Spatial Integration of Beef Cattle Markets in Central Java, Indonesia

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Introduction

- Indonesia is a big importer of live cattle. The country needs to import at least 400,000 heads cattle in 2002 to meet the demand
- President Yudhoyono a President in Indonesia in 2004, he started to revitalize the agricultural sector, specifically the beef sector. In 2004, the Indonesian government through the Livestock Directorate General imposed the self-sufficiency program on meat
- The program aimed to reduce meat importation, develop the beef sector, improve cattle productivity that would lead to an increase in income of the cattle farmers.
- Central Java province is the second largest cattle producer in Indonesia

Market Integration

- Negassa (2003) noted market integration can be defined as a measure of the extent to which demand and supply shocks in one location to other locations
- Barret (1996) distinguished market integration into 1) spatial market integration defined the smooth transmission of price signals across spatially separated market, 2) vertical integration involving different stages in marketing and processing channels, and 3) temporal market integration which refers to arbitrage across periods of time.

Spatial market integration

Gonzalez-Rivera and Helfand (2001), defined a market within a distinct location will be considered integrated if physical flows of goods and services exist among locations and there is evidence of a long run relationship
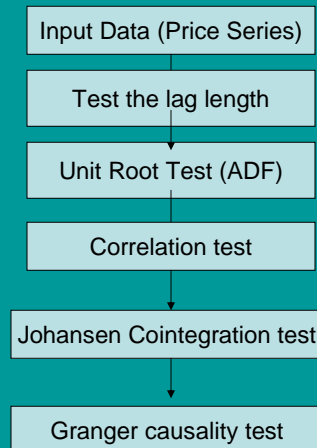
Factors affecting spatial market integration

- Goodwin and Schroeder (1991): distance, volume trade, market infrastructure.
- McNew (2009): transaction cost
- Chavas (1999): transaction cost
- Shilpi and Deininger (2008): market facilities and market infrastucture

Spatial market integration analysis method

- Goodwin and Schroeder (1991) uses Johansen test (cointegration test).
- Behura and Pradhan (1998) uses Pearson Correlation and Johansen test
- Goodwin and Fackler (2008) uses Granger Causality test
- Baulch (1994) and Bernal et al (2008) uses Parity Bound Model (PBM)

Procedure to test spatial market integration

Input Data (Price Series)

Test the lag length

Unit Root Test (ADF)

Correlation test

Johansen Cointegration test

Granger causality test

The extent of market integration

- Law of One Price (LOP) defines the extent of the market and measures market integration, if a single price exists over several spatially separate markets, it implies that these markets are integrated as a single market. Chi-square and t-test can be used to determine the LOP

OBJECTIVE OF THE STUDY

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

1. provide an overview of the trends in cattle population, beef production and consumption, and prices at the farm, wholesale and retail levels;
2. determine the effect of the policy on the cattle population, beef production and consumption, and retail prices;
3. determine the extent of market integration relative to pricing behavior among spatially differentiated beef markets between regional and central markets;
4. determine the effect of transportation cost on the price of beef markets;
5. determine the effect of market infrastructure on the market integration of beef cattle markets in Central Java; and
6. suggest policy directions to enhance market integration in the beef industry.

Types and Sources of Data

- Data were collected include cattle cattle population, number of slaughter cattle, monthly farm, wholesale and retail prices of beef cattle, transport cost for the period covering 1990-2007.

Trends in Population, Prices and Consumption Beef Cattle

- Trend analysis and some descriptive assessments will be adopted in this study to provide an overview of the trends in production, prices, and consumption of beef cattle in central Java province.
- Graphs and tables reflecting the trends and geometric growth rates in the population, prices, and consumption of beef cattle in Central Java Province will be prepared to supplement the analysis.

Price Transmission Across Spatial Markets

- ***Econometric analysis.*** Price transmission in horizontal marketing system is concerned with determining the causal price linkages among different marketing levels (farm, wholesale, and retail)

The Impact of the Policy on the Population, Productivity, Consumption, Price

$$t = \frac{D - \bar{\mu}_D}{S_D}$$

Augmented Dickey Fuller test (Unit Root test)

$$\Delta P_t = \alpha P_{t-1} + \sum_{j=1} b_j \Delta P_{t-j} + \theta + \beta t + \varepsilon_t$$

Correlation

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{(n-1)s_x s_y}$$

The Johansen Multivariate test

$$X_t = \sum_{i=1}^{k} \Pi_i X_{t-i} + \Pi_k X_{t-k} + \mu + e_t$$

Granger Causality test

$$P_{it} = w(t) + \sum_{l=1}^{L} \alpha_l P_{it-l} + \sum_{k=1}^{k} \beta_k P_{jt-k} + e_t$$

Result and Discussion
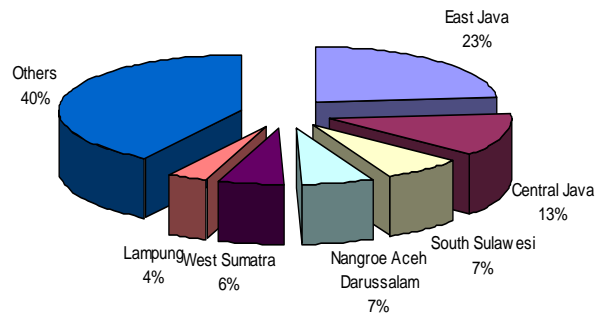
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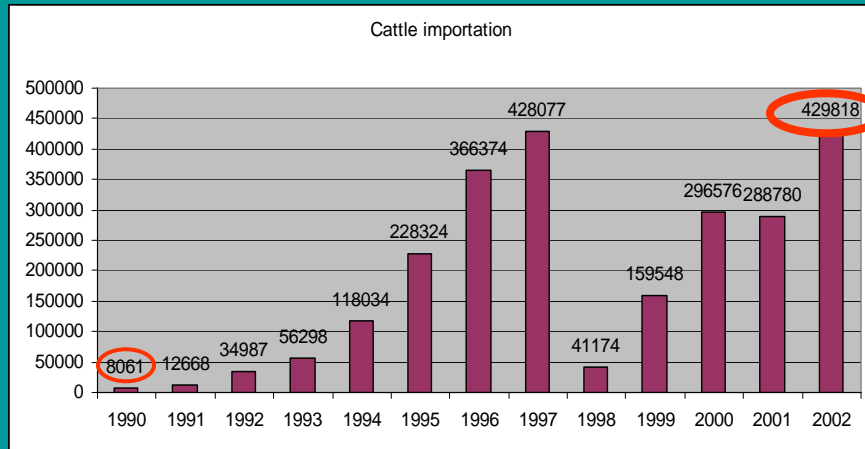

CATTLE PRODUCING AREAS BY PROVINCE, INDONESIA

The top eight cattle producers by province, Indonesia, 2004-2007

East Java
23%

Others
40%

Central Java
13%

South Sulawesi
7%

Nangroe Aceh Darussalam
7%

Lampung
4%

West Sumatra
6%

Cattle population by province, Indonesia, 2000-2004

ID	PROVINCE	YEAR (THOUSAND HEADS)				
		2000	2001	2002	2003	2004
		(000 heads)				
1	Nangroe Aceh Darussalam	668	699	701	701	702
2	West Sumatra	429	501	546	583	623
3	South Sumatra	420	415	419	419	506
4	Lampung	375	373	380	387	388
5	Central Java	1,317	1,331	1,337	1,345	1,346
6	East Java	3,312	3,312	3,312	2,516	2,517
7	East Nusa Tenggara	485	495	502	512	523
8	South Sulawesi	718	722	751	737	751
	Others	3422	3615	3705	3891	3422
	Total	11,008	11,137	11,297	10,504	10,726

Live cattle importation, Indonesia, 1990-2002

Cattle importation

| Year	Value
1990	8061
1991	12668
1992	34987
1993	56298
1994	118034
1995	228324
1996	366374
1997	428077
1998	41174
1999	159548
2000	296576
2001	288780
2002	429818

Meat self-sufficiency program 2004

- since the government extended the necessary technical knowledge and enhanced skills of the farmer through provision of appropriate training program, improvement of the cattle breed quality, feed quality, market infrastructure, and increase access to credit.

