Measuring food price transmission

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Presented at the Comesa training course on
"Food price variability: Causes, consequences, and policy options"
on 28-29 January 2010 in Maputo, Mozambique
under the Comesa-MSU-IFPRI African Agricultural Markets Programme (AAMP)

Outline

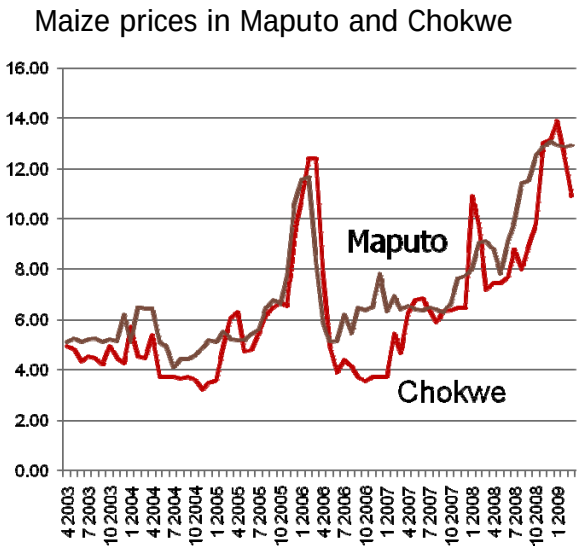
- What is price transmission?
- Why does price transmission occur?
- What is an elasticity of price transmission?
- How do we measure price transmission?
  - Simple percentage changes
  - Correlation analysis
  - Regression analysis
  - Non-stationarity and co-integration analysis
- Summary

What is price transmission?

- Price transmission is when changes in one price cause another price to change
- Types of price transmission:
  - Spatial: Price of maize in South Africa → price of maize in Maputo
  - Vertical: Price of wheat → price of flour
  - Cross-commodity: Price of maize → price of rice

Why does price transmission occur?

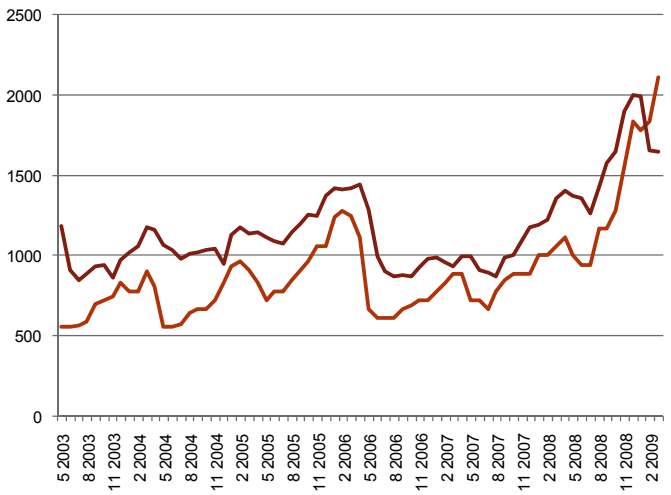
- Spatial price transmission occurs because of flows of good between markets
- If price gap > marketing costs, trade flows will narrow gap
- If price gap < marketing cost, no flows
- Therefore, price gap <= marketing cost



Why does price transmission occur?

- Vertical price transmission occurs because of flows of goods along marketing channel

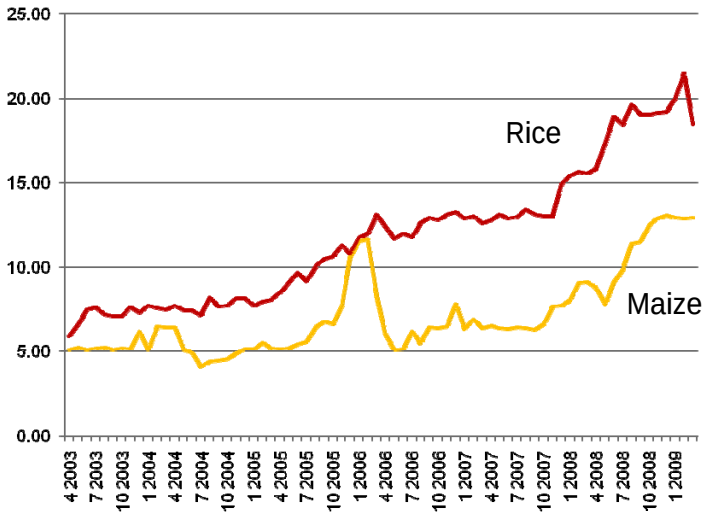
Maize grain and maize meal prices in Kitwe, Zambia



Why does price transmission occur?

