STATISTICS

Index calculation (2)

Individual indices (indices for a given commodity group, for a given type of product, i.e. ratios)

Individual price index:

$$i_p = \frac{p_1}{p_0}$$

i_p

where

p_1: unit price of the current period

p_0: unit price of the base period

Individual volume index:

$$i_q = \frac{q_1}{q_0}$$

where

q_1: volume for the current period

q_0: volume for the base period

Individual value index:

$$i_v = \frac{v_1}{v_0} = \frac{q_1 p_1}{q_0 p_0}$$

$$i_v = i_q \cdot i_p$$

where

v_1: product value for the current period

v_0: product value for the base period

Price index and price difference

- When studying the effect of price changes, the volume is assumed to be constant. Different statisticians use different weighting, so we can calculate, as follows.

  - **Current year weighting: Paashe price index:**

$$I_p^1 = I_p^P = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{1i} * p_{0i}}$$

  - **Base year weighting: Laspeyres price index**

$$I_p^0 = I_p^L = \frac{\Sigma q_{0i} * p_{1i}}{\Sigma q_{0i} * p_{0i}}$$

  - **Geometric mean of the two price indices: Fisher price index:**

$$I_p^F = \sqrt{I_p^1 * I_p^0}$$

Volume index and volume difference

- In this case price is constant, and two types of weighting is possible here as well.

  - **Current year weighting: Paashe volume index:**

$$I_q^1 = I_q^P = \frac{\Sigma q_{1i} * p_{1i}}{\Sigma q_{0i} * p_{1i}}$$

  - **Base year weighting: Laspeyres volume index**

$$I_q^0 = I_q^L = \frac{\Sigma q_{1i} * p_{0i}}{\Sigma q_{0i} * p_{0i}}$$

  - **Geometric mean of the two volume indices: Fisher volume index:**

$$I_q^F = \sqrt{I_q^1 * I_q^0}$$

Characteristics of aggregate-indices

- The individual indices are scattered around their arithmetic or harmonic average.
- All that we know on (the arithmetic and harmonic) average, they are also true to the aggregate indices, as well.
- Their numerical value can not be outside the range determined by the minimum and maximum individual indices.
- The more weight a given item shares in the total value, the more the individual index of the items approaches the aggregate index.
- **Instead of the value data, ratios as weights** calculated on them **can also be used**.

Agricultural producer price index

They reflect changes in producer prices of agricultural products.

Data source

- **monthly purchase report** of agricultural products processing and sales companies,
- **animal market and fair census** of CSO,

The fix-based monthly price index is obtained as a relation of the current year price of a product to its base year (2000) price.

Aggregate indices are calculated by weighting the base year production data.

An index compared to the same period of the previous year, is the quotient of two fixed base price index.

