Spatial Price Transmission in Retail Rice Markets of the Philippines

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Presentation Outline

- Introduction
- Objectives
- Theoretical and Conceptual Framework
- Methodology
- Results and Discussion
- Conclusion
- Policy Recommendations

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Introduction

Food price inflation exacerbates food insecurity by limiting economic access to food.

- Growth in CPI for food: 3.57% (2012-2021) to 4.59% (2018-2023) (PSA 2024)
  - National Capital Region (NCR): 4.16% to 4.63%
  - Areas outside the NCR: 3.46% to 4.58%
- CPI for rice has generally increased with notable decline in 2019 and 2020
- Rice consumption: 6th in the world (2020-2023) (USDA 2023), per capita consumption of ***66.52 kg for regular***, 32.60 kg for well-milled, and 4.49 kg for NFA rice (FIES 2018)
- Rice import: 1st in Southeast Asia, 4 M tons per year (USDA 2023)
- Staple food for 109.04 million Filipinos, 1/3 of the average caloric intake, 13.1% of total household expenditure, and 1/3 of total food consumption (Valera et al. 2022)

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http://images.gmanews.tv/webpics/2018/12/ZZZ_121819_nfa_2018_12_19_16_57_49.jpg

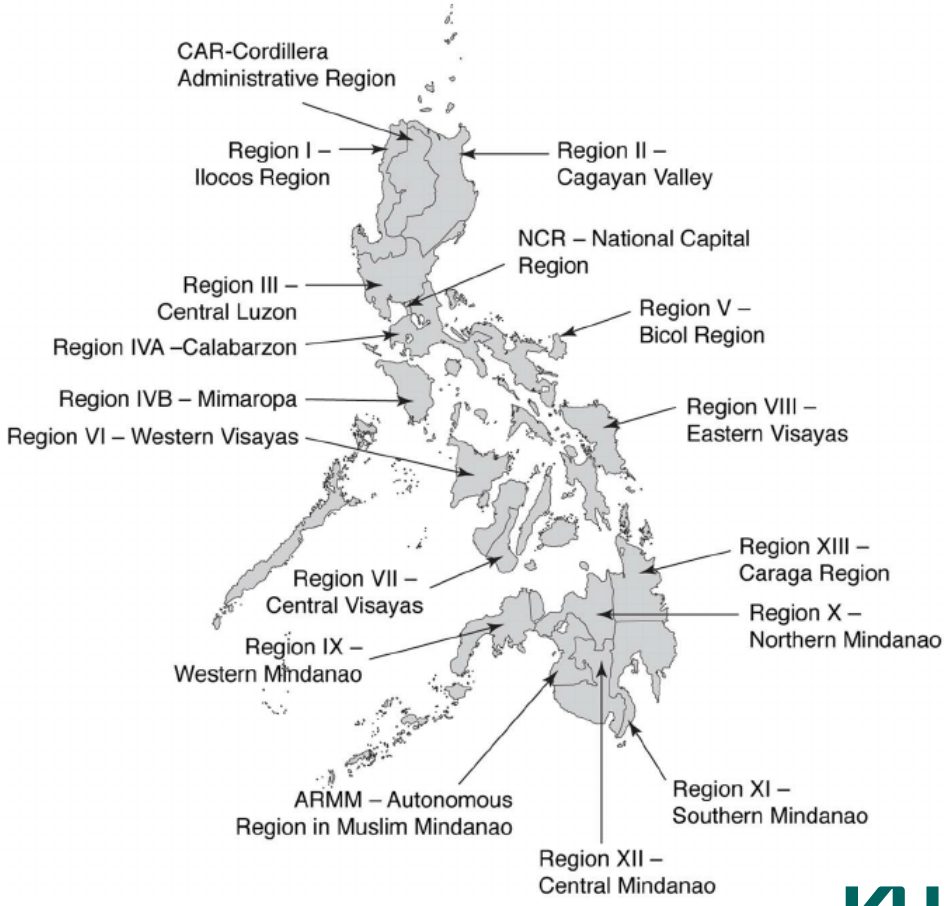
Introduction

As an archipelago, food availability and access differ across geographical locations given varying levels of local production and consumption, and imports.

