Indexes and Standardization

History 3797

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Simple index numbers

- Usually used to show change over time or differences between groups for measures that are calculated in different units
- Calculate just like a percentage
- Example: transportation statistics

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Table 3-6: National Transportation and Economic Trends

	1960	1965	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Passenger-miles (billions)	**1,327**	**1,630**	**2,170**	**2,561**	**2,895**	**3,326**	**3,946**	**3,976**	**4,089**	**4,165**	**4,262**	**4,333**	**4,483**	**4,623**	**4,749**	**4,904**	**U**	**U**
Index (1980 = 100)	46	56	75	88	100	115	136	137	141	144	147	150	155	160	164	169	U	U
Ton-miles (billions)	**1,562**	**1,854**	**2,207**	**2,285**	**2,989**	**2,949**	**3,196**	**3,233**	**3,337**	**3,364**	**3,527**	**3,648**	**3,725**	**3,682**	**3,710**	**3,814**	**U**	**U**
Index (1980 = 100)	52	62	74	76	100	99	107	108	112	113	118	122	125	123	124	128	U	U
Population[a] (millions)	**181**	**194**	**205**	**216**	**228**	**238**	**250**	**253**	**255**	**258**	**261**	**263**	**266**	**268**	**270**	**273**	**R282**	**285**
Index (1980 = 100)	79	85	90	95	100	R105	110	111	112	113	114	116	117	118	119	120	R124	125
Industrial Production Index[b] (1982=1(	**37**	**50**	**59**	**63**	**80**	**88**	**99**	**97**	**100**	**103**	**109**	**114**	**120**	**128**	**R135**	**R139**	**R146**	**P140**
Gross Domestic Product																		
Current $ (billions)	527	720	1,040	1,635	2,796	4,213	5,803	5,986	6,319	6,642	7,054	7,401	7,813	8,318	8,782	R9,274	R9,825	10,082
Index (1980 = 100)	19	26	37	58	100	151	208	214	226	238	252	265	279	R297	R313	R332	R351	361
Chained (1996) $ (billions)	2,377	3,029	3,578	4,084	4,901	5,717	6,708	6,676	6,880	7,063	7,348	7,544	7,813	8,160	8,509	R8,859	R9,191	9,215

KEY: P = preliminary; R = revised; U = data are not available.

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Table 3-6: National Transportation and Economic Trends

	1960	1965	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995
Passenger-miles (billions)	**1,327**	**1,630**	**2,170**	**2,561**	**2,895**	**3,326**	**3,946**	**3,976**	**4,089**	**4,165**	**4,262**	**4,33**
Index (1980 = 100)	46	56	75	88	100	115	136	137	141	144	147	15
Ton-miles (billions)	**1,562**	**1,854**	**2,207**	**2,285**	**2,989**	**2,949**	**3,196**	**3,233**	**3,337**	**3,364**	**3,527**	**3,64**
Index (1980 = 100)	52	62	74	76	100	99	107	108	112	113	118	12
Population[a] (millions)	**181**	**194**	**205**	**216**	**228**	**238**	**250**	**253**	**255**	**258**	**261**	**26**
Index (1980 = 100)	79	85	90	95	100	R105	110	111	112	113	114	11
Industrial Production Index[b] (1982=1(	**37**	**50**	**59**	**63**	**80**	**88**	**99**	**97**	**100**	**103**	**109**	**11**
Gross Domestic Product												
Current $ (billions)	527	720	1,040	1,635	2,796	4,213	5,803	5,986	6,319	6,642	7,054	7,40
Index (1980 = 100)	19	26	37	58	100	151	208	214	226	238	252	26
Chained (1996) $ (billions)	2,377	3,029	3,578	4,084	4,901	5,717	6,708	6,676	6,880	7,063	7,348	7,54

KEY: P = preliminary; R = revised; U = data are not available.