Terms of trade

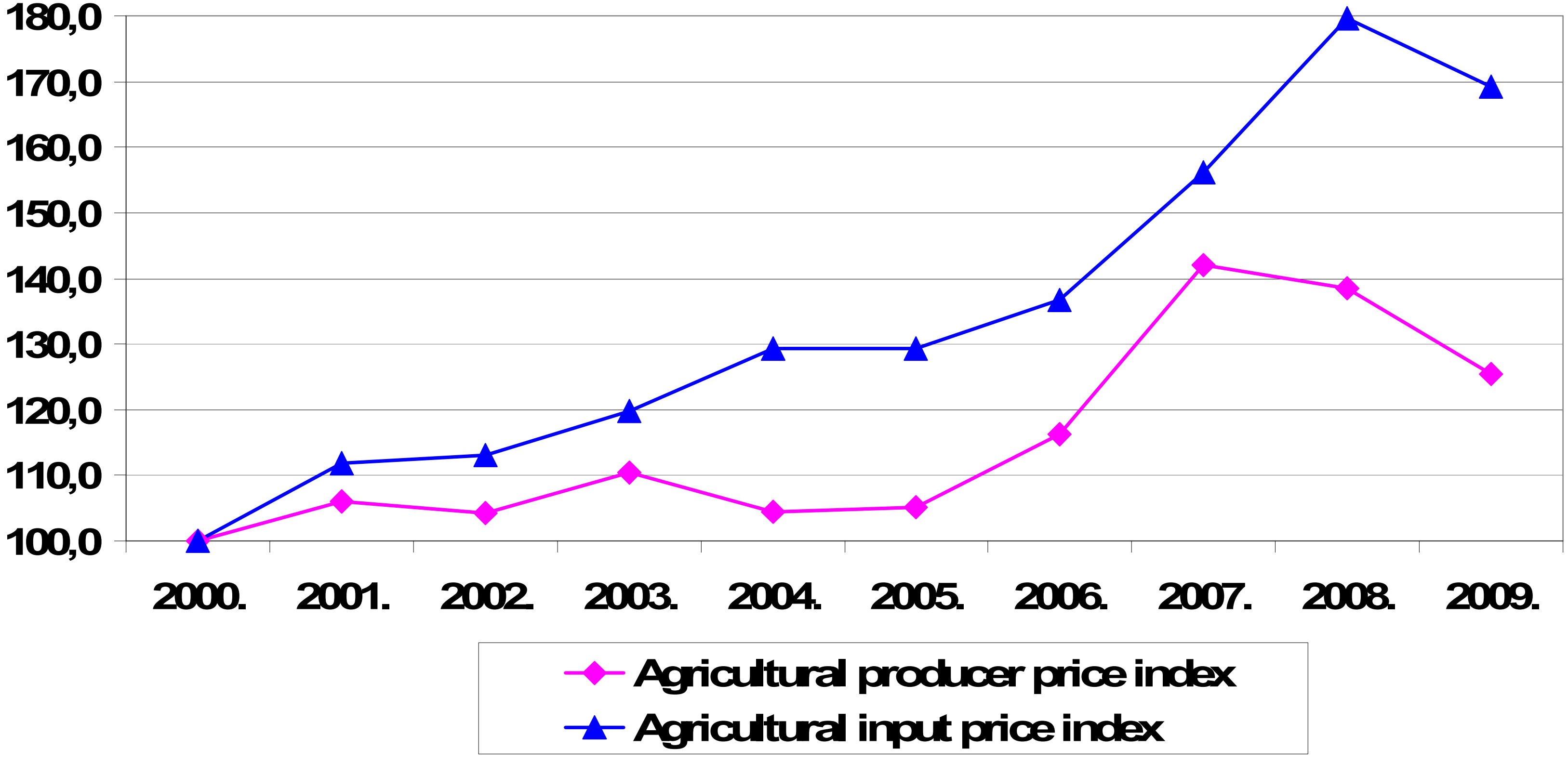
- **Calculation:**

  the agricultural producer price index divided by the price index of agricultural inputs.

- **Interpretation:**

  if the price gap is above 100, then the income situation of producers improves, resulting from improved price ratio.

Terms of trade, year 2000 = 100



Sample task

Product	*Unit*	*Sales volume*		*Price (HUF/unit)*	
		2001 December	*2002 January*	*2001 December*	*2002 January*
Bread	kg	80	86	155	175
Milk	litre	95	106	130	125
Frankfurter	pair	60	55	120	140
Butter	box	20	27	240	255
Sugar	kg	45	57	180	185

- Calculate the individual price index, value index and volume index!
- Calculate the aggregate price index in the learned forms!
- Determine the aggregate volume index of the products with base period and current period weighting!
- Calculate the aggregate value index in the possible forms!
- Resolve changes in the sales revenue to the effect of price changes and volume changes!

Individual indices

Product	$i_p = \frac{p_1}{p_0}$	$i_q = \frac{q_1}{q_0}$	$i_v = \frac{v_1}{v_0}$
Bread	112.90%	107.50%	121.37%
Milk	96.15%	111.58%	107.29%
Frankfurter	116.67%	91.67%	106.94%
Butter	106.25%	135.00%	143.44%
Sugar	102.78%	126.67%	130.19%
Total	-	-	*119.13%*

Additional calculations

Product	$q_{0i} * p_{0i}$	$q_{1i} * p_{1i}$	$q_{0i} * p_{1i}$	$q_{1i} * p_{0i}$
Bread	124.000	150.500	140.000	133.300
Milk	123.500	132.500	118.750	137.800
Frankfurter	72.000	77.000	84.000	66.000
Butter	48.000	68.850	51.000	64.800
Sugar	81.000	105.450	83.250	102.600
Total	*448.500*	*534.300*	*477.000*	*504.500*

Base period weighted price index

$$I_p^{\,0} = \frac{\sum q_{0i} p_{1i}}{\sum q_{0i} p_{0i}} = \frac{477.000}{448.500} = 106,35\%$$

$$Ip^{0} = \frac{124 \cdot 1{,}129 + 123{,}5 \cdot 0{,}9615 + 72 \cdot 1{,}1667 + 48 \cdot 1{,}0625 + 81 \cdot 1{,}0278}{448{,}5} = 106{,}35\%$$

$$Ip^{0} = \frac{\sum q_0 p_1}{\sum \frac{q_0 p_1}{ip}} = \frac{477000}{\frac{140000}{1{,}129} + \frac{118750}{0{,}9615} + \frac{84000}{1{,}1667} + \frac{51000}{1{,}0625} + \frac{83250}{1{,}0278}} = 106{,}35\%$$