- Share in paddy rice production (2010-2023): Central Luzon (19%), Cagayan Valley (14%), Western Visayas (12%), Ilocos Region (10%), SOCCKSARGEN (7%), and Bicol Region (7%) (PSA 2024)

- Annual per capita consumption: Eastern Visayas (104 kg), Western Visayas (102 kg), Bicol Region (98 kg), MIMAROPA (97 kg), SOCCKSARGEN (82), and Caraga (81 kg) (FIES 2018)

- Deficient in rice and far from ports where imported rice is unloaded: (1) Cagayan Valley, (1) Northern Mindanao, (2) CAR, (2) MIMAROPA, (4) Eastern Visayas, and (4) BARMM (DA 2018)



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Introduction

Rice, a highly sensitive and political crop, is central to Philippine politics since the 1950s (Intal & Garcia 2005) and has been a priority for policy interventions of every administration.

- *Production policies*: input subsidies, farm mechanization and post-harvest facilities, irrigation and farm-to-market road infrastructures, training programs and extension services, and research and development

- *Price* policies: price freeze on basic necessities (Proclamation 922 on March 8, 2020) and ceiling prices for milled rice (Executive Order 39 on August 31, 2023 - PhP 41 and 45/kg for regular and well-milled rice)

$0.73 – 0.80/kg

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Introduction

- *Market and trade policies*: procurement of paddy rice at support prices (Administrative Order 14 on September 18, 2023 – PhP 16+3 and 19+4/kg for wet and dry paddy rice), distribution of subsidized NFA well-milled rice (PhP 23 -27.kg), and protectionism and liberalization

  $0.34 – 0.40/kg $0.41 – 0.48/kg

  - Rice Tariffication Law (February 14, 2019)
    - Import quota → Import tariffs and the Rice Competitiveness Enhancement Fund (RCEF)
    - Government → Private sector
    - NFA import permit → DA-Bureau of Plant Industry SPS import clearance

What are the impacts of these policies on the Philippine rice markets?

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Introduction

- **Spatial price transmission denotes that a shock in a reference market is transmitted to a peripheral market.**

- In an efficient market, the price difference is equal to the transfer cost between the two markets.
  - Magnitude: full/complete transmission
  - Speed of Adjustment: rapid/instantaneous transmission
  - Nature: Different response to a price increase or decrease
  - Direction: reference/central to peripheral market

APT = incomplete, slow, and different response to a positive/negative change in price

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Introduction

Determinants of Spatial Asymmetric Price Transmission

- Asymmetric ***adjustment costs***, ***asymmetric information***, ***market power*** and asymmetric ***price reporting*** (Meyer & von Cramon-Taubadel 2002)

- Temporal dimension of ***spatial price arbitrage***, ***transaction costs***, ***border regulations***, and ***non-tradability*** of the product, ***imperfect competition***, or ***market failure*** (Conforti 2004 and Rezitis & Stavropoulous 2010)

- Market power, ***transfer costs***, ***government interventions***, ***exchange rate***, border policies, ***product homogeneity and differentiation***, and ***inventories*** (Traore & Diop 2021)

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Introduction

Research Contribution

- Briones (2019): spatial price transmission for well milled rice (1990-2016), long-run spatial integration in regional markets
- Regular milled rice
- 2012-2023: post-Rice Tariffication Law (2018) regime
- Unit root tests: seasonality and one unknown structural break
- Cointegration tests: seasonal dummies and structural break/s
- Bounds tests and Wald test: asymmetric price transmission

Objectives

General:

Examine the spatial price transmission for regular milled rice in regional retail markets of the Philippines

Specific:

1. Determine structural breaks in the price data
2. Assess the speed and magnitude of price adjustments
3. Determine the nature and direction of price transmissions
4. Identify factors influencing spatial price transmissions

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Law of One Price

Weak form of the LOP: Spatial arbitrage condition – prices will differ by, at most, the transportation cost of moving an identical good from a low-price (surplus) area to a high-price (deficit) area (Fackler and Goodwin 2001).