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Price indexes

Examples:

- Phelps brown and Hopkins
- Weights in the CPI
- Price indexes from EH-Net

Seven Centuries of the Prices of Consumables, compared with Builders' Wage-rates

By E. H. Phelps Brown and Sheila V. Hopkins[1]

In an earlier paper[2] we gave an account of builders' wages in southern England from 1264 to 1954, and now we shall try to relate these to the prices of some of the main articles of consumption. In 1901 Steffen[3] displayed the movements of two wage-rates in comparison with those of the prices of wheat and meat through the preceding six centuries and more: it was his Tafel II that first displayed the striking evidence for a great rise and fall in the real income of the wage-earner between 1300 and 1600, the level reached in 1450–1500 apparently not being regained until after 1860. We shall test these indications by bringing a wider range of prices to bear.

I

Nowadays, real wages are commonly estimated by comparing money earnings with an index of the cost of living, but there are several reasons why we cannot do that here. On the side of income, all we have is the rate of pay for a day, and we do not know how many days' work the builder was getting in the year from time to time, nor what other

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TABLE 1

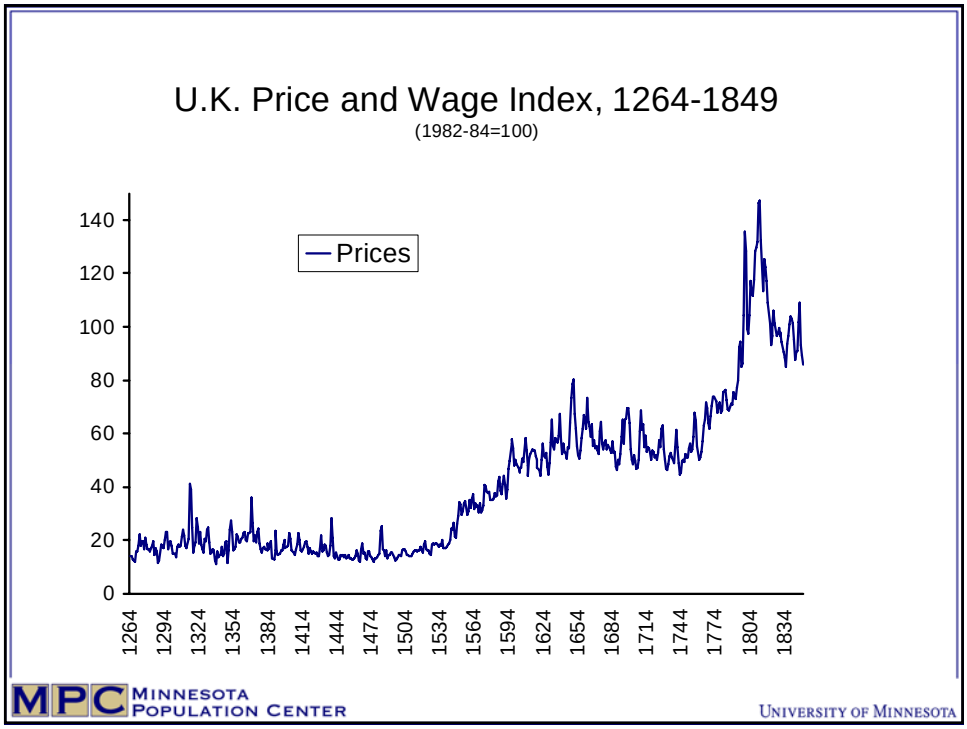
DISTRIBUTION OF OUTLAY BETWEEN CERTAIN HEADS OF HOUSEHOLD EXPENDITURE

	W. Savernak 1453–60	Davies & Eden 1790's	Board of Trade 1904–13	Weights taken here
	%	%	%	%
1. Farinaceous	20	53	16	20
2. Meat, fish	35	12	21½	25
3. Butter, cheese	2	7	16	12½
4. Drink (malt, hops, sugar, tea)	23	9	24	22½
Subtotal, Food	80	81	77½	80
5. Fuel and light	7½	7½	9	7½
6. Textiles	n.a.	11½	13½	12½
Total	87½	100	100	100

