a consideration of the quality that corresponds to the prices of the suppliers' products.

Table 1. Priority Supplier Attributes of Commercial Swine Farms in Sta. Maria, Bulacan, Philippines

Attribute/ Factor	Mode	Frequency
Builds Good Relationship and Trust	Strongly Agree	24
Offers Delivery	Strongly Agree	27
Capacity to Supply the Amount Needed	Agree	20
Highest Quality Products	Agree	15
Buy Feeds/Ingredients on Credit	Strongly Agree	18
Provides Adequate Technical Guidance	Agree	15
Offers Promos and Discounts	Agree	13
Can Supply Other Farm Needs, such as Medication and Equipment	Slightly Agree	12
Near/Accessible Location	Agree	10
Lowest Product Prices	Slightly Agree	13
Company/Brand Credibility	Neither Agree nor Disagree	10
Has the Brand of Feed I Want	Disagree	18

The nearness or accessibility of the supplier's location falls under the SLA category for the farms, and this indicates that although delivery services are being provided by suppliers, the farmers still prefer to have a nearby supplier. The capability of the suppliers to provide other farm supply needs such as medicines and equipment were slightly prioritized by the farms as well in supplier selection.

Contrary to literature, the availability of a specific brand from a supplier falls under "Disagree" since most of the farms do not actually buy branded feeds. Brand credibility falls under the "neither agree nor disagree" category for swine farms. This could also be attributed to the previous results which show that only a small percentage of the farms buy branded feeds.

9. Relationship Between Farm Variables and Strategy

The resulting p-value of the chi-square test shows that there is a statistically significant association between the scale of operation and the strategy of the farm. Furthermore, Cramer's V shows that the association between the scale of operation and strategy applied by farms is strong.

The resulting Cramer's V value shows that the association or relation between the ownership type and strategy applied by the commercial swine farm is also strong. The number of years in operation of the farm also showed significant relation to the strategy applied.

It was also found that the ownership type of commercial swine farms (corporate or sole proprietorship) has a statistically significant association with the strategy to produce or buy feeds by a commercial swine farm. Cramer's V shows that the relationship between years of operation of a farm is moderate (Table 2).

Table 2. P-values and Cramer's V Values Among Different Variables in Commercial Swine Farms in Sta. Maria, Bulacan, Philippines

Independent Variable	Dependent Variable	p-values	Cramer's V
Organizational Variables			
Scale of Operation	Strategy in feed supply sourcing	0.012* (significant)	0.432
Type of Ownership		0.018* (significant)	0.419
Years of Operation		0.028* (significant)	0.300
Personal Variables			
Educational Attainment	Strategy in feed supply sourcing	0.320	-
Gender		0.915	-
Age		0.563	-

Notes: 1. *,**, and *** represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively.
2. A Cramer's V equal to 1, but less than 0.3, means a weak association/relationship; values equal to 0.3 mean a moderate relationship, while values greater than 0.3 mean a strong relationship.

VI. Conclusion and Implications

Since it was found that the self-production of feeds was the most advantageous among all strategies, commercial swine farms should strive to adhere to this strategy. The government could provide technical and credit support to assist commercial farms in doing this. Small-scale commercial swine farms are especially in need of capital to scale operations and be able to produce feeds.

Farms currently producing feeds on their own should be able to upgrade feedmilling facilities so that these farms could accommodate the cooking of feeds, which is needed for pre-starter and booster feeds. This

would lessen digestive problems occurring among piglets, and ultimately decrease farm hog mortality.

In terms of decision criterion, commercial swine farms prioritized the balance of quality and price most, which gives the best value for money. Commercial swine farms mostly prioritized supplier characteristics and services such as (1) the building of a good relationship, (2) provision of delivery services, and (3) acceptance of credit as the preferred payment method. For feeds or feed ingredients, qualities such as the effect on performance and good palatability were the most prioritized attributes. The suppliers of feed and feed ingredients should base marketing strategies on these premises.

The waste-management requirements of the government, such as the establishment of a biogas facility, should be accompanied by assistance so as to reduce the capital expenses to commercial swine farms since not all farms can afford such investment. The private sector may also be tapped for such capital investment requirements.

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