$$P_{i,t} + TC_{ij,t} = P_{j,t} \text{ (i = export market, j = import market, t = time)}$$

$$P_{j,t} - P_{i,t} \geq TC_{ij,t} \text{ (spatial arbitrage) (Baulch 1997)}$$

$$P_{j,t} = \alpha + \beta_1 P_{i,t} + \beta_2 Z_t + e_t$$

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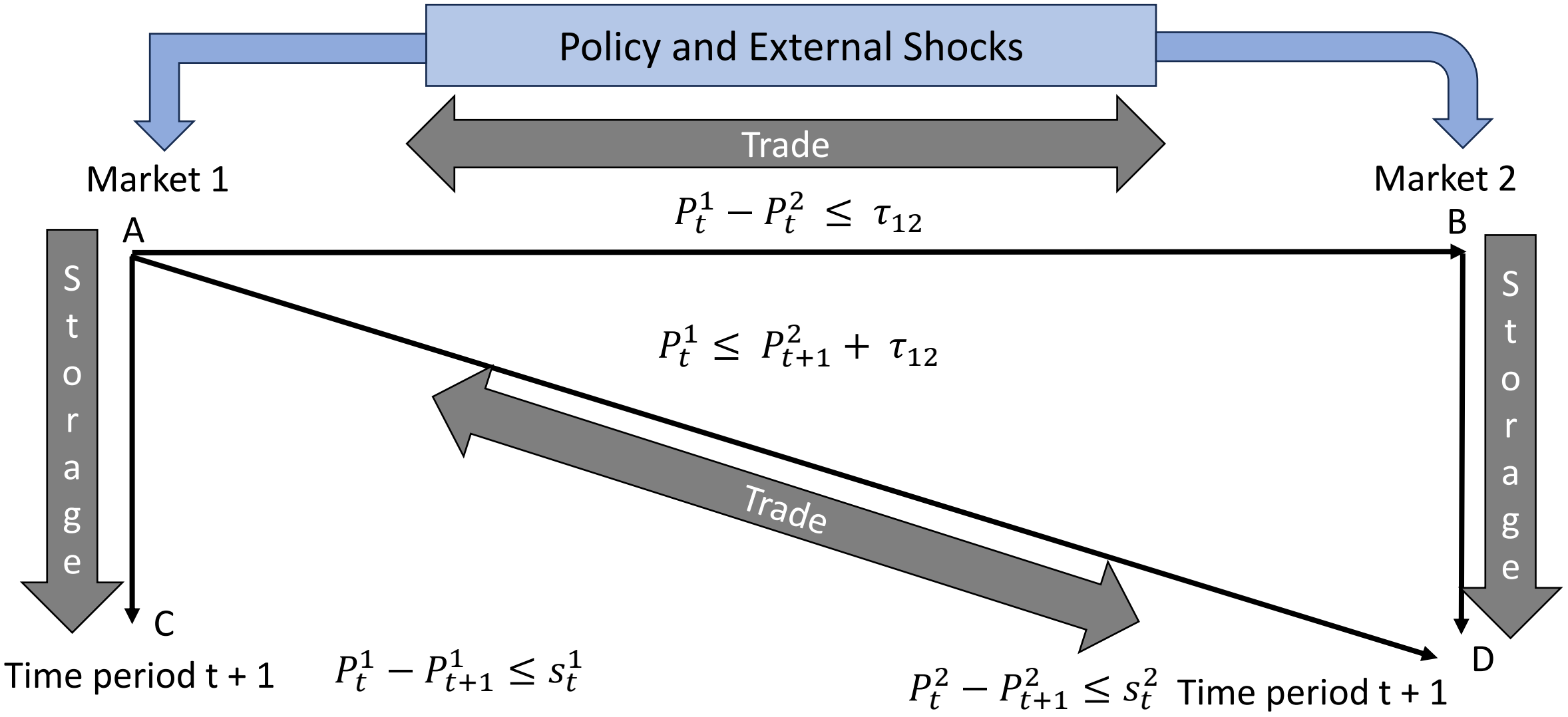
Models of Price Transmission
(Adapted from Cramon-Taubadel and Goodwin 2021)



Methods

Data Collection

- Retail prices of regular milled rice: January 2012-December 2023 and 17 regions
- Consumer Price Index: 2012-2021 with base 2012=100 and 2018-2023 with base 2018=100 → rebased CPI (January 2018=100)
- Source of data: Philippine Statistics Authority (PSA) OpenSTAT website

Nominal vs **Real** Prices

Nerlove, Grether, and Carvalho, as cited in Peterson and Tomek (2000), caution against inducing spurious fluctuations in the adjusted series.

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Methods

Data Analysis

- Descriptive statistics: Mean, maximum, minimum, standard deviation, coefficient of variation, Jarque-Bera test of normality of the original and log-transformed series
- Correlation: level and first difference forms of the log-transformed series

Ho: Series is normally distributed.