Cattle population, Indonesia, 2004-2007

PROVINCE	2004	2005	2006	2007
		(000 heads)		
NAD	655.8	625.1	718.6	763.9
West Sumatra	597.3	419.4	440.6	463
Lampung	391.8	417.1	401.6	412.2
South Sumatra	438.7	449.5	450.3	584
East Nusa Tenggara	522.9	533.7	544.5	555.3
South Sulawesi	628	594.3	637.1	646.8
Central Java	1,357.1	1,390.4	1,392.6	1,401.8
East Java	2,519	2,524.5	2,584.4	2,646.1
Indonesia	10,532.8	10,569.3	10,875.1	11,365

Target cattle population 2006-2010
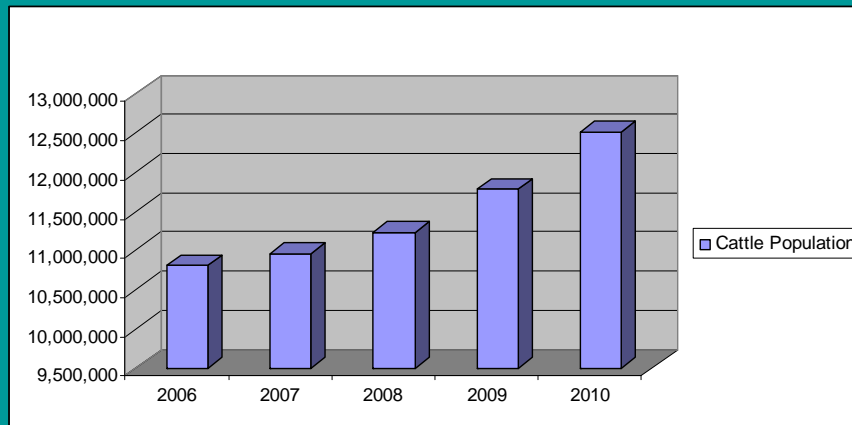
Target beef production, supply and demand, Indonesia, 2006-2010

ID	VARIABLE	YEARS				
		2006	2007	2008	2009	2010
		(tons)				
1	Beef Demand	356,863	370,812	385,035	399,536	414,317
2	Target Domestic Beef Production	330,586	336,517	342,407	345,558	467,131
3	Actual Domestic Beef Production	256,831	258,213	259,925	264,447	373,705
4	Gap : Demand-Supply	-100,032	-125,599	-135,109	-135,089	-40,612

Cattle Situation in Central Java

Cattle population, Central Java, 1990-2007
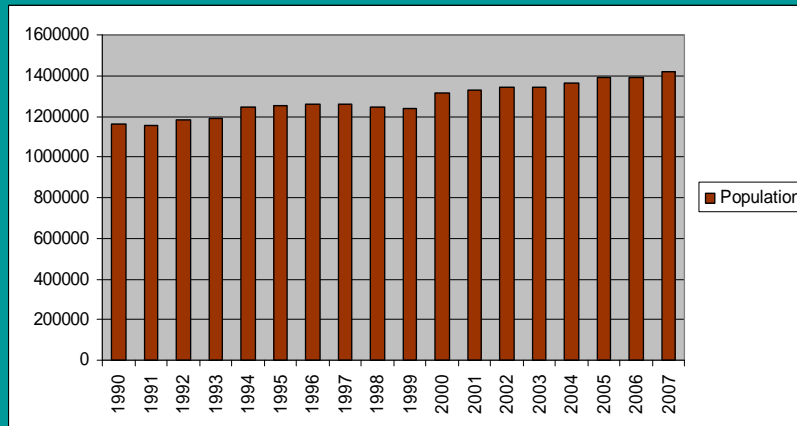
Beef Production, Central Java, 1990-2007
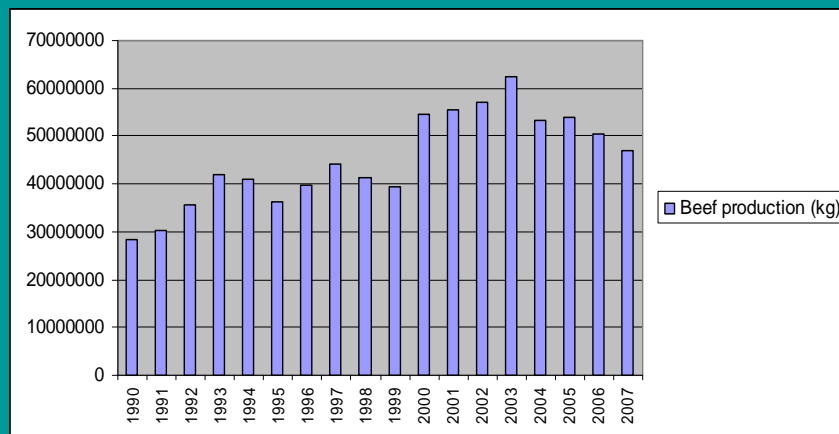
Top ten cattle producers, Central Java, 2007

Others
26%

Kab. Blora
15%

Kab. Wonogiri
11%

Kab. Grobogan
8%

Kab. Pati
5%

Kab. Semarang
5%

Kab. Magelang
5%

Kab. Sragen
6%

Kab. Klaten
6%

Kab. Boyolali
6%

Kab. Rembang
7%
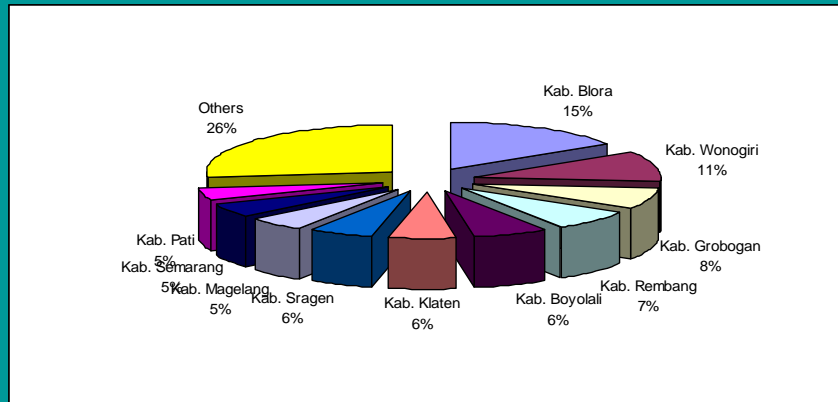
The nominal farm prices
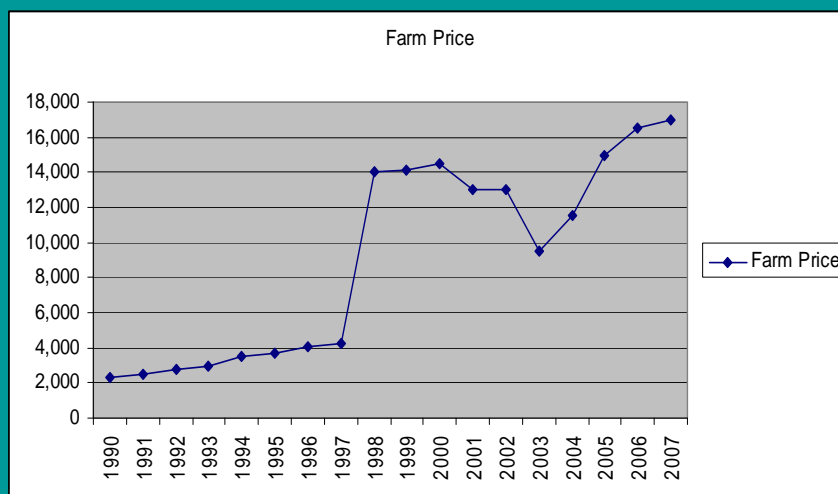
Farm Price