TABLE 2

APPROXIMATE QUANTITIES OF ARTICLES MAKING UP THE COMPOSITE UNIT OF CONSUMABLES, AROUND FOUR DATES

	1275	1500	1725	1950
1. Farinaceous	1½ bush. wheat 1 bush. rye ½ bush. barley ⅝ bush. peas	1½ bush. wheat 1 bush. rye ½ bush. barley ⅝ bush. peas	1½ bush. wheat ¾ bush. rye ½ bush. barley ½ bush. peas	2 bush. wheat 1 cwt. potatoes
2. Meat, fish	The meat of ¼ pig ⅓ sheep 40 herrings	The meat of 1½ sheep 15 white herrings 25 red herrings	The meat of ½ sheep 33 lb. beef 1½ salt cod	The meat of ⅝ sheep 28 lb. beef 1½ lb. cod 3 lb. herrings
3. Butter, cheese	10 lb. butter 10 lb. cheese	nil	10 lb. butter 10 lb. cheese	10 lb. butter 10 lb. cheese
4. Drink	4½ bush. malt	4½ bush. malt	3½ bush. malt 3 lb. hops 1½ lb. sugar	2½ bush. malt 2½ lb. hops 5 lb. sugar 4½ lb. tea
5. Fuel, light	nil	4¼ bush. charcoal 2¾ lb. candles ½ pt. oil	1½ bush. charcoal 1 cwt. coal 2½ lb. candles ½ pt. oil	2 cwt. coal 5½ pts. paraffin 300 cu. ft. coal gas
6. Textiles	3¼ yd. canvas	⅝ yd. canvas ½ yd. shirting ⅓ yd. woollen cloth	⅛ yd. woollen cloth	¼ lb. wool yarn 3 yds. printer's cotton cloth


