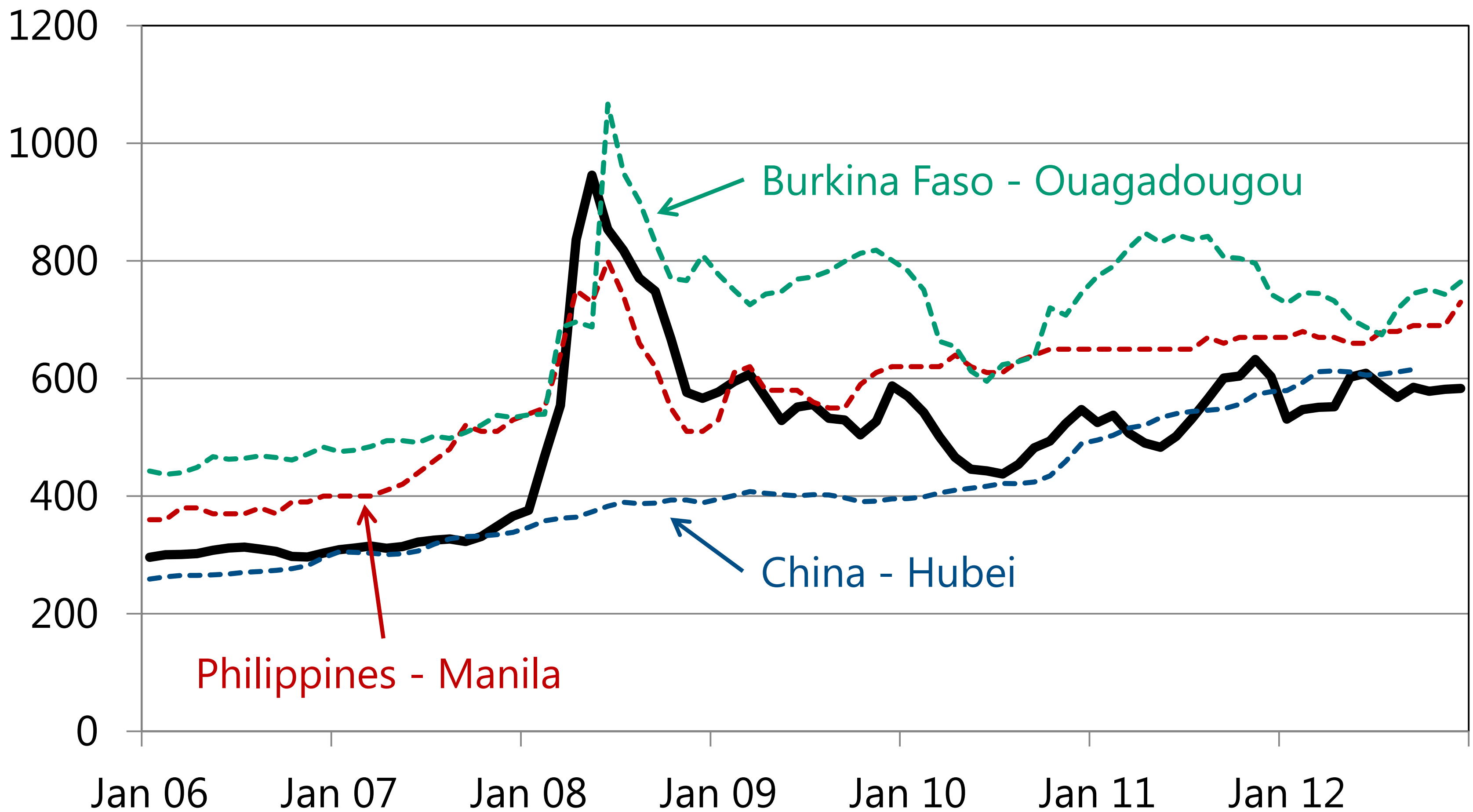
# Market integration and price transmission

