SPATIAL INTEGRATION AND PRICE TRANSMISSION OF CHICKEN MARKETS IN CENTRAL JAVA, INDONESIA

PANJI DEORANTO
LECTURER OF BRAWIJAYA UNIVERSITY, MALANG, INDONESIA

ABSTRACT

The study analyzed the spatial market integration and price transmission and proposed policy directions to enhance market efficiency of the chicken markets in Central Java Province, Indonesia for the period 2004-2009. Broiler and native chicken prices were increasing, especially during periods with religious activities. Broiler's prices at the farm level fluctuated more than the wholesale and retail levels.

Augmented Dickey Fuller test results showed that there was sufficient evidence for the non-stationarity of prices in all market locations. However, differencing all prices at the first level resulted in a stationary process. Pearson correlation test showed a strong correlation between all market pairs indicating a higher degree of market integration.

The Law of One Price test results indicated there were four co-integrated market pairs in each market level. Four to five market pairs showed Granger Causality conditional at the farm, wholesale and retail levels. However, only a unidirectional price transmission was observed among the market pairs.

The effect of imposition of import tariff policy and road distance was found significant in increasing prices at the retail level.

Keyword : spatial integration, market transmission, market pairs

BACKGROUND

In Indonesia, chicken is widely sold in all markets because of its advantages. With an estimated national demand of about 3-5 million per day, consumption of chicken meat ranks highest among meat products at 56%. The increasing population growth, income, urbanization, changing lifestyle, and the relatively low price of chicken compared to red meat as a source of protein are factors affecting the increase in chicken meat consumption, especially with the large Moslem population in Indonesia.

The changing price of chicken and other poultry industry products are influenced by production cost, supply and demand in the market, transportation cost, marketing, price of its substitution and government policy. These conditions are transmitted across all other market levels, from the farm, the wholesale and to the retail markets if these markets are integrated. On the other hand, the efficiency in one market cannot effectively and efficiently affect the other markets since price the linkage of market integration does not work well.

The general objective of the study is to analyze the extent of spatial integration of chicken markets in Central Java Province, Indonesia. Specifically, it aims to:

1. provide an overview of prices at the farm level;
2. determine the market integration relative to pricing behavior among spatially differentiated chicken markets;
3. propose policy directions to enhance market integration in the chicken market.

METHODOLOGY

The study was conducted in Central Java Province, Indonesia. This province is considered as one of the largest and important chicken producer in Indonesia which supplies other provinces as well. The study covered six (6) districts of Central Java namely: Kendal, Karanganyar, Klaten, Sukoharjo, Banyumas and Semarang as Central Market. ***Econometric analysis.*** In the following sections, applications of various econometric steps and models in examining spatial market integration and price

transmission on selected districts were employed. In order to examine the relationship of the chicken price data series in different market locations and stages of marketing channels, Augmented Dickey Fuller (ADF) test was used to test for the stationarity of the series. Akaike Information Criterion (AIC) was used to choose the optimum lag length by trading-off parsimony against reduction in the sum of squares. However, each market price series resulted in different optimum lag length.

Pearson price correlation was also employed to measure the price series relationship and followed by Johansen test used for measuring market integration for each price market pairs. Error Correction Model (ECM) was constructed based on Vector Auto Regression (VAR) of the markets pairs. The restriction of Low of One Price (LOP) was imposed and tested for each market pairs. Lastly, Granger causality test was applied to examine the pattern of interdependence at the market level.

RESULTS AND DISCUSSION

An Overview of Chicken Situation in Central Java, Indonesia

Based on Muladno, et al., (2008), there are four types of broiler industries in Indonesia:

1. Full vertical integration (A- Type) - an enterprise that has all the business of the primary components (grandparent stock, parent stock, final stock, and abattoir) and contributing components (feed mill companies, Medicine Company, and meat processing plants).
2. Semi-vertical integration (B-Type) - an enterprise which has all the business of the primary components (grandparent stock, parent stock, final stock, and abattoir), but only has one contributing component (feed mill or drug company, or meat processing plant).
3. Partial vertical integration (C-Type) () which has two primary components and one or two contributing components.
4. Non-vertical integration (D-Type), an enterprise which has only one primary component and only one or two contributing components.