U.K. Price and Wage Index, 1264-1849
(1982-84=100)
Prices
140
120
100
80
60
40
20
0
1264
1294
1324
1354
1384
1414
1444
1474
1504
1534
1564
1594
1624
1654
1684
1714
1744
1774
1804
1834
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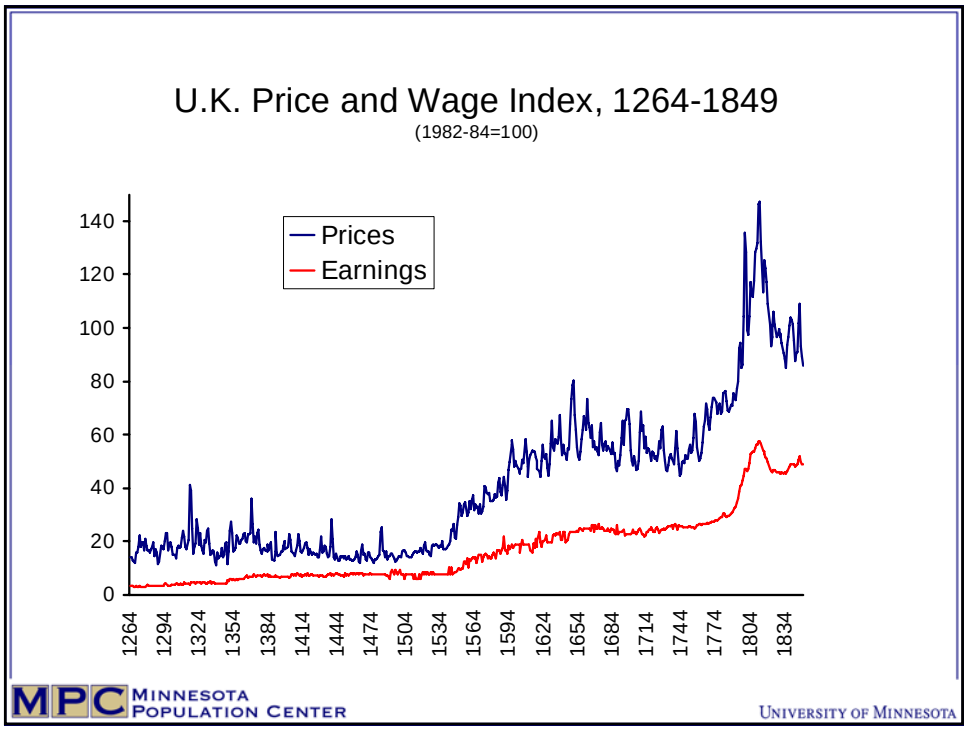
U.K. Price and Wage Index, 1264-1849
(1982-84=100)
Prices
Earnings
140
120
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1594
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1804
1834
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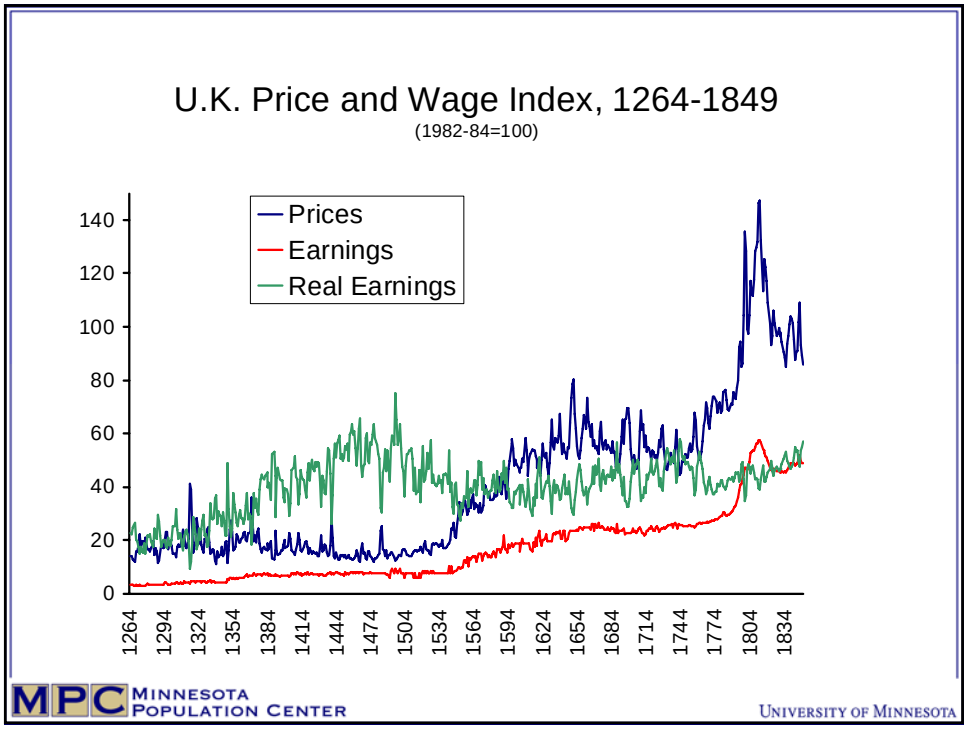
U.K. Price and Wage Index, 1264-1849