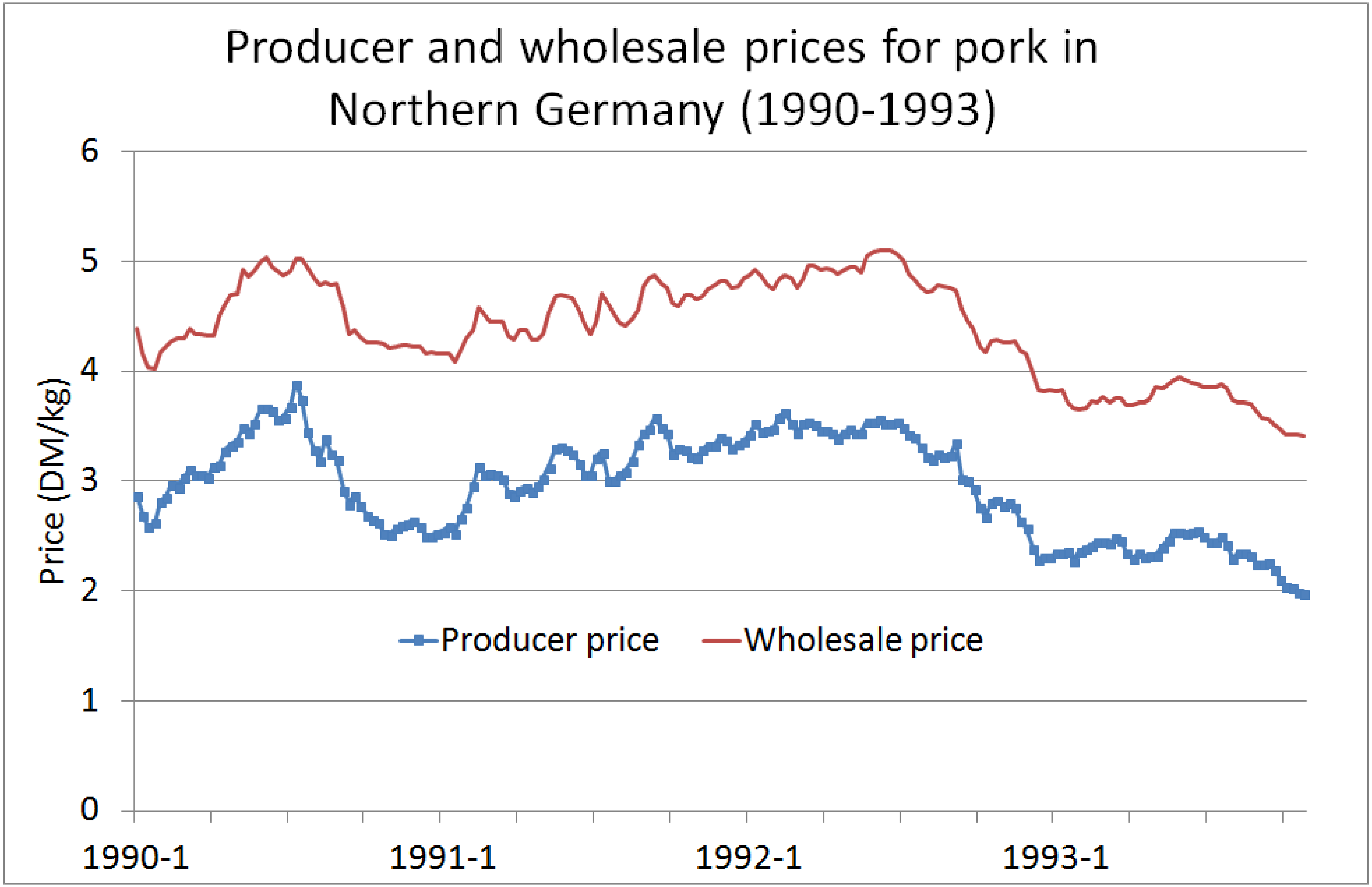
- (Agricultural) Economists work a lot with market models (diagrams, simulation models)
- But what exactly is a market, and how does it function?
  - What are the boundaries of a market?
  - What goes on between equilibria – market dynamics?
  - How do markets interact across boundaries (vertical and spatial)?