The nominal wholesale prices
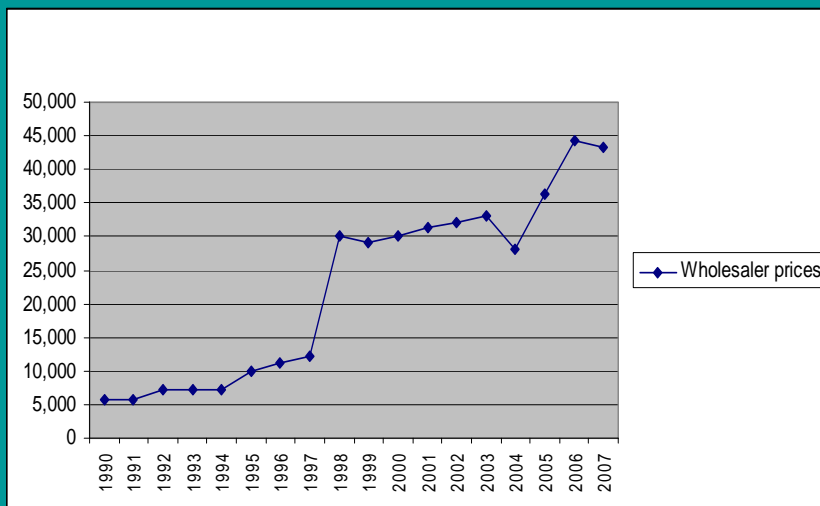
The nominal retail prices

The real farm prices
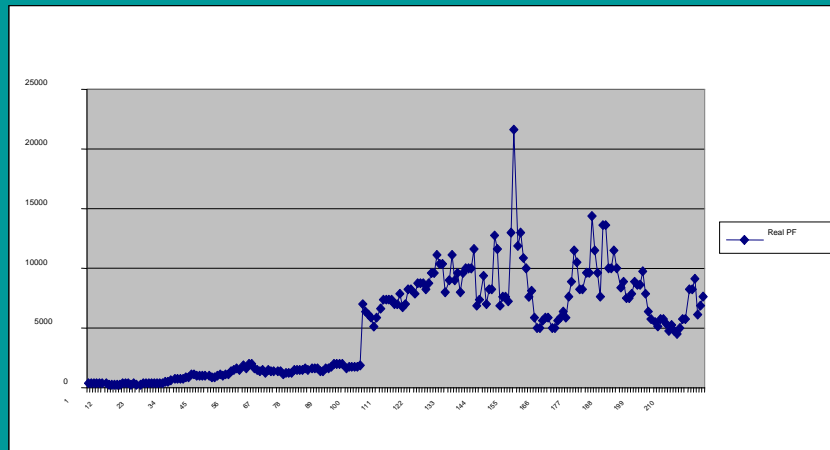
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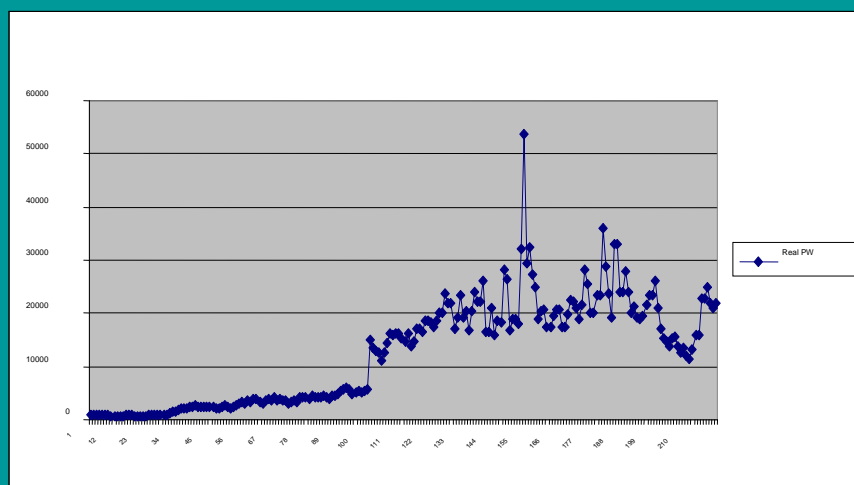
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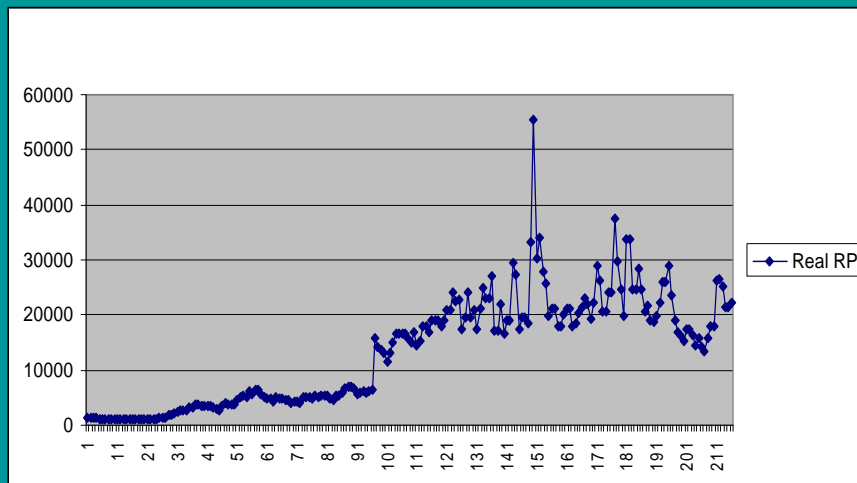
Real meat consumption and target, Central Java, 1990-2007
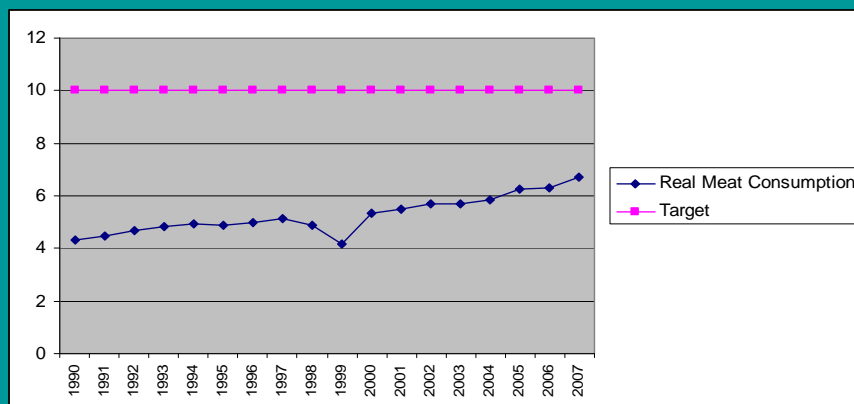
Estimated beef consumption, Central Java, 2000-2008
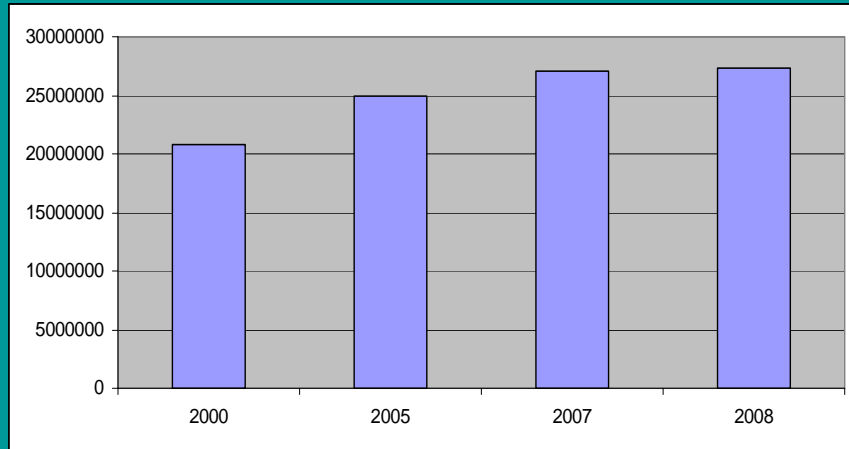
Total Human Population, Central Java, 2000-2008
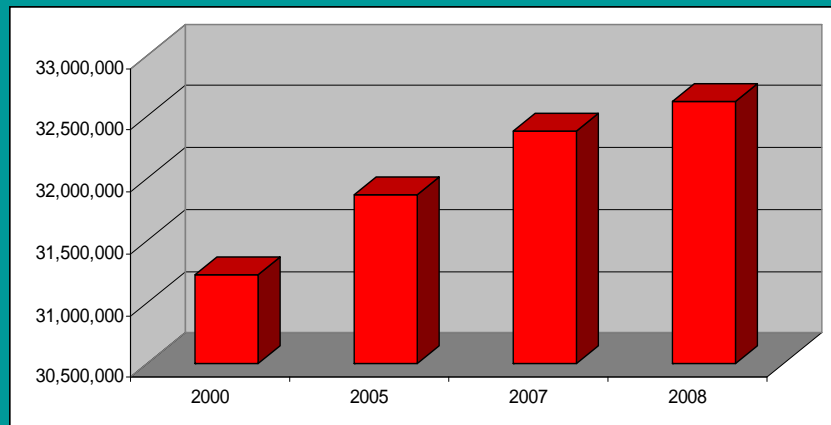
Cattle owned by farmers