(1982-84=100)
Prices
Earnings
Real Earnings
140
120
100
80
60
40
20
0
1264
1294
1324
1354
1384
1414
1444
1474
1504
1534
1564
1594
1624
1654
1684
1714
1744
1774
1804
1834
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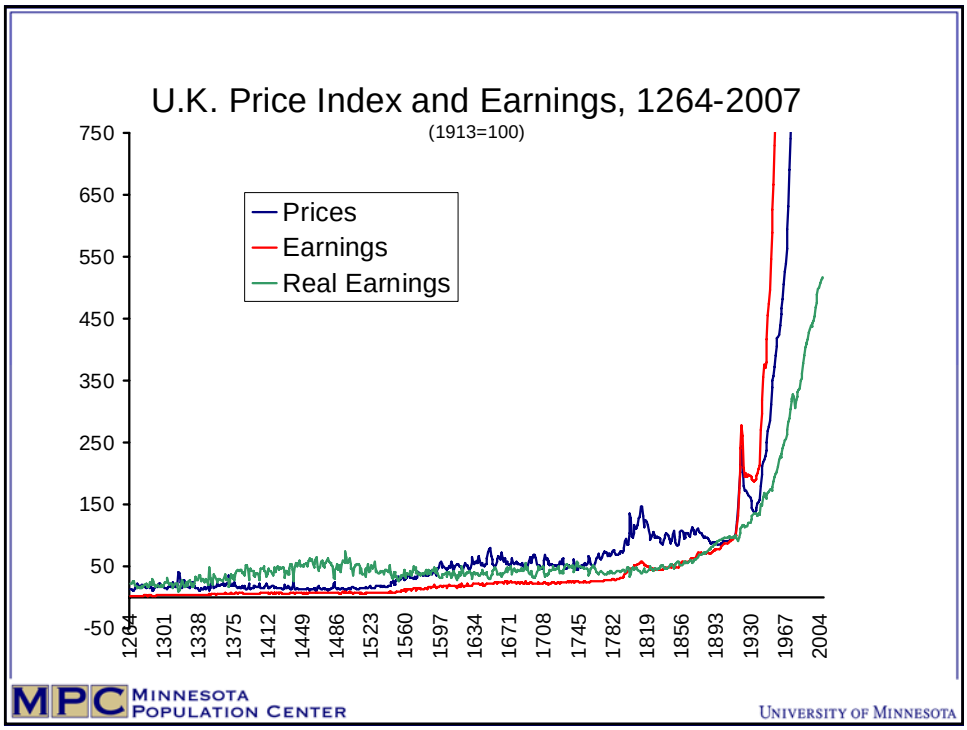
U.K. Price Index and Earnings, 1264-2007
(1913=100)
Prices
Earnings
Real Earnings
750
650
550
450
350
250
150
50
-50
1264
1301
1338
1375
1412
1449
1486
1523
1560
1597
1634
1671
1708
1745
1782
1819
1856
1893
1930
1967
2004
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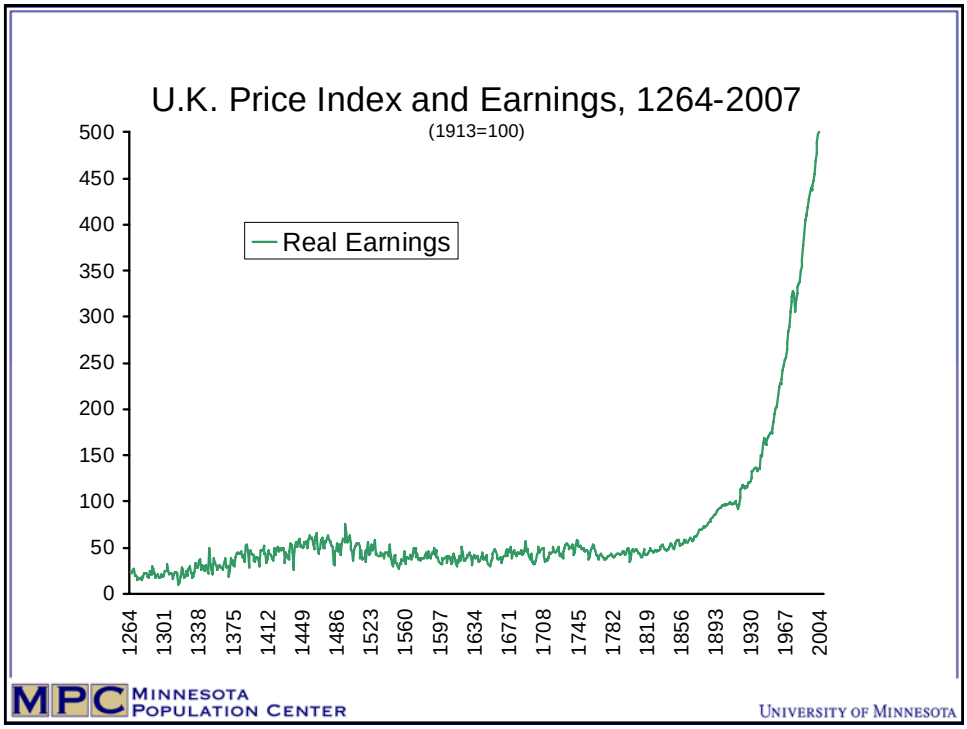