In the downstream industry, its focus is on broiler and layer chickens as commodities since these types of chicken are produced and consumed the most. There are interconnections among chain businesses in the broiler poultry, slaughtering houses and food processing industry to produce meat, food, and other products. The layer industry, on the other hand focuses on egg production as its main concern to supply the food processing industry. Egg production and its distribution to the markets and food industries are the main businesses in layer poultry. Eggs mostly sold in the markets are fresh eggs while the rest are salted and powder eggs which are produced by food industries. Layers which are no longer productive are sold as dressed layers in the markets.

At the upstream, there is good business prospect in industries supplying input to poultry production such as feeds, vaccines, breeding and farm equipment (Figure 1). Almost 60-80% of the total cost of production on chickens is spent on feeds. The demand for imported corn as the main feed ingredient has been increasing yearly. A positive growth in the poultry industry will likewise benefit the feeds industry.

Households and large industries have been optimizing poultry processing and have resulted in the availability of large quantities of by-products like head, feet, blood, viscera, bone, shell and feather. Using traditional (home made) or modern technology, inedible by-products (blood, viscera, heads and feet) are processed for pet and chicken feed. Chicken skin and viscera could be made into crispy snacks for consumers. The feathers are being made into feather dusters, scarf, craft and shuttle cock while egg shells are made into fancy ornaments.

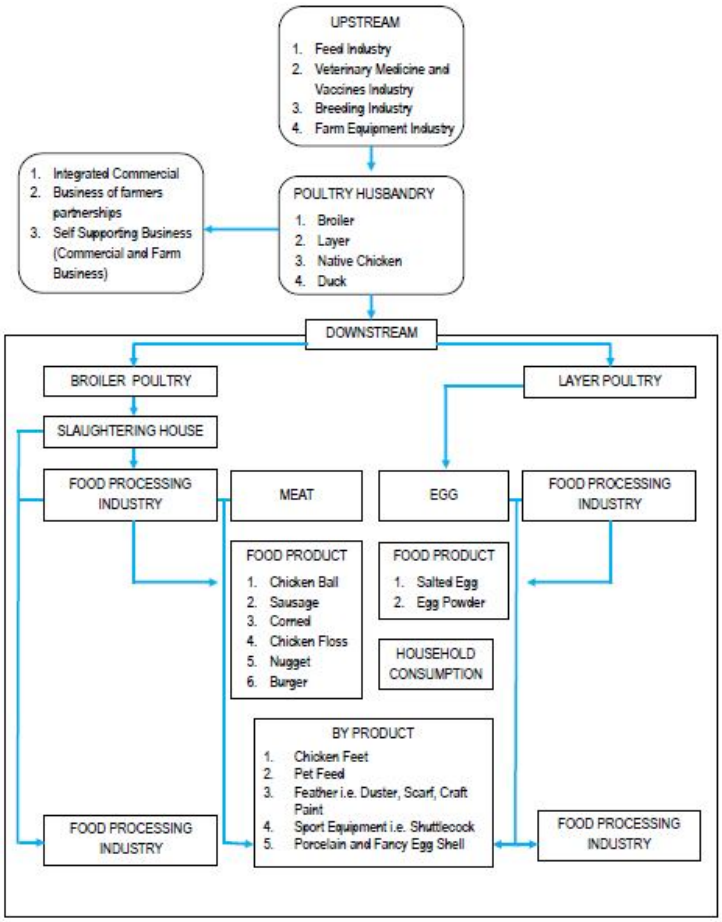

Figure 1. Poultry Industry Tree in Indonesia

Prices

Prices of chicken in Central Java were observed to be increasing from 2007-2009. Sharp increases in prices were observed in periods with more religious activities thereby increasing the demand for chicken meat. Peak prices were regularly observed during Islamic events such as *Ramadan* month following *Idul Fitri* day. These are major events in Indonesia as 80% of the populations are Moslems. During these traditional activities, family members, even those working and living overseas, come together to pray and celebrate by preparing various foods including meat but only coming from chicken. Pork is not allowed during these events.

Other events such as *Natal* (Christmas day) and New Year's Eve also affected prices of chicken to increase. Since this pattern has been established for many years, the

local government, through the Animal Husbandry Department, ensures that the availability of chicken stocks are enough to supply the consumer demands during these events.