- Cross-commodity price transmission occurs because of substitution in consumption and/or production

Price of maize and rice in Maputo



Why might price transmission not occur?

- High transportation cost makes trade unprofitable
- Trade barriers make trade unprofitable
- Goods are imperfect substitutes (e.g. imported rice and local rice)
- Lack of information about prices in other markets
- Long time to transport from one market to another (lagged transmission)

What is an elasticity of price transmission?

- Price transmission elasticity: % change in one price for each 1% increase in the other price

- Example: if a 10% increase in the world price of maize causes a 3% increase in the local price of maize, then price transmission elasticity is 0.03/0.10 = 0.3

What is an elasticity of price transmission?

- Elasticity of 1.0 is not always “perfect transmission”

  Example:
  - World price = $200/ton
  - Local price = $400/ton
  - $100 increase in world price causes $100 increase in local price
  - But transmission elasticity is (100/400)/(100/200)= 25%/50% = 0.50

- For imports, perfect transmission elasticity can be less than 1.0
- For exports, perfect transmission elasticity can be more than 1.0

How do we measure price transmission?

- Ratio of percentage changes between two time periods
- Correlation coefficient
- Regression analysis
- Co-integration analysis
- Other methods

Ratio of percentages

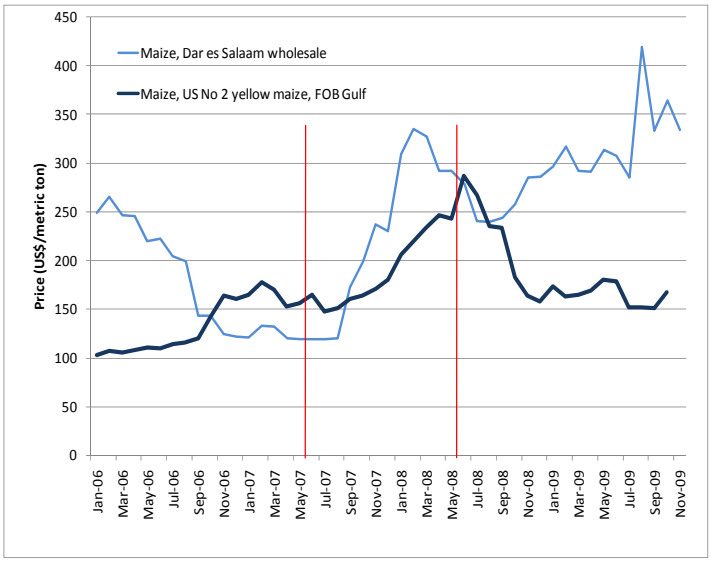
- Ratio of percentage changes between two time periods

	Price of maize in Dar in US$/ton	Price of US No 2 yellow maize in US$/ton
June 2007	120	165
June 2008	239	287
Percent change	99%	75%

- Elasticity of transmission is 1.32 (=.99/.75)

Ratio of percentages

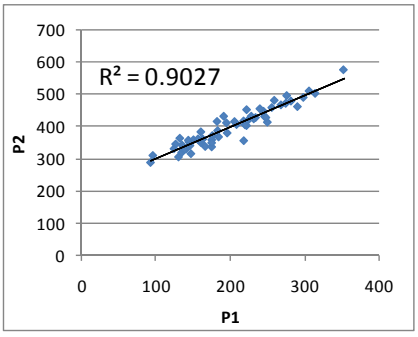
- Very crude method: only uses two points in time, does not take trends into account