- Standard unit root and stationarity tests: Augmented Dickey-Fuller (SIC), and Philips-Perron (SIC, Newey-West using the Bartlett kernel) without constant and trend, with constant, and with constant and trend models; Kwiatkowski-Phillips-Schmidt-Shin (SIC, Newey-West using the Bartlett kernel) with constant and with constant and trend models

ADF & PP
Ho: Series has a unit root.
KPSS
Ho: Series is stationary.

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Methods

Data Analysis

- Seasonal unit root tests: Hylleberg-Engle-Granger-Yoo (AIC, seasonal dummies) and Canova-Hansen (HAC, Newey-West Fixed using the Bartlett kernel, including lagged dependent variable(-1)) with constant and with constant and trend models
- Breakpoint unit root test: One unknown structural break (SIC, innovation outlier, Dickey-Fuller minimum t-statistic)
- Multiple breakpoint tests: Global Bai Perron L Breaks method (HAC, pre-whitening with lag equal to one, Andrews bandwidth using the Quadratic-Spectral kernel, 15% trimming percentage, 5 maximum breaks, modified Schwarz criterion)

HEGY
Ho: Series has a unit root at specified frequency.
CH
Ho: Series has no unit root at specified frequency.

Ho: Series has a unit root.

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Methods

Data Analysis

- Toda-Yamamoto causality test: initial optimal lag – LR, FPE, AIC, SIC, and HQ; final optimal lag (p) – inverse roots of the characteristic AR polynomial, autocorrelation LM test, and White heteroscedasticity test; VAR model was estimated at VAR ($p+d_{max}$ where $d_{max}=1$)
- ARDL model specification
  - Dependent variable is I(1), independent variables are either I(0) or I(1), and there is at most one cointegrating equilibrium involving the dependent variable, where only the dependent variable responds to deviations from this equilibrium (not the regressors) (Montenegro 2018)
  - Proximity, probable peripheral-reference market relationship, and Toda-Yamamoto causality test results
  - Inclusion of seasonal dummy variables (seasonal unit root tests)
  - Exclusion of trend variable (i.e., d>1 or unit root at specified frequencies)
- Bounds test: F-Bounds and t-Bounds

F-Bounds
Ho: No cointegration.
t-Bounds
Ho: Nonsensical cointegration
Ha: Generate cointegration [t-stat > I(1)]
Ha: Degenerate cointegration [I(1) > t-stat > I(0)]

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Methods

Data Analysis

- ARDL-Bounds model in error-correction form: **short-run** and long-run price adjustments in a single equation

  - Case of symmetric price transmission

$$\Delta Y_t = \beta_0 + \rho Y_{t-1} + \sigma Z_t + \varphi X_{1,t-1} + \varphi X_{2,t-1} + \varphi X_{3,t-1} + \sum_{i=1}^{p} \boldsymbol{\lambda_i \Delta Y_{t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i \Delta X_{1,t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i \Delta X_{2,t-i}} + + \sum_{i=0}^{q} \boldsymbol{\delta_i \Delta X_{3,t-i}} + \nu_t$$

  - Case of asymmetric price transmission

$$\Delta Y_t = \beta_0 + \rho Y_{t-1} + \sigma Z_t + \varphi^{+} X^{+}_{1,t-1} + \varphi^{-} X^{-}_{1,t-1} + \varphi^{+} X^{+}_{2,t-1} + \varphi^{-} X^{-}_{2,t-1} + \varphi^{+} X^{+}_{3,t-1} + \varphi^{-} X^{-}_{3,t-1} + \sum_{i=1}^{p-1} \boldsymbol{\lambda_i \Delta Y_{t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i^{+} \Delta X^{+}_{1,t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i^{-} \Delta X^{-}_{1,t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i^{+} \Delta X^{+}_{2,t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i^{-} \Delta X^{-}_{2,t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i^{+} \Delta X^{+}_{3,t-i}} + \sum_{i=0}^{q} \boldsymbol{\delta_i^{-} \Delta X^{-}_{3,t-i}} + \nu_t$$