U.K. Price Index and Earnings, 1264-2007
(1913=100)
Real Earnings
500
450
400
350
300
250
200
150
100
50
0
1264
1301
1338
1375
1412
1449
1486
1523
1560
1597
1634
1671
1708
1745
1782
1819
1856
1893
1930
1967
2004
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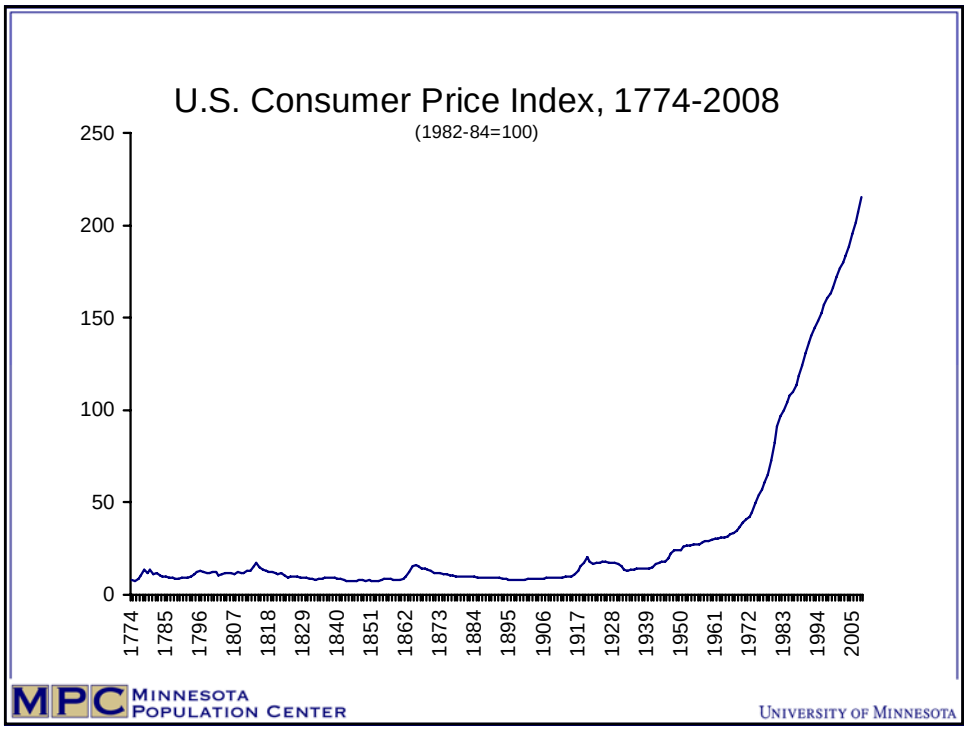
U.S. Consumer Price Index, 1774-2008
(1982-84=100)
250
200
150
100
50
0
1774
1785
1796
1807
1818
1829
1840
1851
1862
1873
1884
1895
1906
1917
1928
1939
1950
1961
1972
1983
1994
2005
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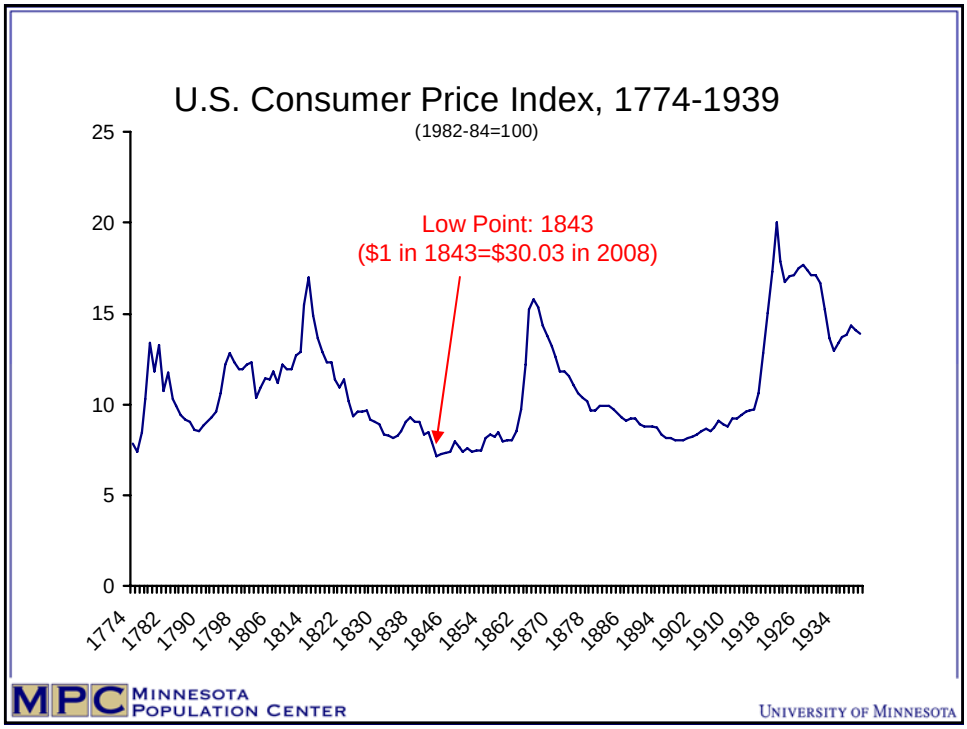