Price volatility. Volatility measured in terms of standard deviations and coefficient of variations shows that the farm prices had the largest price volatility with a coefficient of variation of 18.54% (Table 1). The high volatility in farm prices indicates the high risks faced by farmers as chicken mortality due to pestilence, injury, aging and sickness considering the biological nature of chickens. In such situations, farmers had to decide immediately on whether to lower or increase the price. At the farm level, the minimum price was 6,667 Rp/kg

Wholesale and retail prices had lower CV indicating that prices were more stable than that at the farm level since the traders faced lower risks because the chickens they purchased from the farms were already slaughtered and could be stored and kept frozen for much longer periods. At the wholesale level, the minimum price was 7,700 Rp/kg, the maximum price is 14,367 Rp/kg with an average price of 11,581 Rp/kg. Higher prices were observed at the retail ranging from 8,344 Rp/kg to 15,427 Rp/kg. This can be attributed to the influence of the marketing cost on the wholesale/retail price. Fluctuating prices, on the other hand, did not significantly affect the profit margin.

Table 1. Broiler price and price volatility, Central Java, 2007-2009

PRICE	AVERAGE PRICE			STD. DEVIATION	CV %
	MINIMUM	MAXIMUM			
	Rp/kg				
Farm	6,667	14,167	10,830	2,008.2	18.54
Wholesale	7,700	14,367	11,581	1,951.4	16.85
Retail	8,344	15,427	12,470	1,914.3	15.35

Source: Fieldwork, 2010

Farm prices were more volatile. It can be explained by the over supply of chicken from East Java finding it markets in Central Java. This condition resulted to the instability of farm prices. The increasing of price input production (price of corn and soybean increasing) further added to price volatility. The corn price was increasing from 2,400 Rp/kg to 3,500 Rp/kg or 45.83% and also broiler feed price was increasing from 3,800 Rp/kg to 4,400 Rp/kg in during 2007.

As shown in Figure 1, broiler prices were found to be fluctuating at all levels, starting from the farm price up to the retail level. The farm price was lowest during the month of September 2007 at 6,667 Rp/kg while highest in October 2008.

From January 2007 until July 2008, there was an increasing trend (pattern) of broiler price series since this is the rainy season period. The susceptibility of chickens to virus can cause mortality thereby affecting chicken production to decrease and the price to increase. From July 2008 to December 2009, a flat pattern of prices could be observed because there was balance between supply and demand since production could meet the consumption, hence the price tended to be stable.

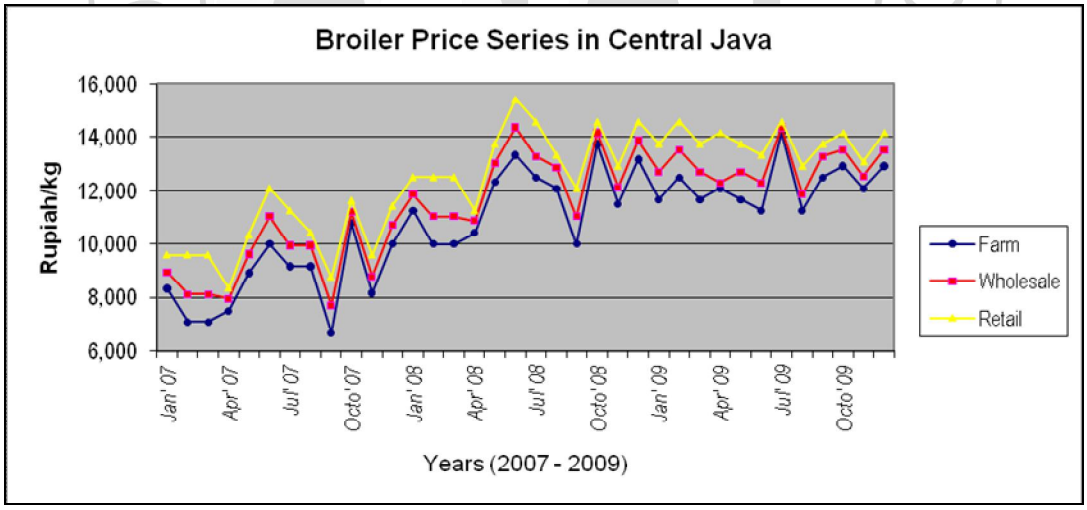

Figure 1. Broiler Price Series, Central Java, 2007-2009

For the wholesale price, the highest was recorded at 14,167 Rp/kg in June 2008 and in July 2009. There were high demand from retailers to supply chicken in schools and small restaurants since enrollment starts in the months of June and July. The

tendency of wholesale price tended to increase during these periods. The lowest for the wholesale price was recorded at 7,500 Rupiah/kg in September 2007. The presence of Avian Influenza tended to reduce the consumer's preference for dressed chickens causing the low market price.