ID	DISTRICT	AVERAGE OWNERSHIP (heads)
1	Kab. Magelang	2
2	Kab. Boyolali	2
3	Kab. Klaten	4
4	Kab. Wonogiri	3
5	Kab. Sragen	2
6	Kab. Grobogan	2
7	Kab. Blora	2
8	Kab. Rembang	2
9	Kab. Pati	2
10	Kab. Semarang	3
11	Kota Semarang	0
12	Average total province	3

Spatial Integration and Price Asymmetry at Farm Level

Market Areas
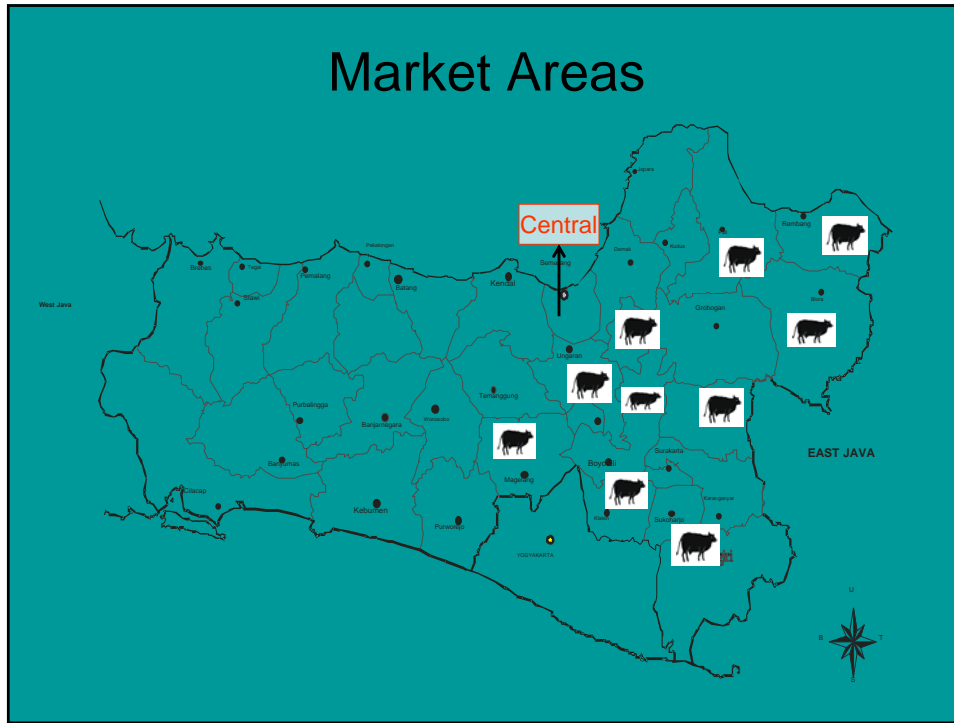
Transportation cost, regional markets to central market, Central Java, 1990-2008

YEAR	BLORA	GROBOGAN	REMBANG	PATI	KAB. SEMARANG	KLATEN	BOYOLALI	SRAGEN	MAGELANG	WONOGIRI
						(Rp/kg)				
1990	385	288	337	96	48	360	144	385	96	385
1991	385	337	337	192	48	288	144	385	96	385
1992	529	385	529	288	48	529	144	529	144	529
1993	529	433	529	337	48	385	144	529	192	529
1994	529	433	529	433	48	529	144	529	288	529
1995	673	577	673	565	48	529	192	673	337	673
1996	673	625	673	625	96	625	192	673	337	673
1997	673	625	913	529	96	625	192	673	337	673
1998	769	625	913	529	96	625	192	769	337	769
1999	769	625	913	529	96	625	192	769	337	769
2000	769	625	913	529	96	625	192	769	337	769
2001	769	625	913	529	144	625	192	769	337	769
2002	769	673	913	529	144	625	288	769	385	769
2003	913	673	962	577	192	360	288	913	385	913
2004	913	673	962	577	192	360	288	913	385	913
2005	913	673	962	577	288	360	288	913	385	913
2006	913	673	962	577	288	360	288	913	385	913
2007	1154	673	962	577	288	360	288	1154	385	1058
2008	1154	673	962	577	288	360	288	1154	385	1058

Descriptive price analysis

MARKET	MINIMUM	MAXIMUM	AVERAGE PRICE	STD. DEVIATION
		Rp/kg		
Blora	1,763	27,173	14,030.53	1021.5
Grobogan	1,758	27,150	14,048.46	1025.1
Rembang	1,757	27,125	14,041.95	1024.6
Pati	1,760	27,550	14,188.68	1032.4
Kabupaten Semarang	1,775	28,000	14,216.58	1034.5
Klaten	1,762	27,375	14,090.91	1026.3
Boyolali	1,750	26,500	13,845.97	1006.5
Sragen	1,748	26,250	13,709.59	996.3
Magelang	1,675	26,000	13,468.55	985.3
Wonogiri	1,650	25,925	13,338.68	977.7
Central	1,950	28,750	14,999.41	1053.3

PEARSON CORRELATION

MARKET	CEN	BLO	GRO	REM	PA	SEM	KLA	BOY	SRA	MAG	WON
Cen	1.00										
Blo	0.90	1.00									
Gro	0.93	0.99	1.00								
Rem	0.92	0.98	0.98	1.00							
Pa	0.93	0.99	0.99	0.99	1.00						
Sem	0.99	0.99	0.99	0.97	0.99	1.00					
Kla	0.97	0.99	0.99	0.99	0.99	0.99	1.00				
Boy	0.98	0.99	0.99	0.99	0.99	0.99	0.99	1.00			
Sra	0.98	0.99	0.99	0.98	0.98	0.99	0.99	0.99	1.00		
Mag	0.98	0.99	0.99	0.98	0.98	0.99	0.99	0.99	0.99	1.00	
Won	0.99	0.99	0.99	0.97	0.97	0.99	0.99	0.99	0.99	0.99	1.00