# Example (spatial – rice prices)




*Quelle: FAO – GIEWS.*

# Example (vertical – pork prices)



# In this course

- We will learn the basic theory of vertical and spatial price relations
- We will review the econometric methods that are used to estimate dynamic vertical and spatial price transmission relationships
- We will practice these methods using real price data
- We will discuss the strengths but also the many important weaknesses of existing theories and methods

# What you will need

- Solid command of English
- Basic econometrics
- The software (freeware) package ‘Gretl’
- Willingness to participate actively!

# Simple model of the farm-retail price spread

[Recommended reading: Gardner (1975), *The Farm-Retail…*]

$x = f(a,b)$ Supply of final food product 'x'

$f_a P_x = P_a$ Demand for farm raw input 'a'

$f_b P_x = P_b$ Demand for other inputs 'b'

$a = g(P_a)$ Supply of farm raw input 'a'

$b = g(P_b)$ Supply of other inputs 'b'

$x = D(P_x)$ Demand for final food product 'x'

# In equilibrium displacement terms…

$$x = f(a,b) \quad \Rightarrow \quad \dot{x} = S_a \dot{a} + S_b \dot{b}$$

$$f_a P_x = P_a \quad \Rightarrow \quad \dot{P}_a = \frac{-S_b}{\sigma} \dot{a} + \frac{S_b}{\sigma} \dot{b} + \dot{P}_x$$

$$f_b P_x = P_b \quad \Rightarrow \quad \dot{P}_b = \frac{-S_a}{\sigma} \dot{b} + \frac{S_a}{\sigma} \dot{a} + \dot{P}_x$$

$$a = g(P_a) \quad \Rightarrow \quad \dot{a} = \varepsilon_{a,P_a} \dot{P}_a$$

$$b = g(P_b) \quad \Rightarrow \quad \dot{b} = \varepsilon_{b,P_b} \dot{P}_b$$

$$x = D(P_x) \quad \Rightarrow \quad \dot{x} = \varepsilon_{x,P_x} \dot{P}_x$$

# Example derivation (1)

$$x = f(a,b) \quad \Rightarrow \quad \begin{aligned} dx &= f_a da + f_b db \\ \frac{dx}{x} &= \frac{P_a}{P_x}\frac{a}{x}\frac{da}{a} + \frac{P_b}{P_x}\frac{b}{x}\frac{db}{b} \\ \dot{x} &= S_a \dot{a} + S_b \dot{b} \end{aligned}$$

# Example derivation (2)

$$f_a P_x = P_a \quad \Rightarrow$$

$$dP_a = f_a dP_x + P_x df_a$$

$$\frac{dP_a}{P_a} = \frac{P_a}{P_x}\frac{dP_x}{P_a} + \frac{P_x}{P_a}( f_{ab} db + f_{aa} da )$$

$$\dot{P}_a = \frac{dP_x}{P_x} + \frac{P_x}{P_a}( \frac{f_a f_b}{\sigma x} db - \frac{f_a f_b}{\sigma x}\frac{b}{a} da )$$

$$\dot{P}_a = \dot{P}_x + \frac{P_x}{P_a}( \frac{P_a}{P_x}\frac{P_b}{P_x}\frac{b}{b}\frac{db}{\sigma x} - \frac{P_a}{P_x}\frac{P_b}{P_x}\frac{b}{a}\frac{da}{\sigma x} )$$

$$\dot{P}_a = \dot{P}_x + \frac{P_b}{P_x}\frac{b}{x}\frac{db}{b\sigma} - \frac{P_b}{P_x}\frac{b}{x}\frac{da}{a\sigma}$$

$$\dot{P}_a = \dot{P}_x + \frac{S_b}{\sigma}\dot{b} - \frac{S_b}{\sigma}\dot{a}$$