Lastly, for the retail price, the highest was 14,167 Rupiah/kg recorded in February 2009. This may be partly due to the celebration of Valentine's Day. Teenagers tended to celebrate this occasion in international food chains such as McDonald's and KFC which serve mostly chicken meals. The lowest price was observed in April 2007 at 7,917 Rupiah/kg due to declining demand of dressed chicken because most school canteens were temporarily closed due to summer vacation.

The real price of broiler was likewise observed as fluctuating in trend (Figure 2). The farm price was highest at 96 Rupiah/kg in July 2009 while the lowest was 45 Rupiah/kg in September 2007. The highest price recorded for wholesale was 97 Rupiah/kg in June 2008 while the lowest was 52 Rupiah/kg in September 2007. The conditions previously stated such as AI alert and enrollment affected the price to fluctuate. For the retail price, it was in June 2008 when the highest price was recorded at 105 Rupiah/kg while April 2007 had the lowest retail price at 57 Rupiah/kg.

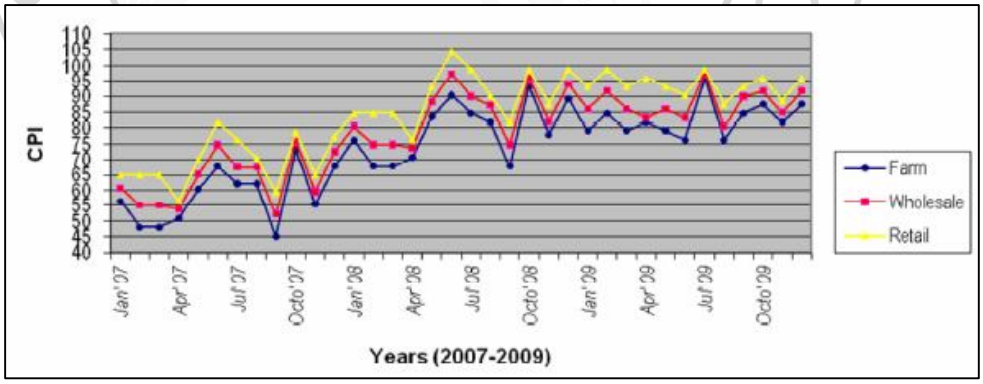

Figure 2. Real Price of Broiler Chicken, Central Java, 2007-2009

The prices for the native chickens were observed to have a fluctuating trend at all levels (Figure 3). For the retail price, the highest was 33,333 Rupiah/kg in May 2009 while the lowest price was 16,000 Rupiah/kg in April 2007.

The highest price for wholesale was recorded in May 2009 at 31,333 Rupiah/kg while in April 2007, the lowest price was observed at 14,667 Rupiah/kg. Farm price was found to be highest (30,000 Rupiah/kg) in June 2009.