Unit root test for cattle markets at the farm level, Central Java, 1990-2008

PRICE SERIES	LEVEL	FIRST DIFFERENCES
	With Drift and Trends	
Blora	-1.505	-3.88**
Grobogan	-3.072	-3.69*
Rembang	-2.725	-3.76*
Pati	-2.240	-3.98**
Kab. Semarang	-2.20	-3.56**
Klaten	-2.312	-3.95**
Boyolali	-2.110	-3.90**
Sragen	-2.290	-4.30**
Magelang	-2.412	-3.60**
Wonogiri	-2.781	-3.75*
Central	-2.57	-3.95**

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level

Cointegration test at the farm level, Central Java, 1990-2008

HO:RANK=P	EIGENVALUE	TRACE TEST	MAX TEST
1. Blora and Central P=0 P≤1	0.722 0.031	25.78*** 1.621	25.78*** 1.621
2. Grobogan and Central P=0 P≤1	0.718 0.032	21.56*** 1.532	121.56*** 1.532
3. Rembang and Central P=0 P≤1	0.43 0.011	7.926*** 1.314	7.926*** 1.314
4. Pati and Central P=0 P≤1	0.423 0.032	14.579*** 1.382	13.630*** 1.382
5. Kab. Semarang and Central P=0 P≤1	1.00 0.036	490.00*** 1.980	490.00*** 1.980
6. Klaten and Central P=0 P≤1	0.541 0.025	12.417*** 1.837	12.417*** 1.837
7. Boyolali and Central P=0 P≤1	0.754 0.021	16.424*** 1.765	16.425*** 1.765
8. Sragen and Central P=0 P≤1	0.736 0.014	23.856*** 1.888	23.856*** 1.888
9. Magelang and Central P=0 P≤1	0.813 0.041	16.713*** 1.670	16.713*** 1.670

continue

HO:RANK=P	EIGENVALUE	TRACE TEST	MAX TEST
10. Wonogiri and Central P=0 P≤1	0.901 0.042	31.540*** 1.530	31.540*** 1.530
11. Blora and Grobogan P=0 P≤1	0.677 0.012	25.780*** 1.856	25.780*** 1.856
12. Blora and Sragen P=0 P≤1	0.670 0.045	21.980*** 1.754	21.980*** 1.754
13. Blora and Boyolali P=0 P≤1	0.820 0.042	23.120*** 1.736	23.120*** 1.736
14. Blora and Kab. Semarang P=0 P≤1	0.452 0.021	21.210*** 1.342	21.210*** 1.342
15. Blora and Wonogiri P=0 P≤1	0.711 0.016	15.750*** 1.340	15.750*** 1.340
16. Kab. Semarang and Klaten P=0 P≤1	0.762 0.013	16.651*** 1.314	16.651*** 1.314

Law of one price (LOP)

COINTEGRATING VECTOR	LOP IMPOSITION
1	Blora = Central +c1
2	Grobogan = Central +c2
3	Rembang = Central +c3
4	Pati = Central +c4
5	Kab. Semarang = Central +c5
6	Klaten = Central +c6
7	Boyolali = Central +c7
8	Sragen = Central +c8
9	Magelang = Central +c9
10	Wonogiri = Central +c10
11	Blora = Grobogan + c11
12	Blora = Sragen + c12
13	Blora = Boyolali + c13
14	Blora = Kab. Semarang +c14
15	Blora = Wonogiri + c15
16	Kab. Semarang = Klaten + c16

Results of Granger-Causality test for cattle price series at the farm level, Central Java, 1990-2008

RELATION	TYPE	RELATION	TYPE
Central – Blora	Unidirectional	Blora - Grobogan	Bi-directional
Central – Grobogan	Unidirectional	Blora - Sragen	Bi-directional
Central – Rembang	Unidirectional	Blora - Boyolali	Bi-directional
Central – Pati	Unidirectional	Blora - Kab. Semarang	Bi-directional
Central – Kab. Semarang	Unidirectional	Blora and Wonogiri	Bi-directional
Central – Klaten	Unidirectional	Kab. Semarang and Klaten	Bi-directional
Central – Boyolali	Unidirectional		
Central – Sragen	Unidirectional		
Central – Magelang	Unidirectional		
Central – Wonogiri	Unidirectional		

Asymmetric test results at the farm price level, Central Java, 1990-2008

ID	MARKET PAIR	LAG	CHI-STATISTICS
1	Blora and Central	1	0.678
2	Grobogan and Central	1	0.532
3	Rembang and Central	1	0.431
4	Pati and Central	2	0.356
5	Kab. Semarang and Central	2	0.890
6	Klaten and Central	1	0.038
7	Boyolali and Central	2	0.064
8	Sragen and Central	1	0.264
9	Magelang and Central	2	0.242
10	Wonogiri and Central	1	0.237
11	Blora and Grobogan	1	0.726
12	Blora and Sragen	3	0.156
13	Blora and Boyolali	3	0.567
14	Blora and Kab. Semarang	2	0.221
15	Blora and Wonogiri	1	0.340
16	Kab. Semarang and Klaten	1	0.254

Spatial Integration and Price Asymmetry at the Wholesale Level

Descriptive price analysis

MARKET	MINIMUM	MAXIMUM	AVERAGE PRICE	STD. DEVIATION
		Rp/kg		
Blora	5,261	40,425	20,503.84	1269.6
Grobogan	5,250	39,825	20,365.00	1250.9
Rembang	5,264	40,120	20,263.63	1258.5
Pati	5,247	40,268	20,400.37	1263.7
Kabupaten Semarang	5,267	40,443	20,557.21	1273.1
Klaten	5,262	40,400	20,494.37	1269.2
Boyolali	5,250	40,410	20,497.58	1269.3
Sragen	5,255	40,409	20,503.84	1269.8
Magelang	5,249	40,412	20,505.42	1269.3
Wonogiri	5,259	40,656	20,507.00	1270.8
Central	5,600	55,325	25,067.63	1639.5

Pearson correlation

MARKET	CEN	BLO	GRO	REM	PA	SEM	KLA	BOY	SRA	MAG	WON
Cen	1.00										
Blo	0.99**	1.00									
Gro	0.98**	0.99**	1.00								
Rem	0.95**	0.98**	0.98**	1.00							
Pa	0.97**	0.99**	0.99**	0.99**	1.00						
Sem	0.99**	0.99**	0.99**	0.97**	0.99**	1.00					
Kla	0.97**	0.99**	0.99**	0.99**	0.99**	0.99**	1.00				
Boy	0.98**	0.99**	0.99**	0.99**	0.99**	0.99**	0.99**	1.00			
Sra	0.98**	0.99**	0.99**	0.98**	0.98**	0.99**	0.99**	0.99**	1.00		
Mag	0.98**	0.99**	0.99**	0.98**	0.98**	0.99**	0.99**	0.99**	0.99**	1.00	
Won	0.99**	0.99**	0.99**	0.97**	0.97**	0.99**	0.99**	0.99**	0.99**	0.99**	1.00

Unit root test for cattle markets at the wholesale level, Central Java, 1990-2008

PRICE SERIES	LEVEL	FIRST DIFFERENCES
	With Drift and Trends	
Blora	-1.549	-3.88**
Grobogan	-3.078	-3.87*
Rembang	-2.238	-3.90*
Pati	-2.160	-3.95**
Kab. Semarang	-2.983	-3.80**
Klaten	-2.732	-3.96**
Boyolali	-2.13	-3.77**
Sragen	-2.602	-4.48**
Magelang	-2.76	-3.90**
Wonogiri	-2.11	-3.71*
Central	-2.18	-3.98**