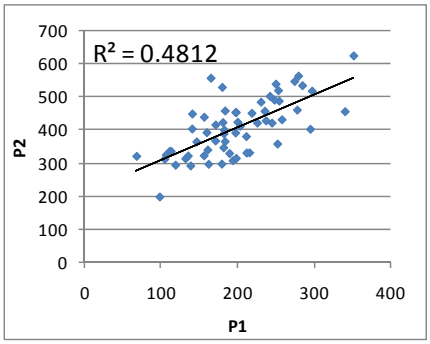


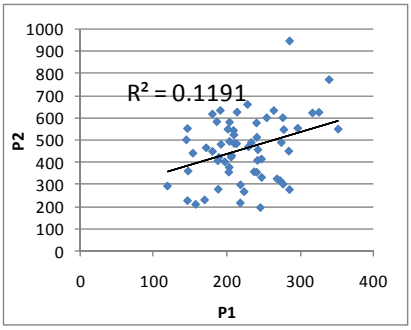
Correlation coefficient

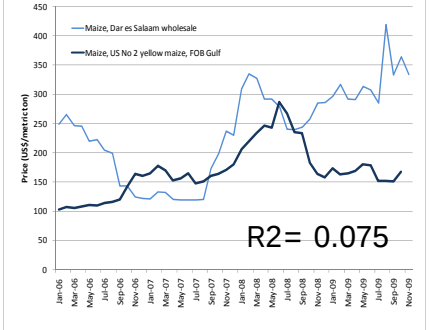
- Correlation coefficient measures the degree of relatedness of two variables
- In Excel: =correl(range1, range2)
- Advantage: easy to calculate and understand
- Disadvantage: only considers relationship between prices at same time, does not take into account lags
- **Exercise**
  1) In “correlation” worksheet, change b9 and look at effect on correlation in graph
  2) In “Data” worksheet, calculate correlation coefficient of two prices

Correlation coefficient









Regression analysis

- Multiple regression analysis finds equation that best fits data: $Y = a + b*X_1 + c*X_2 \ldots$
- Advantages
  - Gives information to calculate transmission elasticity
  - Can test relationships statistically
  - Can take into account lagged effects, inflation, and seasonality; can analyze relationship of >2 prices
- Disadvantages
  - Awkward to do in Excel (easier with Stata or SPSS)
  - Misleading results if data are non-stationary

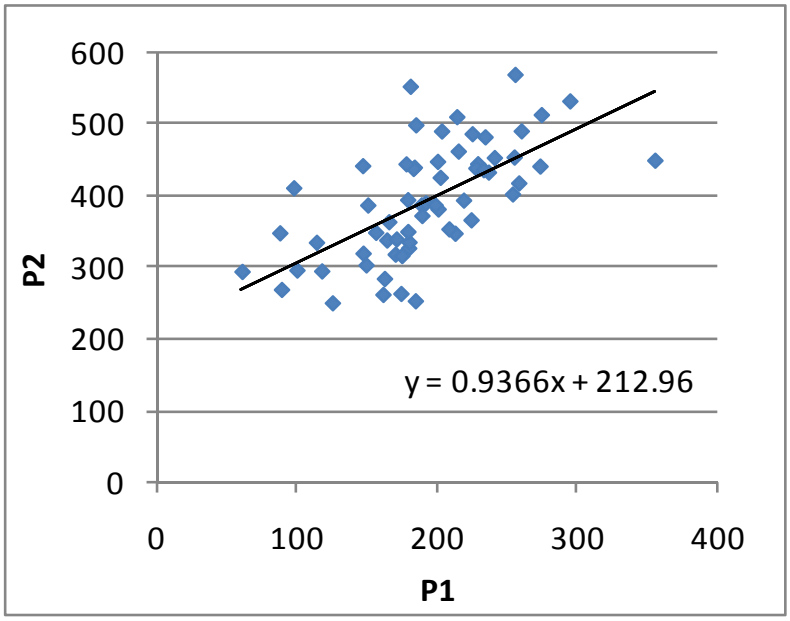
Regression analysis

- Using Excel 2003 for regression analysis (method 1)
  1) Mark columns with two prices
  2) Insert/Chart/XY(Scatter) /Finish
  3) Chart/Add trendline/ Linear
  4) Click “Options”, then “Display equation”

- Using Excel 2007 for regression analysis (method 1)
  1) Mark columns with two prices
  2) Insert/Scatter graph
  3) Chart tools/Layout/ Trendline/More trendline options
  4) Click box for “Display equation on chart”

Note: only one “x” allowed with this method

Regression analysis



Regression analysis

- Using Excel for regression analysis (method 2)
  1) =linest(y range, x range,1,1)
  2) Mark 5x2 block around formula
  3) F2 shift-control-enter

  Note: Can use multiple x's with this method

	=linest(..		