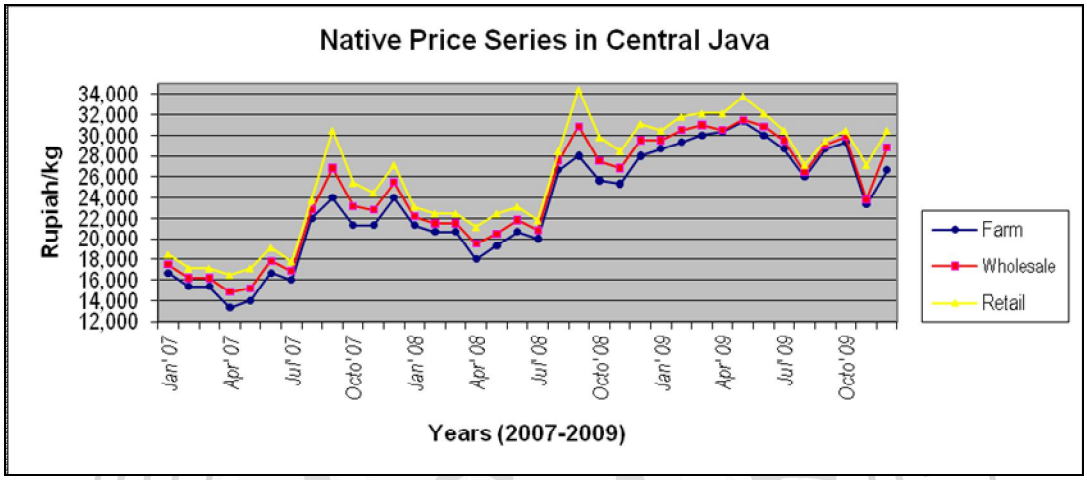

Figure 3. Native Chicken Price Series, Central Java, 2007-2009

Spatial Integration and Price Transmission

Broiler chicken price data series representing the six market locations, with Semarang as central market were used for the analysis of chicken markets at farm levels in Central Java. Each farm chicken price data series consisted of 72 monthly observations from January 2004 to December 2009.

Farm Level

The monthly chicken farm price did not change very much except in Karanganyar as shown in Table 2. There was an Avian Influenza (AI) alert issued in this district which caused the demand for this commodity to decline and its price to go down to 3,850 Rp/kg.

Volatility measured in terms of standard deviations and coefficient of variations shows that Banyumas and Kendal districts had the largest price volatility with the

coefficient of variations of 32.73% and 30.24%, respectively (Table 2). The strong price variation in these districts was due to unstable production which was caused by the high cost of input production, especially on feeds since the prices of soybean and corn fluctuated and tended to increase. Because of this, the farms were not able to anticipate the capacity of chicken production. Another reason is the distance of Banyumas to Central Java of 196 km. The variability in oil prices are also easily reflected to the farm prices.

Prices in other districts such as Semarang, the Central market, had lower values of CV at 20.50, indicating that chicken farm price in this district was more stable than in Banyumas and Kendal. Supply and demand were relatively stable in the area.

Table 2. Farm chicken price and price volatility in Central Java, 2007-2009

DISTRICT/MARKET	MINIMUM	MAXIMUM	AVERAGE PRICE	STD. DEVIATION	CV %
	Rp/kg				
Semarang	6,900	14,500	9,738	1,996.37	20.50
Kendal	5,500	17,500	9,526	2,880.24	30.24
Banyumas	5,500	17,200	9,337	3,056.45	32.73
Klaten	6,000	16,700	9,770	2,562.73	26.23
Sukoharjo	5,500	15,000	9,898	2,251.20	22.74
Karang anyar	3,850	15,000	9,795	2,693.51	27.50

Source: Animal Husbandry Office, Central Java, 2007-2009

Unit Root Test

The Augmented Dicky-Fuller (ADF) test was used to determine the level of stationarity of prices in the various markets. Prices are stationary and integrated at I(0) when the null hypothesis (Ho :ß=1) is rejected. If the null hypothesis is accepted, this means the prices are not stationary and need to be differenced until a price becomes

stationary. At the level, farm prices were found not stationary. Results show that there was sufficient evidence to accept the null hypothesis of non-stationarity of farm prices in all market locations (Table 3).

Table 3. Augmented Dickey Fuller test of prices at farm level, Central Java, 2004-2009.

NO.	MARKET DISTRICT	LEVEL	FIRST DIFFERENCE
1	Semarang	-1.70	-9.08**
2	Karanganyar	-3.11	-7.97**
3	Banyumas	-1.47	-9.41**
4	Kendal	-1.82	-9.64**
5	Klaten	-2.30	-9.57**
6	Sukoharjo	-2.43	-9.91**

Notes: ** : Significant at 5 levels.

In the absence of stationarity in all districts, there was a need for a first difference process to obtain stationarity. When the chicken price data series were converted to their first difference series, the ADF test with a drift rejected the null hypothesis of non-stationarity for all chicken farm price data series. This means that the chicken price data series at different chicken market locations were integrated into order one I(1). This is a sufficient condition for the price series to be tested using VAR and VEC frameworks.