$$Ip^{1} = \frac{\sum q_1 p_0 \cdot ip}{\sum q_1 p_0}$$

$$Ip^{1} = \frac{133300 \cdot 1{,}129 + 137800 \cdot 0{,}9615 + 66000 \cdot 1{,}1667 + 64800 \cdot 1{,}0625 + 102600 \cdot 1{,}0278}{504500} = 105{,}91\%$$

$$Ip = \frac{\sum q_1 p_1}{\sum q_1 p_0} = \frac{534300}{504500} = 105{,}91\%$$

$$Ip^{1} = \frac{\sum q_1 p_1}{\sum \frac{q_1 p_1}{ip}} = \frac{534300}{\frac{150500}{1{,}129} + \frac{132500}{0{,}9615} + \frac{77000}{1{,}1667} + \frac{68850}{1{,}0625} + \frac{105450}{1{,}0278}} = 105{,}91\%$$

Current period weighted price index

$$I_p^{1} = \frac{\sum q_{1i} p_{1i}}{\sum q_{1i} p_{0i}} = \frac{534300}{504500} = 105{,}91\%$$

$$Ip^1 = \frac{\sum v_1}{\sum \frac{v_1}{i_p}} = \frac{534{,}3}{\frac{150{,}5}{1{,}129} + \frac{132{,}5}{0{,}9615} + \frac{77}{1{,}1667} + \frac{68{,}85}{1{,}0625} + \frac{105{,}45}{1{,}0278}} = 105{,}91\%$$

$$Ip^1 = \frac{\sum q_1 p_0 \cdot ip}{\sum q_1 p_0}$$

$$Ip^1 = \frac{133{,}3 \cdot 1{,}129 + 137{,}8 \cdot 0{,}9615 + 66 \cdot 1{,}1667 + 64{,}8 \cdot 1{,}0625 + 102{,}6 \cdot 1{,}0278}{504{,}5} = 105{,}91\%$$

Volume indices

$$I_q^{0} = \frac{\sum q_{1i} p_{0i}}{\sum q_{0i} p_{0i}} = \frac{504500}{448500} = 112{,}49\%$$

$$I_q^{1} = \frac{\sum q_{1i} p_{1i}}{\sum q_{0i} p_{1i}} = \frac{534300}{477000} = 112{,}01\%$$

Value index

$$I_v = \frac{\sum q_{1i} p_{1i}}{\sum q_{0i} p_{0i}} = \frac{534300}{448500} = 119{,}13\%$$

$$I_v = \frac{\sum v_{0i}\, i_{vi}}{\sum v_{0i}}$$

$$I_v = \frac{124 \cdot 1{,}2137 + 123{,}5 \cdot 1{,}0729 + 72{,} \cdot 1{,}0694 + 48 \cdot 1{,}4344 + 81 \cdot 1{,}3019}{448{,}5} = 119{,}13\%$$

$$I_v = \frac{\sum v_{1i}}{\sum \frac{v_{1i}}{i_{vi}}} = \frac{477000}{\frac{140000}{1{,}2137} + \frac{118750}{1{,}0729} + \frac{84000}{1{,}0694} + \frac{51000}{1{,}4344} + \frac{83250}{1{,}3019}} = 119{,}13\%$$

Difference resolution

$$K_v = \sum q_{1i}p_{1i} - \sum q_{0i}p_{0i} = 534300 - 448500 = 85800$$

$$K_p = \sum q_{1i}p_{1i} - \sum q_{1i}p_{0i} = 534300 - 504500 = 29800$$

$$K_q = \sum q_{1i}p_{0i} - \sum q_{0i}p_{0i} = 504500 - 448500 = 56000$$

Index series

- Index series for more than two periods

Classification of index series

- ***According to its content:***
  - value
  - price
  - volume

- ***According to the comparison order of the periods:***
  - base
  - chain

- ***According to the method of weighting:***
  - fix-weighted
  - variable weighted

Areal indices

- To some products of the total, the **regional volume index** determines the **percentage of the production** at the **subject area** compared to the **base area**.

- The **regional price index** shows the **quotient of the price index (price level) in one area compared to the price index (price level) in another area**. If the compared entities are countries (of different currencies), then the regional price index expresses the ratio (of the purchasing power) of the unit value of the two currencies.

Indices in the practice (1)

- **Consumer price index:** it measures the **average price change of goods and services** purchased by the public.
- **Terms of trade:** the **quotient** of **sales price index** of agricultural products and **purchasing price index** of manufactured goods used in agriculture.
- **Exchange rate index:** **the quotient of the price indices of the exported and imported goods** by a country.