# Simple model of the farm-retail price spread

In matrix form…

$$
\begin{bmatrix}
1 & 0 & -S_a & -S_b & 0 & 0 \\
0 & -1 & S_b/\sigma & -S_b/\sigma & 1 & 0 \\
0 & -1 & -S_a/\sigma & S_a/\sigma & 0 & 1 \\
0 & 0 & 1 & 0 & -\varepsilon_{a,P_a} & 0 \\
0 & 0 & 0 & 1 & 0 & -\varepsilon_{b,P_b} \\
1 & -\varepsilon_{x,P_x} & 0 & 0 & 0 & 0
\end{bmatrix}
*
\begin{bmatrix}
\dot{x} \\ \dot{P}_x \\ \dot{a} \\ \dot{b} \\ \dot{P}_a \\ \dot{P}_b
\end{bmatrix}
=
\begin{bmatrix}
0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0
\end{bmatrix}
$$

# Simple model of the farm-retail price spread

To model the impact of a change in $P_a$ (the farm raw input)

$$
\begin{bmatrix}
1 & 0 & -S_a & -S_b & 0 & 0 \\
0 & -1 & S_b/\sigma & -S_b/\sigma & 1 & 0 \\
0 & -1 & -S_a/\sigma & S_a/\sigma & 0 & 1 \\
0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 & 0 & -\varepsilon_{b,P_b} \\
1 & -\varepsilon_{x,P_x} & 0 & 0 & 0 & 0
\end{bmatrix}
*
\begin{bmatrix}
\dot{x} \\ \dot{P}_x \\ \dot{a} \\ \dot{b} \\ \dot{P}_a \\ \dot{P}_b
\end{bmatrix}
=
\begin{bmatrix}
0 \\ 0 \\ 0 \\ \overline{\dot{P}_a} \\ 0 \\ 0
\end{bmatrix}
$$

Solve this for $\dfrac{\dot{P}_x}{\overline{\dot{P}_a}}$

# Simple model of the farm-retail price spread

Result (equation 19 in Gardner):

$$\frac{\dot{P}_x}{\dot{P}_a} = \frac{S_a(\sigma + \varepsilon_{b,P_b})}{\varepsilon_{b,P_b} + S_a\sigma - S_b\varepsilon_{x,P_x}}$$

1) Show that:

$$\frac{\dot{P}_x}{\dot{P}_a} < 1 \quad if \quad \varepsilon_{b,P_b} > \varepsilon_{x,P_x}$$

(i.e. In all ‘normal’ cases)

# Simple model of the farm-retail price spread

Result (equation 19 in Gardner):

$$\frac{\dot{P}_x}{\dot{P}_a} = \frac{S_a(\sigma + \varepsilon_{b,P_b})}{\varepsilon_{b,P_b} + S_a\sigma - S_b\varepsilon_{x,P_x}}$$

2) Show that:

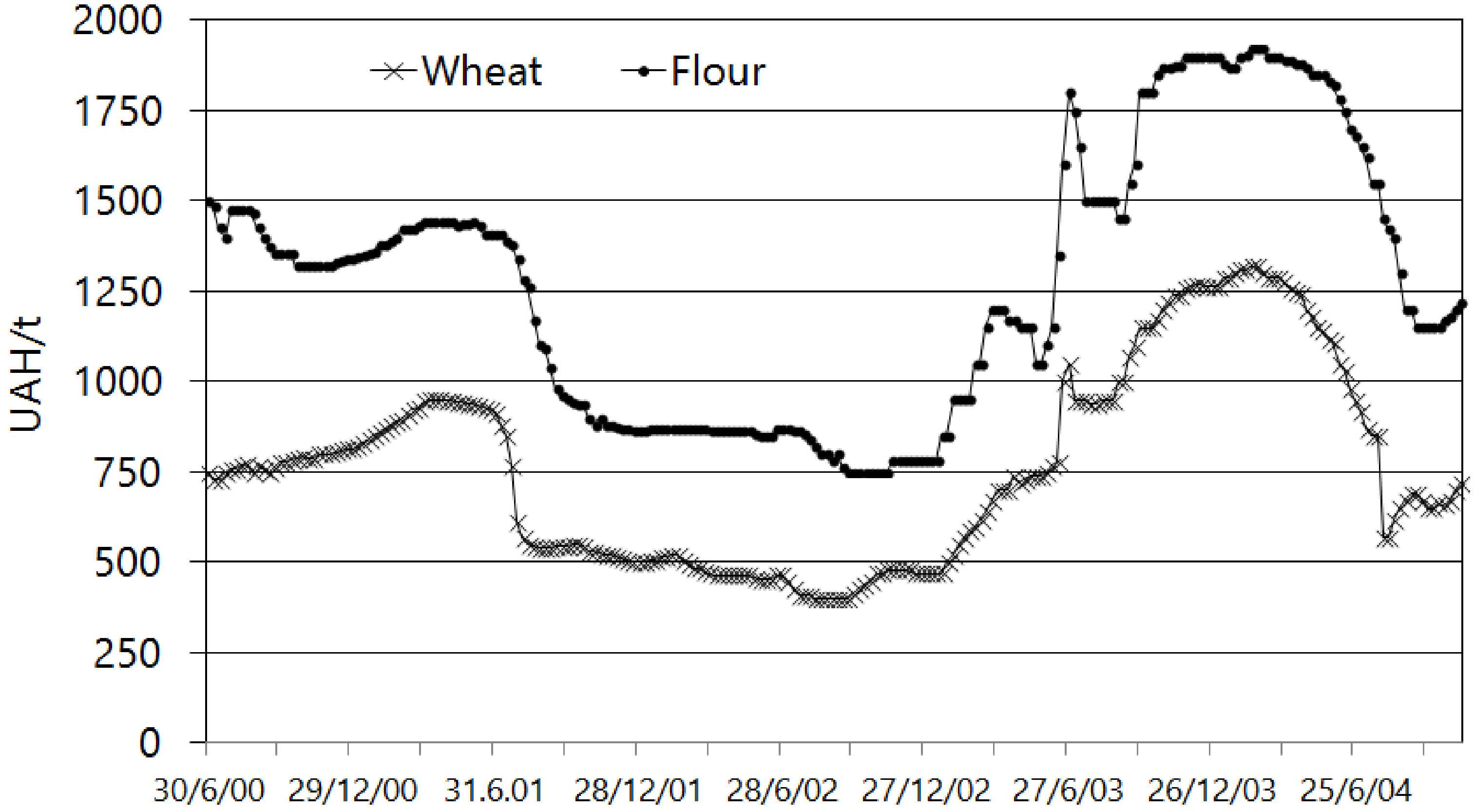
$$\frac{\dot{P}_x}{\dot{P}_a} \approx S_a$$

if there is little substitution possible between the farm input (a) and the non-farm input (b) and $S_b$ is not too large.

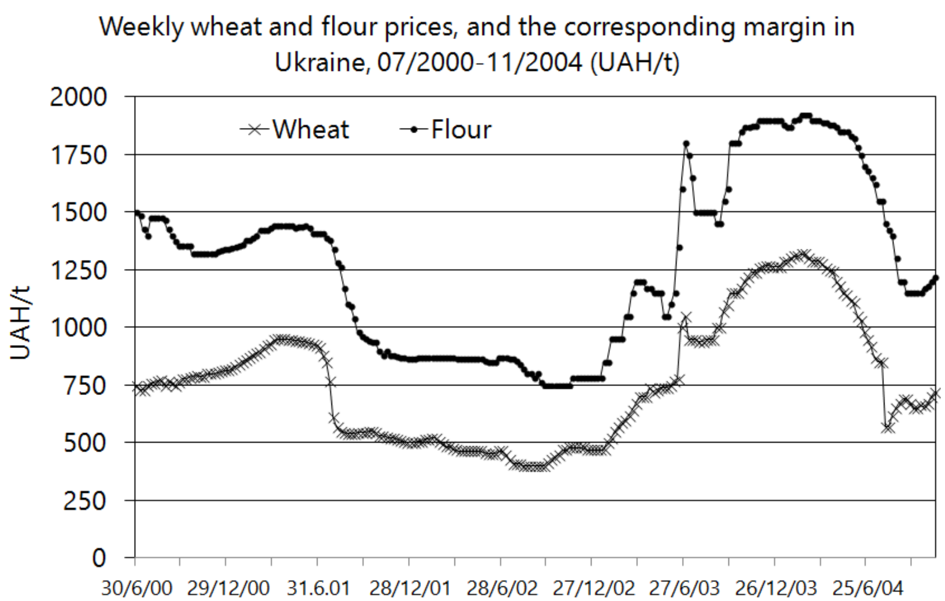
In the following two empirical examples we confirm this.