Cointegration test at the wholesale level, Central Java, 1990-2008

HO:RANK=P	EIGENVALUE	TRACE TEST	MAX TEST
1. Blora and Central P=0 P≤1	0.670 0.036	22.214*** 1.850	22.214*** 1.850
2. Grobogan and Central P=0 P≤1	0.773 0.031	20.20*** 1.560	20.20*** 1.560
3. Rembang and Central P=0 P≤1	0.450 0.015	7.875*** 1.230	7.875*** 1.230
4. Pati and Central P=0 P≤1	0.671 0.018	12.500*** 1.470	12.500*** 1.470
5. Kab. Semarang and Central P=0 P≤1	1.000 0.038	390.88*** 1.841	390.88*** 1.841
6. Klaten and Central P=0 P≤1	0.330 0.044	12.312*** 1.714	12.312*** 1.714
7. Boyolali and Central P=0 P≤1	0.42 0.031	17.240*** 1.752	17.240*** 1.752
8. Sragen and Central P=0 P≤1	0.745 0.031	20.875*** 1.652	20.875*** 1.652
9. Magelang and Central P=0 P≤1	0.650 0.030	14.541*** 1.723	14.541*** 1.723
10. Wonogiri and Central P=0 P≤1	0.555 0.030	11.450*** 1.415	11.450*** 1.415
11. Blora and Grobogan P=0 P≤1	0.431 0.024	14.240*** 1.540	14.240*** 1.540

Continue

HO:RANK=P	EIGENVALUE	TRACE TEST	MAX TEST
12. Blora and Sragen P=0 P≤1	0.651 0.029	10.760*** 1.532	10.760*** 1.532
13. Blora and Boyolali P=0 P≤1	0.761 0.018	17.800*** 1.570	17.800*** 1.570
14. Blora and Kab. Semarang P=0 P≤1	0.485 0.030	18.540*** 1.867	18.540*** 1.867
15. Blora and Wonogiri P=0 P≤1	0.478 0.026	16.780*** 1.615	16.780*** 1.615
16. Sragen and Wonogiri P=0 P≤1	0.660 0.027	15.217*** 1.823	15.217*** 1.823

LOP

COINTEGRATING VECTOR	LOP IMPOSITION
1	Blora = Central +c1
2	Grobogan = Central +c2
3	Rembang = Central +c3
4	Pati = Central +c4
5	Kab. Semarang = Central +c5
6	Klaten = Central +c6
7	Boyolali = Central +c7
8	Sragen = Central +c8
9	Magelang = Central +c9
10	Wonogiri = Central +c10
11	Blora = Grobogan + c11
12	Blora = Sragen + c12
13	Blora = Boyolali + c13
14	Blora = Kab. Semarang +c14
15	Blora = Wonogiri + c15
16	Kab. Semarang = Klaten + c16

Results of Granger-Causality test for beef price series at the wholesale level, Central Java, 1990-2008

RELATION	TYPE	RELATION	TYPE
Central – Blora	No Granger Causality	Blora - Grobogan	Bi-directional
Central – Grobogan	No Granger Causality	Blora - Sragen	No Granger Causality
Central – Rembang	No Granger Causality	Blora - Boyolali	No Granger Causality
Central – Pati	No Granger Causality	Blora - Kab. Semarang	No Granger Causality
Central – Kab. Semarang	Bi-directional	Blora and Wonogiri	No Granger Causality
Central – Klaten	No Granger Causality	Kab. Semarang-Klaten	Bi-directional
Central – Boyolali	No Granger Causality		
Central – Sragen	No Granger Causality		
Central – Magelang	No Granger Causality		
Central – Wonogiri	No Granger Causality		

Asymmetric test results at the wholesale price level, Central Java, 1990-2008

ID	MARKET PAIR	LAG	CHI-STATISTICS
1	Blora and Central	1	0.980
2	Grobogan and Central	1	0.640
3	Rembang and Central	2	0.775
4	Pati and Central	2	0.470
5	Kab. Semarang and Central	2	0.490
6	Klaten and Central	1	0.017
7	Boyolali and Central	2	0.760
8	Sragen and Central	1	0.450
9	Magelang and Central	2	0.397
10	Wonogiri and Central	4	0.476
11	Blora and Grobogan	1	0.659
12	Blora and Sragen	3	0.457
13	Blora and Boyolali	3	0.982
14	Blora and Kab. Semarang	2	0.760
15	Blora and Wonogiri	1	0.324
16	Kab. Semarang and Klaten	1	0.642

Spatial Integration and Price Asymmetry at the Retail level

Descriptive price analysis

MARKET	MINIMUM	MAXIMUM	AVERAGE PRICE	STD. ERROR OF MEAN
		Rp/kg		
Blora	7,463	47,232	25,467	1378.6
Grobogan	7,367	45,052	25,074	1333.7
Rembang	7,315	40,540	23,966	1216.3
Pati	6,975	43,156	24,484	1283
Kabupaten Semarang	7,627	48,367	25,263	1405.6
Klaten	7,367	41,848	24,565	1255.7
Boyolali	6,523	41,367	23,467	1265.4
Sragen	6,963	44,232	24,309	1321.1
Magelang	7,175	43,963	24,503	1289.3
Wonogiri	6,963	46,136	24,694	1382.1
Central	7,900	55,800	27,052	1592.3

Pearson Correlation

MARKET	CEN	BLO	GRO	REM	PA	SEM	KLA	BOY	SRA	MAG	WON
Cen	1.00										
Blo	0.99**	1.00									
Gro	0.98**	0.99**	1.00								
Rem	0.95**	0.98**	0.98**	1.00							
Pa	0.97**	0.99**	0.99**	0.99**	1.00						
Sem	0.99**	0.99**	0.99**	0.97**	0.99**	1.00					
Kla	0.97**	0.99**	0.99**	0.99**	0.99**	0.99**	1.00				
Boy	0.98**	0.99**	0.99**	0.99**	0.99**	0.99**	0.99**	1.00			
Sra	0.98**	0.99**	0.99**	0.98**	0.98**	0.99**	0.99**	0.99**	1.00		
Mag	0.98**	0.99**	0.99**	0.98**	0.98**	0.99**	0.99**	0.99**	0.99**	1.00	
Won	0.99**	0.99**	0.99**	0.97**	0.97**	0.99**	0.99**	0.99**	0.99**	0.99**	1.00

Unit Root test

PRICE SERIES	LEVEL	FIRST DIFFERENCE
	With Drift and Trends	
Blora	-1.706	-3.97**
Grobogan	-3.094	-3.48*
Rembang	-2.94	-3.56*
Pati	-2.157	-3.97**
Kab. Semarang	-2.24	-3.79**
Klaten	-2.512	-3.95**
Boyolali	-2.200	-3.79**
Sragen	-2.607	-4.27**
Magelang	-2.68	-3.93**
Wonogiri	-2.22	-3.62*
Central	-2.73	-3.89**

Cointegration test

HO:RANK=P	EIGENVALUE	TRACE TEST	MAX TEST
1. Blora and Central P=0 P≤1	0.799 0.034	24.09*** 1.765	24.09*** 1.765
2. Grobogan and Central P=0 P≤1	0.728 0.032	19.55*** 1.665	19.55*** 1.665
3. Rembang and Central P=0 P≤1	0.41 0.014	7.926*** 1.265	7.926*** 1.265
4. Pati and Central P=0 P≤1	0.596 0.044	13.630*** 1.465	13.630*** 1.465
5. Kab. Semarang and Central P=0 P≤1	1.00 0.034	551.05*** 1.875	551.05*** 1.875
6. Klaten and Central P=0 P≤1	0.538 0.034	11.613*** 1.765	11.613*** 1.765
7. Boyolali and Central P=0 P≤1	0.665 0.034	16.424*** 1.765	16.425*** 1.765
8. Sragen and Central P=0 P≤1	0.799 0.034	22.091*** 1.765	22.091*** 1.765