Pearson Correlation

Results of the correlation test showed that there was strong price correlation between each district except between Semarang-Karanganyar and Karanganyar-Klaten. The highest price correlation of 0.91 was observed between Banyumas-Kendal while the lowest (0.65) between Klaten-Karanganyar and between Semarang-Karanganyar (Table 4). The road distance between these market pairs is more than 100 km with poor condition of road infrastructures thereby lowering the strength of correlation between these markets.

Table 4. Pearson correlation between broiler price series at farm level, Central Java, 2004-2009.

MARKET	SEMARANG	KARANGANYAR	BANYUMAS	KENDAL	KLATEN	SUKOHARJO
SEMARANG	1.00					
KARANGANYAR	0.67	1.00				
BANYUMAS	0.79	0.75	1.00			
KENDAL	0.84	0.72	0.91	1.00		
KLATEN	0.86	0.65	0.90	0.87	1.00	
SUKOHARJO	0.79	0.85	0.82	0.84	0.77	1.00

Source: Fieldwork, 2010

The farm price correlation between all other market pairs was positive indicating that if the farm price changed in one market, then it will follow that farm prices in other markets will also change.

Very strong correlation coefficients of more than 0.9 were found between Kendal-Banyumas and Klaten-Banyumas. This is caused by the good road infrastructure and short distance which is less than 100 km, between market pairs. In summary, the strong Pearson price coefficients among these market pairs showed that the farm prices were highly correlated.

Co-integration Test and Law of One Price

Market integration for each price market pairs was examined and subjected to two different null hypotheses: (1) there was no co-integrating vector between them; and (2) there was one co-integrating vector between them. Trace test was used to justify rejection of the null hypotheses.

Based on bi-variate co-integration test, significant market integration was observed in four selected pairs as follows: Semarang-Karanganyar, Banyumas-Karanganyar, and Kendal-Klaten significantly co-integrated at 10% and 5% for Klaten-Sukoharjo (Table 5).

This was due to the speed of information and communication transfer observed in these areas as well as good road infrastructure, and proximity of the farms to the market. The effectiveness of price transmission information among market pairs will enable the

farms to respond quickly and the traders to achieve appropriate gains. For the rest of the pairs, no significant market integration was observed. These are indications that these market pairs are weakly correlated and tended to be independent. This was due to low speed of price transmission information, road distance, low trade volume and also because some of the roads are still classified as district roads. In addition, there is a tendency among market pairs that are not integrated to convey inaccurate price information and distort production and marketing decisions thereby contributing to inefficient product movements.

Based on the integrated market pairs shown in Table 6, restriction of the Law of One Price (LOP) was imposed and tested for each market pair using the formulated VAR framework. The test of the null hypothesis of LOP held in each market pair was based on the computed Chi-square statistics with the number of degrees of freedom equal to the number of restrictions.

Table 5. Bi-variate co-integration test at broiler's farm level, Central Java, 2004 - 2009

NO.	MARKET PAIR	EIGEN VALUE	TRACE TEST
1	Semarang-Karanganyar		
	none	0.22	19.10*
	at most 1	0.03	1.91
2	Banyumas-Karanganyar		
	none	0.22	18.10*
	at most 1	0.01	0.76
3	Banyumas-Kendal		
	none	0.14	10.90
	at most 1	0.01	0.89
4	Kendal-Klaten		
	none	0.27	22.44*
	at most 1	0.01	0.96
5	Klaten-Sukoharjo		
	none	0.26	23.33**
	at most 1	0.03	2.45
6	Semarang-Klaten		
	none	0.07	7.13
	at most 1	0.03	2.13
7	Banyumas-Sukoharjo		
	none	0.15	11.58
	at most 1	0.01	0.72
8	Semarang-Kendal		
	none	0.12	9.78
	at most 1	0.02	1.47
9	Kendal-Sukoharjo		
	none	0.14	10.99
	at most 1	0.01	0.71

Notes: **, *: Significant at 5% and 10% levels, respectively.

The LOP test results indicate that in using 4 co-integrated chicken farm market pairs at the farm level, the null hypothesis of LOP could not be rejected at 5% and 10% significant levels, respectively(Table 10). Hence, there was LOP in 4 market pairs as prices were fully transmitted between markets. There was perfect integration pattern between these 4 market pairs.