# Empirical example (I)

Weekly wheat and flour prices, and the corresponding margin in Ukraine, 07/2000-11/2004 (UAH/t)



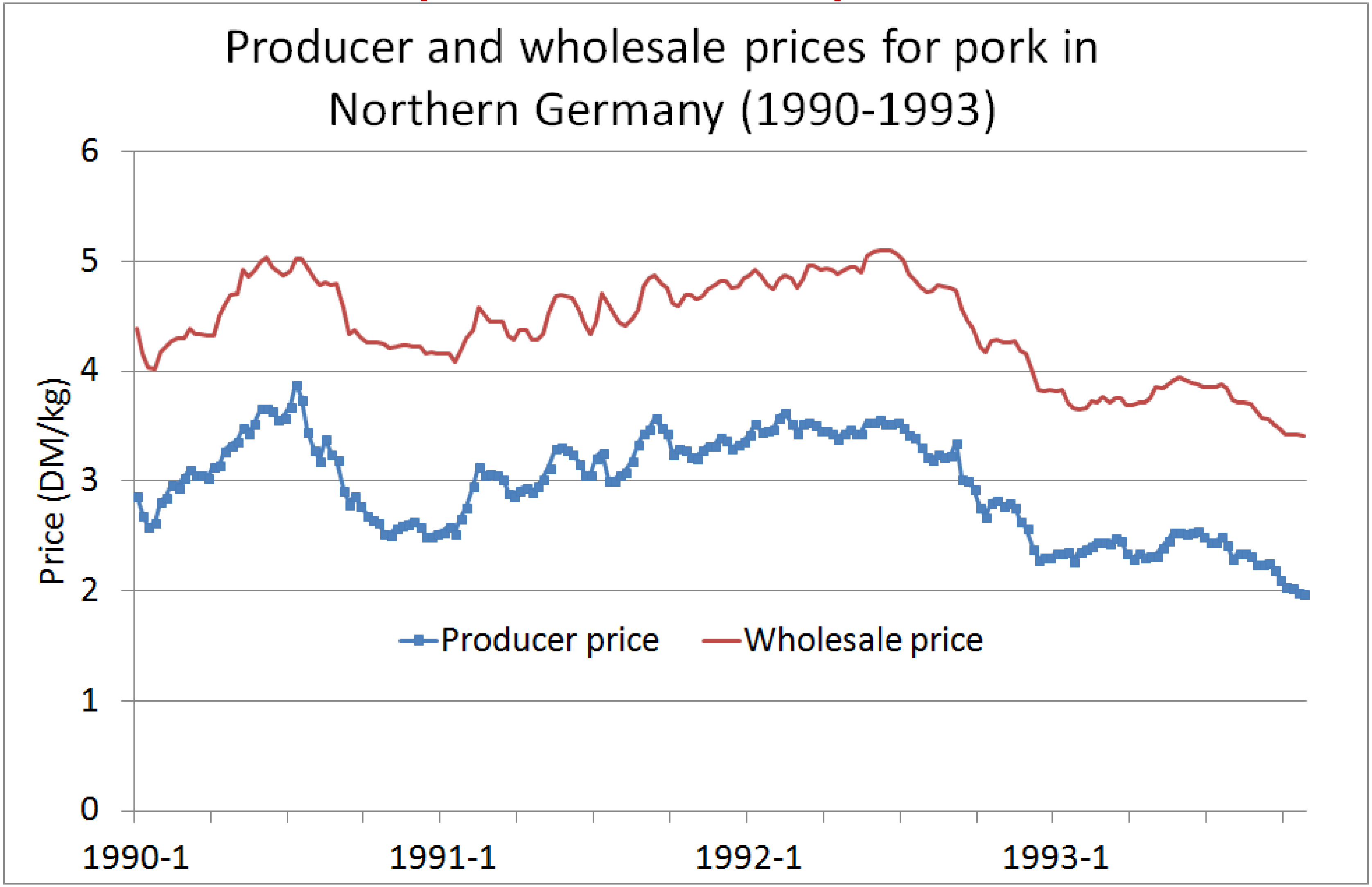
# Empirical example (I)