Indices in the practice (2)

- Real earning index
- GDP volume index
- Foreign trade volume indices

Turnover of key vegetables at a market merchant

Vegetable	March			April		
	Sales volume q_0	Unit price (HUF/unit) p_0	Traffic (HUF) $q_0p_0=v_0$	Sales volume q_1	Unit price (HUF/unit) p_1	Traffic (HUF) $q_1p_1=v_1$
Paprika	8200 db	70	574000	9500 db	40	380000
Tomato	1220 kg	510	622000	2340 kg	350	819000
Cucumber	380 kg	400	152000	550 kg	310	170500
Total	-	-	1348200	-	-	1369500

Price changes of some vegetables:

$$i_{pi} = \frac{p_{1i}}{p_{0i}} \qquad i = 1, 2, 3$$

$$\text{paprika}: \frac{40}{70} = 0{,}5714 \approx 57{,}1\%$$

$$\text{paradicsom}: \frac{350}{510} = 0{,}6862 \approx 68{,}6\%$$

$$\text{uborka}: \frac{310}{400} = 0{,}775 \approx 77{,}5\%$$

Aggregate price index weighted with the quantity (volume) of the base period:

$$I_p^{\,0} = \frac{\sum q_{0i} p_{1i}}{\sum q_{0i} p_{0i}} = \frac{8200 \cdot 40 + 1220 \cdot 350 + 380 \cdot 310}{8200 \cdot 70 + 1220 \cdot 510 + 380 \cdot 400} = \frac{872800}{1348200} = 0{,}6473$$

Aggregate price index weighted with the quantity (volume) of the current period:

$$I_p^{\,1} = \frac{\sum q_{1ii} p_{1i}}{\sum q_{1i} p_{0i}} = \frac{9500 \cdot 40 + 2340 \cdot 350 + 550 \cdot 310}{9500 \cdot 70 + 2340 \cdot 510 + 550 \cdot 400} = \frac{1369500}{2078400} = 0{,}689$$

Weighted with the current period quantity, the traffic decreased due to the price changes:

$K_p=\sum q_{1i}p_{1i}-\sum q_{1i}p_{0i}=1369500-20784000=-708900$ Ft

	Traffic decrease per item	
paprika	9500•(40-70)=9500•(-30)=	–285000 Ft
tomato	2340•(350-510)=2340•(-160)=	–374400 Ft
cucumber	550•(310-400)=550•(-90)=	–49500 Ft
total		–708900 Ft

Geometric mean of the price indices of the two weightings:

$$I_p^F=\sqrt{0{,}647\cdot 0{,}689}=\sqrt{0{,}426373}=0{,}6529\approx 65{,}3\%$$

Sales volume of certain vegetables:

$$i_q = \frac{q_1}{q_0}$$

paprika $: \frac{9500}{8200} = 1{,}158 \approx 115{,}8\%$

tomato $: \frac{2340}{1220} = 1{,}918 \approx 191{,}8\%$

cucumber $: \frac{550}{380} = 1{,}447 \approx 144{,}7\%$

Aggregate volume index weighted with the quantity of the base period:

$$I_q^{\,0} = \frac{\sum q_{1i} p_{0i}}{\sum q_{0i} p_{0i}} = \frac{9500 \cdot 70 + 2340 \cdot 510 + 550 \cdot 400}{8200 \cdot 70 + 1220 \cdot 510 + 380 \cdot 400} = \frac{2078400}{1348200} = 1{,}542 \approx 154{,}2\%$$

Aggregate volume index weighted with the quantity of the current period :

$$I_q^{\,1} = \frac{\sum q_{1i} p_{1i}}{\sum q_{0i} p_{1i}} = \frac{9500 \cdot 40 + 2340 \cdot 350 + 550 \cdot 310}{8200 \cdot 40 + 1220 \cdot 350 + 380 \cdot 310} = \frac{1369500}{872800} = 1{,}569 \approx 156{,}9\%$$

Weighted with the base period prices, the traffic decrease due to the change in quantity:

$K_q = \sum q_{1i} p_{0i} - \sum q_{0i} p_{0i} = 20784000 - 1348200 = 730200$ Ft

Cikkenkénti forgalomcsökkenés		
paprika	70•(9500-8200)=	91000 Ft
paradicsom	510•(2340-1220)=	571200 Ft
uborka	400•(550-380)=	68000 Ft
Együtt		730200 Ft

Fisher volume index:

$$I_q^F = \sqrt{1{,}542 \cdot 1{,}569} = 1{,}555 \approx 155{,}5\%$$

Always look on the bright side of things!

We finished for today, goodbye!

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талыг нь үргэлж олж харцгаая

өнөөдөртөө ингээд дуусгацгаая, баяртай

让我们总是从光明的一面来看待事
物吧！

今天的课程到此结束，谢谢！

دعونا ننظر دائما إلى الجانب المشرق من
الأشياء!

انتهينا لهذا اليوم، وداعا!