Table 6. LOP Imposition on farm price, Central Java, 2004-2009

CO-INTEGRATING VECTOR	LOP IMPOSITION
1	Semarang=Karanganyar+c1
2	Banyumas=Karanganyar+c2
3	Kendal=klaten+c3
4	Klaten=Sukoharjo+c4

Source: Fieldwork, 2010

Granger- Causality Test

Table 7 shows that five market pairs, namely Semarang-Karanganyar, Banyumas-Karanganyar, Kandal-Klaten, Semarang-Klaten and Banyumas-Sukoharjo had significant Granger-causing price relationships.

For these market pairs, Granger Causality was unidirectional. This means that the price in the first market Granger-caused the price change in the second market and not vice versa.

On the other hand, the rest of the market pairs were found to have no significant transmission of price and no Granger causality, which means that the price change in one market was not caused by the price change in other markets and vice versa.

Table 7. Granger-Causality test for broiler price series at farm level, Central Java, 2004-2009.

NO.	MARKET PAIR	GRANGER-CAUSALITY TEST	TYPE
1	Karanganyar-Semarang	0.867	No Granger Causality
	Semarang-Karanganyar	2.92*	Unidirectional
2	Karanganyar-Banyumas	0.83	No Granger Causality
	Banyumas-Karanganyar	3.35*	Unidirectional
3	Kendal-Banyumas	0.25	No Granger Causality
	Banyumas-Kendal	1.92	No Granger Causality
4	Klaten-Kendal	0.11	No Granger Causality
	Kendal-Klaten	3.39*	Unidirectional
5	Sukoharjo-Klaten	2.39	No Granger Causality

	Klaten-Sukoharjo	1.96	No Granger Causality
6	Klaten-Semarang	0.80	No Granger Causality
	Semarang-Klaten	6.77**	Unidirectional
7	Sukoharjo-Banyumas	0.86	No Granger Causality
	Banyumas -Sukoharjo	2.87*	Unidirectional
8	Kendal-Semarang	0.27	No Granger Causality
	Semarang-Kendal	0.57	No Granger Causality
9	Sukoharjo-Kendal	1.79	No Granger Causality
	Kendal-Sukoharjo	1.81	No Granger Causality

Notes: **, *: Significant at 5% and 10% levels, respectively.

At the farm level, it can be explained that Semarang, as central market, Granger caused both Karanganyar and Klaten indicating that the central market remains to be the reference price for their areas.

CONCLUSION

Prices for both broiler and native chickens in Central Java were increasing for the period 2007-2009, especially during religious activities, Natal (Christmas day) as well as New Year's Eve. Prices of broiler at the farm level fluctuated as shown by the coefficient of variation (CV). The farm price variations can be explained by the factors that affect production considering that chicken is a biological commodity.

Augmented Dickey Fuller (ADF) test results show that there was sufficient evidence to accept the null hypothesis of non-stationarity of the chicken price in all market locations at farm. It means that prices are integrated at process I(0) at the level. However, differencing all prices at the first level resulted in a stationary process.

Pearson correlation test showed that there was strong correlation between markets. At farm, the highest values were observed between Banyumas-Kendal, while at the retail level it was observed between Banyumas-Semarang. The lowest value was observed between Klaten-Karanganyar. The road distance between each market pairs and road infrastructure condition strongly influenced correlation levels between market pairs.

Among the 18 chicken market pairs, there were 13 pairs where the markets had no Granger Causality at the farm level showing no Ganger Causality. This condition shows that a price change in one market was not caused by the price change in the other market and vice versa. Unidirectional relations were, however, found in the market pairs of Karanganyar-Semarang, Kendal-Klaten, Semarang-Klaten and Sukoharjo-Banyumas, which means that price in one market influenced the other market pairs otherwise other market pairs could be influenced.

The LOP test results indicate that using 4 co-integrated chicken farm market pairs at the farm level, the null hypothesis of LOP could not be rejected at 5% and 10% significant levels, respectively. Hence, LOP in 4 market pairs were fully transmitted between markets. In this situation, the integration pattern was perfect between these 4 market pairs. The LOP test results indicate that using 4 co integrated chicken market pairs at farm, the market was integrated.

In order to achieve greater market integration, the construction of more asphalted roads as well as repair of damaged ones should be given priority for faster delivery of chicken from the farms to the markets. The conversion of district roads to provincial roads will give more access to a much greater number and type of transportation that can pass through since district roads are narrow and are limited only to smaller types of vehicles.

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