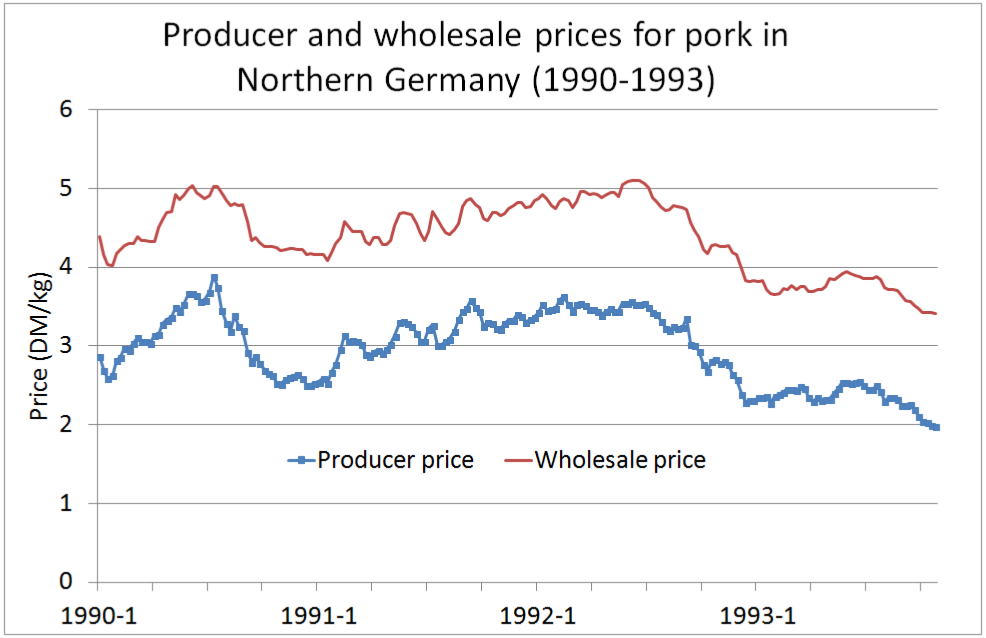

$$\ln P_f = 1{,}790 + 0{,}808 \ln P_w \quad \overline{P}_w = 766 \quad \overline{P}_f = 1275$$

Note: It takes roughly 1 kg of wheat to produce 0,75 kg of flour.
Therefore, to produce 1 kg of flour it cost 766/0,75 = 1021 UAH on average.
The cost share of wheat in flour production was thus ≈ 1021/1275 ≈ 0,80.

# Empirical example (II)



# Empirical example (II)




$$P_{whole} = 1{,}55 + 0{,}96 P_{prod} \quad \overline{P}_{whole} \approx 4{,}4 \quad \overline{P}_{prod} \approx 3{,}0$$

$$\ln(P_{whole}) = 0{,}781 + 0{,}644 \ln(P_{prod})$$