Continue

HO:RANK=P	EIGENVALUE	TRACE TEST	MAX TEST
9. Magelang and Central P=0 P≤1	0.799 0.034	15.559*** 1.765	15.559*** 1.765
10. Wonogiri and Central P=0 P≤1	0.799 0.034	30.489*** 1.765	30.489*** 1.765
11. Blora and Grobogan P=0 P≤1	0.773 0.014	14.520*** 1.816	14.520*** 1.816
12. Blora and Sragen P=0 P≤1	0.617 0.031	12.430*** 1.856	12.430*** 1.856
13. Blora and Boyolali P=0 P≤1	0.525 0.021	13.500*** 1.721	13.500*** 1.721
14. Blora and Kab. Semarang P=0 P≤1	0.75 0.018	16.540*** 1.651	16.540*** 1.651
15. Blora and Wonogiri P=0 P≤1	0.731 0.030	11.680*** 1.850	11.680*** 1.850
16. Kab. Semarang and Klaten P=0 P≤1	0.753 0.029	16.889*** 1.751	16.889*** 1.751

LOP

COINTEGRATING VECTOR	LOP IMPOSITION
1	Blora = Central +c1
2	Grobogan = Central +c2
3	Rembang = Central +c3
4	Pati = Central +c4
5	Kab. Semarang = Central +c5
6	Klaten = Central +c6
7	Boyolali = Central +c7
8	Sragen = Central +c8
9	Magelang = Central +c9
10	Wonogiri = Central +c10
11	Blora = Grobogan + c11
12	Blora = Sragen + c12
13	Blora = Boyolali + c13
14	Blora = Kab. Semarang + c14
15	Blora = Wonogiri +c15
16	Kab. Semarang = Klaten +c16

Result of Granger-Causality test for beef price series at the retail level, Central Java, 1990-2008

RELATION	TYPE	RELATION	TYPE
Central – Blora	Unidirectional	Blora - Grobogan	Bi-directional
Central – Grobogan	Unidirectional	Blora - Sragen	Bi-directional
Central – Rembang	Unidirectional	Blora - Boyolali	Bi-directional
Central – Pati	Unidirectional	Blora - Kab. Semarang	Bi-directional
Central – Kab. Semarang	Unidirectional	Blora and Wonogiri	Bi-directional
Central – Klaten	Unidirectional	Kab. Semarang and Klaten	Bi-directional
Central – Boyolali	Unidirectional		
Central – Sragen	Unidirectional		
Central – Magelang	Unidirectional		
Central – Wonogiri	Unidirectional		

Asymmetric test results at the retail level, Central Java, 1990-2008

ID	MARKET PAIR	LAG	CHI-STATISTICS
1	Blora and Central	2	0.678
2	Grobogan and Central	2	0.532
3	Rembang and Central	2	0.431
4	Pati and Central	2	0.356
5	Kab. Semarang and Central	2	0.890
6	Klaten and Central	2	0.038
7	Boyolali and Central	2	0.064
8	Sragen and Central	2	0.264
9	Magelang and Central	2	0.242
10	Wonogiri and Central	2	0.237
11	Blora and Grobogan	1	0.726
12	Blora and Sragen	3	0.156
13	Blora and Boyolali	3	0.567
14	Blora and Kab. Semarang	2	0.221
15	Blora and Wonogiri	3	0.340
16	Kab. Semarang and Klaten	2	0.320

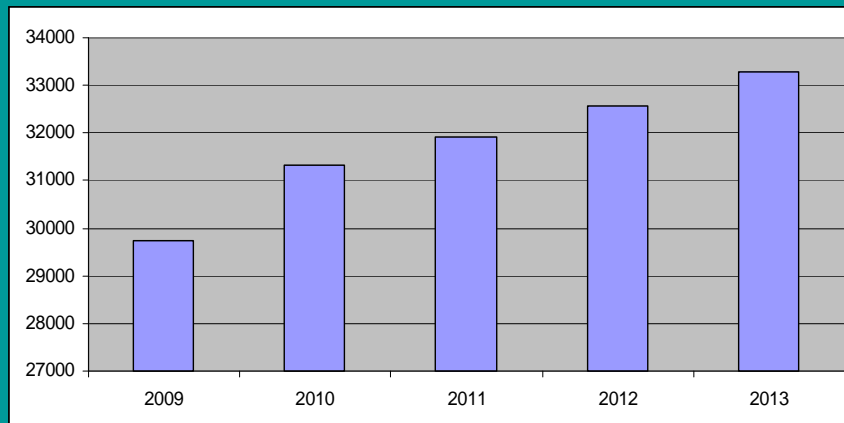# The Impact of Meat Self-Sufficiency Program in Beef Cattle Sector, Central Java

Cattle population

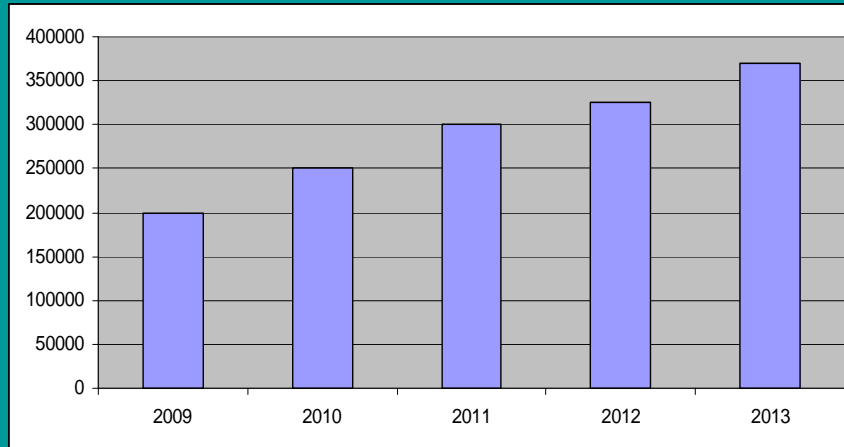| PERIOD	CATTLE POPULATION (heads)
Pre-implementation meat self sufficiency program	1,252,621
Post-implementation meat self sufficiency program	1,391,278
t-value	-4.157***

Target cattle population, Central Java, 2009-2013
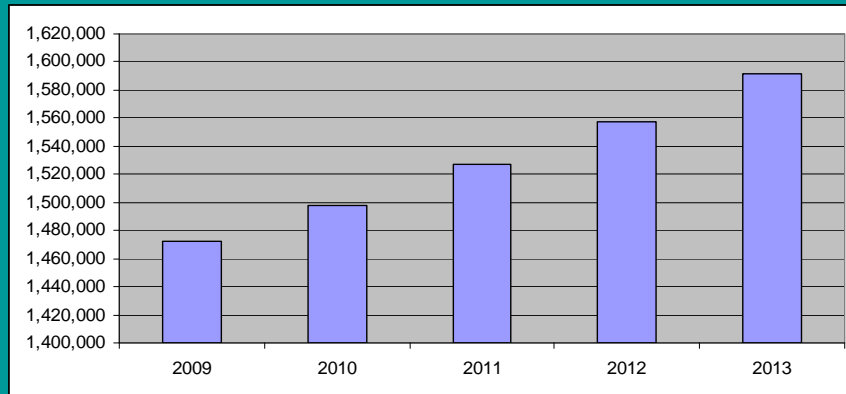
The target young cattle population, Central Java, 2009-2013

Target semen production, Central Java, 2009-2013

Beef Production

PERIOD	BEEF PRODUCTION (tons)
Pre-implementation meat self sufficiency program	40,000
Post-implementation meat self sufficiency program	50,000
t-value	-1.455

per capita meat consumption

PERIOD	AVERAGE MEAT CONSUMPTION (Kg/year)
Pre-implementation meat self sufficiency program	4.98
Post-implementation meat self sufficiency program	6.28
t-value	-5.194***

Beef consumption

PERIOD	BEEF CONSUMPTION	
	Total (tons)	Per capita (kg/year)
Pre-implementation meat self sufficiency program	161,961	0.651
Post-implementation meat self sufficiency program	208,426	0.785
t-value	-4.021***	-3.531***

Beef retail price

PERIOD	RETAIL PRICE (Rp/kg)
Before imposition of meat self sufficiency	20,325
After imposition of meat self sufficiency	43,437
t-value	-3.614**