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Methods

Data Analysis

- Diagnostics and stability tests: Jarque-Bera normality test, Breusch-Godfrey serial correlation LM test, Breusch-Godfrey Serial Correlation LM Test, Autoregressive Conditional Heteroskedasticity (ARCH) test – corrected through HAC, Newey-West fixed using Bartlett kernel, Ramsey Regression Equation Specification Error Test (RESET), Cumulative Sum of Recursive Residuals test, and Cumulative Square Sum of Recursive Residuals test
- Software: Eviews12

- Speed of price adjustment (in months): -1/Error Correction Term from the Error Correction Model

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Descriptive Analysis

- Log-transformation resulted in more normally distributed nominal retail price series: 6 to 9
- Highest and lowest dispersions of nominal prices from the mean (CV): BARMM (0.11) and CAR (0.07)
- Highest and lowest mean nominal prices (PhP/kg): Central Visayas (41.91) and Cagayan Valley (36.41)
- Mean nominal price in the Philippines (PhP 38.98/kg): 59% above and 41% below

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Unit Root and Stationarity Tests

- Using ADF, PP, and KPSS tests with constant model, none of the log-transformed series have an order of integration greater than one (i.e., I(0) or I(1).
- Using HEGY and Canova-Hansen tests with constant and seasonal dummies model, all series have no unit root at all/joint seasonal frequencies.
- No seasonality: NCR and Central Visayas (highest mean price)
- Common seasonality: August (+) and September (+) – planting season in Ilocos Region and Central Luzon (40%) and wet season planting (July to December)

Structural Breaks

Market Level	Break Date	Regions	Policy or External Shock
Retail	October 2013 (+)	Cagayan Valley, Central Luzon, CALABARZON, Bicol Region, Central Visayas, Eastern Visayas, Zamboanga Peninsula, Northern Mindanao, SOCCKSARGEN, and Caraga	Decline in rice stocks and imports
	November 2013 (+) / **December 2013 (+)**	NCR	Typhoon Haiyan
	January, February 2014 (+)	Ilocos Region and MIMAROPA	Aftermath of Typhoon Haiyan
	January-March, September, November 2018 (+) / **January 2019 (+)**	NCR, Ilocos Region, MIMAROPA, Western Visayas, CAR, CALABARZON, and BARMM	NFA's inability to procure enough paddy rice from local farmers and delayed rice imports in 2018 (Tolentino & dela Pena 2020)

Nominal vs **Real** Prices

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Structural Breaks

Market Level	Break Date	Regions	Policy or External Shock
Retail	April 2020 (+)	SOCCKSARGEN	COVID-19 nationwide/local lockdowns
	August 2023 (+) / September 2023 (+)	CAR, CALABARZON, Bicol Region, Central Visayas, Eastern Visayas, Zamboanga Peninsula, Davao Region, Caraga, and BARMM (-)	Mandated price ceilings on milled rice (EO 39) – alleged illegal price manipulation, Russia-Ukraine conflict, India's rice export ban, and unpredictability of world oil prices

Direction of Causality

Dependent Variable ⟵ Independent Variables

Retail Price (n=144)

VAR Models

CAR		NCR and Ilocos Region
Ilocos Region	⟷	NCR
Central Luzon		Ilocos Region and Western Visayas
CALABARZON	⟷	Ilocos Region
Central Visayas		Western Visayas
Davao Region		Western Visayas
BARMM	⟷	Western Visayas

Nominal vs **Real** Prices

ARDL Models

Cagayan Valley	NCR, ***Ilocos Region***, and ***Central Luzon***
MIMAROPA	Central Luzon and Western Visayas
Western Visayas	**NCR**/Davao Region, Eastern Visayas, and ***SOCCKSARGEN***
Eastern Visayas	***NCR***, ***Bicol Region***, and ***Western Visayas***
Caraga	**NCR**/BARMM and **Central Luzon**/***Western Visayas***
Bicol Region	**NCR**, **CAR**, and **Cagayan Valley**
CALABARZON	**Ilocos Region** and **Cagayan Valley**