	=linest(..		

	b	a	
Coef	0.999	236.3	
SE	0.354	81.26	
R2	0.119	137.8	
	7.98	58.00	
	155	1,112	

Regression analysis

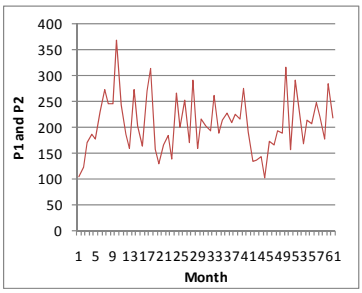
- Calculating transmission elasticity from regression coefficient
  - Regression coefficient b = ΔP2/ΔP1
  - Transmission elasticity is (ΔP2/P2) / (ΔP1/P1)
  - So transmission elasticity = b*(P1/P2)

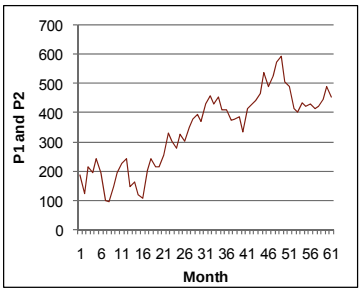
    where b = regression coefficient
    P2 = price on left side (Y variable)
    P1 = price on right side (X variable)
- **Exercise**
  - In “Regression” worksheet, change green cells and examine effect on results and graph
  - In “Data” worksheet, use regression analysis to analyze relationship between two prices

Non-stationarity - definition

- What is a non-stationary variable?
  - A variable that does not tend to go back to a mean value over time, also called “random walk”

Stationary variable	**Non-stationary variable**
Tends to go back toward mean	Does not tend to go back to mean
Finite variance	Infinite variance
Regression analysis is valid	**Regression analysis is misleading**





Non-stationarity - problem

- Why are non-stationary variables a problem?
  - If prices are non-stationary, regression analysis will give misleading results
  - **With non-stationary variables, regression analysis will say there is a statistically significant relationship even when there is NO relationship**

- **Exercise**
  - Use worksheet “Non-stationarity 1” to see that regression gives a high t statistics when there is no relationship

Non-stationarity - diagnosis

- How do you identify non-stationarity?
  - Several tests, most common one is the Augmented Dickey-Fuller test
  - Cannot easily be done in Excel, but Stata and SPSS can do it easily
  - Price data are usually non-stationary
    - Of 62 staple food prices tested, most (60%) were non-stationary

Non-stationarity - solution

- How do you analyze non-stationary prices?
  - Simple approach (with Excel)
    - First differences ($\Delta P = P_t - P_{t-1}$) are generally stationary
    - Regress ΔP_1 on ΔP_2, possibly with lags
  - Co-integration analysis (with Stata)
    - Test to see if prices are co-integrated, meaning that P2-b*P1-a is stationary
    - If prices are co-integrated, run error correction model (ECM)
    - ECM gives estimates of
      1) Long-run transmission
      2) Short-run transmission
      3) Speed of adjustment to long-run equilibrium

Non-stationarity - solution

- **Exercise**
  - Use “Stationarity 2” worksheet to see that regressing ΔP_1 and ΔP_2 correctly shows no relationship
  - Examine “Stationarity 3” to see how regressing ΔP_1 and ΔP_2 correctly shows a relationship that exists
  - Use “Data” to calculate first differences in two price and regress ΔP_2 on ΔP_1

Summary

- Price transmission occurs between markets, between stages of a market channel, and between commodities… but not always
- Correlation coefficient is easy but gives limited info
- Regression analysis
  - Can be done in Excel but easier in Stata
  - Gives estimate of price transmission
  - Can take into account lagged effects
  - But is misleading if prices are non-stationary
- Non-stationarity
  - Means prices follow a “random walk”
  - Can be tested with Stata
  - If prices are non-stationary, need to
    - At minimum, regress first-differences (can be done in Excel)
    - Preferably, carry out co-integration analysis (requires Stata)