# Factors Contributing to the Beef Cattle Integration in Central Java

Transportation cost

MARKETS	CONSTANT	COEFFICIENT	TEST STATISTIC	P VALUE
Blora-Semarang	-23568.8	67.824	10.757***	0.000
Grobogan-Semarang	-26940.3	93.995	4.808***	0.000
Rembang-Semarang	-17878.9	57.461	5.716***	0.000
Pati-Semarang	-12727	86.835	5.377***	0.000
Kab. Semarang-Semarang	5650.95	156.880	9.002***	0.000
Klaten-Semarang	-23535.2	83.312	5.683***	0.000
Boyolali-Semarang	-20324.2	220.627	6.392***	0.000
Sragen-Semarang	-23568.8	67.824	10.757***	0.000
Magelang-Semarang	-9021.73	116.77	4.394***	0.000
Wonogiri-Semarang	-26933.5	73.324	9.975***	0.000

Distance

ROAD CLASSIFICATION	LENGTH (km)
Provincial Roads	22,459
District Roads	17,270
Total	39,720
Asphalted	60%
Non Asphalted	40%

Road network
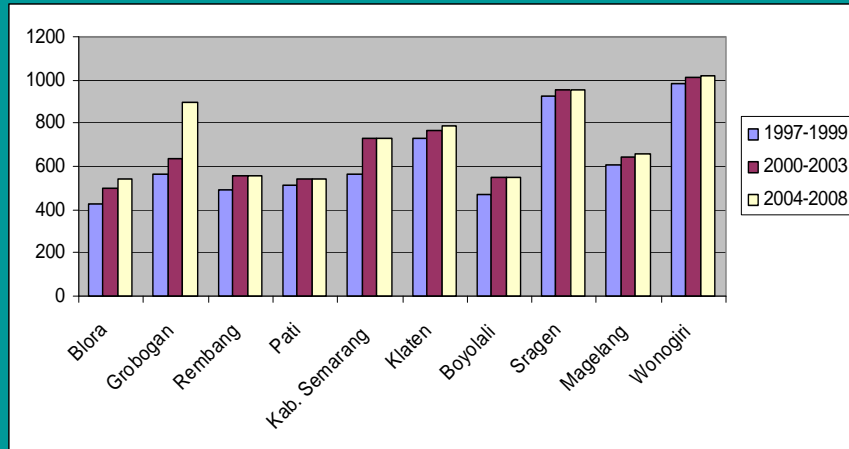
Total number radio stations
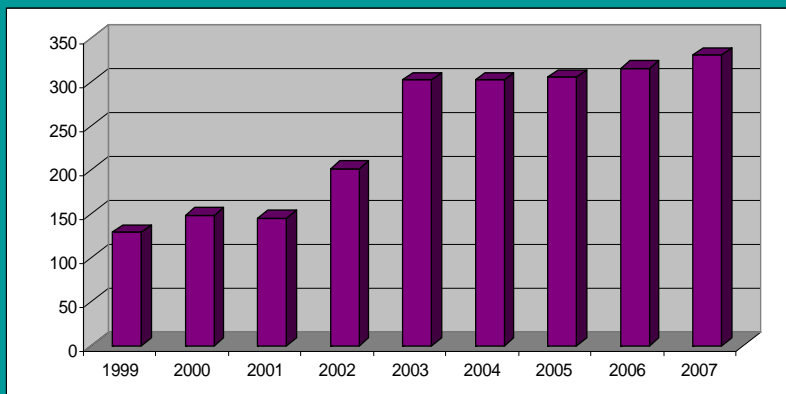
Econometric Model for Retail Price in Central Java

ID	VARIABLE	COEFFICIENT	T -VALUE	P- VALUE
1	Constant	3194.13	19.929***	0.000
2	PR_{t-1}	0.084	2.257**	0.025
3	PW	0.895	55.678***	0.000
4	PW_{t-1}	-0.050	-1.266	0.207
5	PF	0.080	2.481**	0.014
6	PF_{t-1}	-0.078	-2.432**	0.016
7	PF_{t-2}	-0.008	-0.440	0.660
8	dummy variable	341.140	1.862*	0.064
	R^2	0.98		
	Dependent Variable	Retail Price		

Summary, Conclusions

Farm level
- Results of the Johansen cointegration test at the farm level showed that all of the 16 market pairs had one cointegrating vector. The price series were highly integrated with each other.
- Law of One Price (LOP) test, all market pairs were cointegrated and integration patterns are perfect in the said market pairs
- In the Granger-causality analysis, there were 6 cattle market pairs among the 16 market pairs which had bi-directional relations. It means that a price change in one market was caused by the price change in the other markets and vice versa. Unidirectional relations were found in the 10 market pairs
- At the farm level, price transmission from one market to the other market for all market pairs was symmetric. This is significant since it indicates that any increase or decrease in the farm price is more efficiently transmitted to the other market

Wholesale level
- At the wholesale level, the Johansen co-integration test results revealed showed that among the 16 market pairs there is one co-integrating vector which indicates indicator that the price series are highly integrated with each other.
- In the LOP test, all market pairs were found to be cointegrated. The integration patterns were also found to be perfect
- Among the 16 wholesale market pairs, only 3 market pairs had bi-directional relations. It means that a price change in one market was caused by the price change in the other market and vice versa. The other 13 wholesale market pairs had no Granger-causality
- At the wholesale level, the price transmission from one to the other market pairs were symmetric. This is significant since it indicates that increases or decreases in wholesale price are more efficiently transmitted

Retail level
- At the retail level, the Johansen co-integration test results showed that all of the 16 market pairs had one co-integrating vector. This implies that the price series are highly integrated with each other
- In the LOP test, all market pairs were found to be co-integrated, which means that the prices are fully transmitted between markets. The integration patterns were also found to be perfect
- In the Granger-causality analysis done, it was found that among the 16 retail market pairs, 6 pairs had bi-directional relations. It means that a price change in one market is caused by the other and vice versa. Unidirectional relations were found in 10 market pairs
- Price transmission from one to the other market for all market pairs at the retail level was symmetric. This is also significant since it indicates that any increase or decrease in the farmer price are more efficiently transmitted to the other market.

Market infrastructure

- In Central Java, all the regional markets have good road networks, which help facilitate the price transmission process. The arbitrage flows easily from the regional market to the central market and vice versa and from the regional market to the other regional market.

Impact meat self sufficiency program

- cattle population in Central Java has increased after the implementation of the meat self-sufficiency program
- Total and average per capita beef consumption in Central Java has increased after the implementation of the meat self-sufficiency program
- beef production did not increase significantly after the implementation of the meat-self sufficiency program

continue

- The retail price of beef increase after meat self-sufficiency program was implemented
- The increase in the demand for meat led to the increase in the beef retail price in the province.

continue

- Transportation cost has a positive impact on the beef retail price in the central market
- Efficient market infrastructure and telecommunication facilities are found in Central Java, thus, the arbitrage of cattle from regional market to central market or from regional market to regional market was not affected

continue

- Regression analysis was done to examine the factors that influence the retail price of beef in central market. The regression model was statistically significant at the 1 % level. Retail price during the previous year (PRt-1) significantly affected the current retail price. The wholesale price (PW) significantly affected the retail price of beef in the Central Market. On the other hand, the wholesale price during the previous year (PWt-1) did not influence the beef retail price in the central market. The farm price lagged one year (PFt-1) and the farm price lagged two years (PFt-2) significantly influenced the retail price of beef in the central market. The dummy variable representing the meat self-sufficiency program was significant.

Policy Direction

1. *Strengthen the meat self sufficiency program in Central Java*
2. *Increasing the investments in market infrastructure and communication facilities*
3. *Enhancing technical support to improve the cattle farm productivity*

continue

4. *Establishment of a cattle auction center*
5. *Improvement of the live cattle market facilities*
6. *Production of better quality beef*

Thank You