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ARDL Estimation

Dependent Variable	Long-Run Coefficient	Short-Run Coefficient
Cagayan Valley	• NCR (0.19^{ns}) • Ilocos Region (0.46**) • Central Luzon (0.52**)	• Cagayan Valley (+, lag 2, 3, 8, 9) • NCR (+, 0, lag 2, 3) • Ilocos Region (+, 0, -, lag 3, 9, 10) • Central Luzon (+, 0, lag 6)
MIMAROPA	• Central Luzon (0.09^{ns}) • Western Visayas (0.30^{ns})	• Central Luzon (+, 0, lag 2, 3) • Western Visayas (+, 0, lag 1, 7, 9, 10)
Western Visayas	• Eastern Visayas (0.11^{ns}) • Davao Region (0.04^{ns}) • SOCCKSARGEN (0.65***)	• Western Visayas (-, lag 3) • Eastern Visayas (-, lag 1) • Davao Region (+, lag 3, 10 and - , lag 4, 11) • SOCCKSARGEN (+, 0)
Caraga	• BARMM (0.11^{ns}) • Western Visayas (0.78***)	• BARMM (+, 0, lag 2) • Western Visayas (+, 0, lag 1)

*** and ** denote 1 and 5% level of significance

Long-run symmetry in direction and magnitude

Short-run symmetry in direction, speed, and magnitude

Full/complete price transmission ($\Sigma EPT = 1.0$)

Nominal Prices

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ARDL Estimation

Dependent Variable	Seasonal Dummy Coefficient	Structural Break Coefficient
Cagayan Valley	• August (-0.01**) – 2 months after harvest season • October (-0.02***)	• October 2013 (-0.03***) • December 2017 (-0.01**)
MIMAROPA	• October (0.01**) – start of harvest season	• January 2014 (0.02***) – Aftermath of Typhoon Haiyan (November 2013) December 2017 (0.01**) – Typhoons Urduja and Vinta • September 2019 (0.01**) – Typhoon Nimfa
Western Visayas	• November (-0.01**) – 1 month after harvest season	• March 2018 (0.01**) • December 2019 (-0.01**) – Rice Tariffication Law
Caraga	• May (-0.01**) • June (-0.01***) • July (-0.02***)	• None

*** and ** denote 1 and 5% level of significance
Seasonal dummy variables: December (dropped)

Nominal Prices

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NARDL Estimation

Dependent Variable	Long-Run Coefficient	Short-Run Coefficient
Eastern Visayas	• NCR_POS (0.25***) • NCR_NEG (0.09^{ns}) • Bicol Region (0.55***) • Western Visayas_POS (0.25***) • Western Visayas_NEG (0.46***)	• Eastern Visayas (+, lag 1-6, 9) • NCR_POS (-, lag 6, 9) • NCR_NEG (+, 0, lag 2) • Bicol Region (+, 0, -, lag 1-4, 6, 8, 9) • Western Visayas_POS (-, lag 2) • Western Visayas_NEG (-, lag 1, 4)
Remarks	• Symmetry in direction (same sign of POS and NEG) • Symmetry in magnitude based on Wald test	• Asymmetry in direction (different sign of POS and NEG) for NCR and symmetry for Western Visayas • Asymmetry in speed (different lag) for NCR and Western Visayas • Negative asymmetry in magnitude for NCR and positive for Western Visayas based on Wald test

*** denotes 1 % level of significance

Full/complete price transmission ($\Sigma EPT = 1.0$)

Nominal Prices

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Speed of Price Adjustments

Dependent Variable	Months
Nominal Prices	
Cagayan Valley	2.26
MIMAROPA	3.79
Western Visayas	4.16
Eastern Visayas	1.01
Caraga	7.07
Real Prices	
Bicol Region	1.18
CALABARZON	2.90
Western Visayas	2.51
Caraga	3.60

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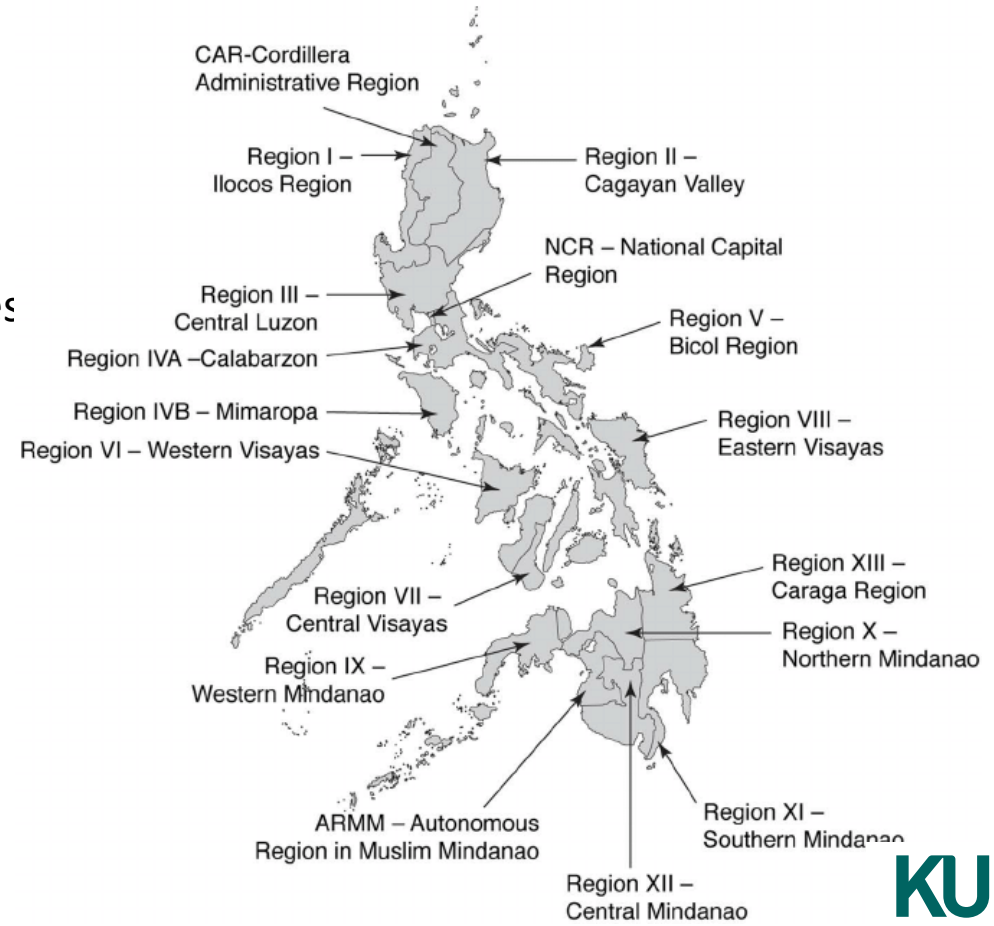
Determinants of Spatial Price Transmission

- ***Transfer costs***
  - MIMAROPA – Central Luzon (0.78)
  - Western Visayas – SOCCKSARGEN (0.58)
  - Caraga – BARMM (2.58) and Western Visayas (2.26)
  - Eastern Visayas – NCR (3.41), Bicol Region (2.31), and Western Wes (2.10)

- ***Imperfection competition***
  - Complete transmission
    - Cagayan Valley (2nd production)
    - Eastern Visayas (1st consumption)
  - Incomplete transmission
    - MIMAROPA (7th vs Central Luzon and Western Visayas)
    - Caraga (12th vs Western Visayas)



Nominal Prices

Image Credit: https://www.researchgate.net/figure/Map-of-the-Philippines-showing-the-administrative-17-regions-19-20-The-Republic-of-the_fig1_267872402

Determinants of Spatial Price Transmission

- ***Asymmetric price information***
  - Caraga has the slowest speed of price adjustment (7.07 months)
  - MIMAROPA (3.79 months)

- ***Policy interventions***
  - Decline in rice imports in 2013
  - Failure of NFA to procure enough paddy and import rice in 2018
  - Mandated price ceilings on milled rice in September 2023

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Conclusion

- Policy and external shocks brought positive or negative changes in retail price of regular milled rice.

- Price transmission in selected regional markets is incomplete, slow, and/or asymmetric due to factors such as high transfer costs, imperfect competition, asymmetric information, and policy failures related to paddy procurement, rice importation, and inventory management.

- Targeted policies are necessary to stabilize prices based on regional circumstances.

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Policy Recommendations

- ***Implication: Regions respond differently to price stabilization and trade liberalization policies, as well as external shocks (e.g., weather and pandemic).***

- ***Improved logistics and market infrastructure***
  - Eastern Visayas (Western Samar, Northern Samar, Southern Leyte, and Eastern Samar) and MIMAROPA (Romblon and Marinduque) – deficit and far from ports where imported rice is disembarked)
  - Caraga linked with BARMM (Maguindanao) - surplus but far from ports
- ***Enhanced price monitoring and access to market information***
  - Caraga and MIMAROPA

- ***Investigations into unfair trade practices***

- ***Timely procurement and efficient inventory management***
  - August and September (positive seasonal index)
  - NFA, traders, and retailers

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