Price Indexes from Measuring Worth

- http://www.measuringworth.com/

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Price indexes

- Represent the weighted average of a group of prices
- The weight of each item is determined by consumption at a particular moment
- The weights cannot be allowed to vary continuously, because then we couldn't distinguish changes in prices from changes in the pattern of consumption

Standardization

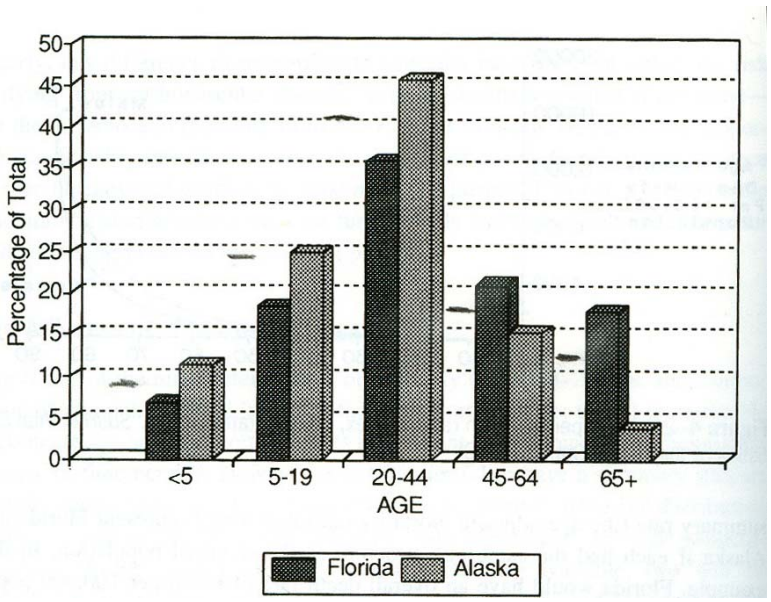
- Same idea as price indexes, but instead of holding distribution of items constant we hold some aspect of population composition constant
- Most commonly used by demographers to hold age distribution constant.

Standardized (adjusted) rate =

A rate which has been *weighted* to remove the influence of some extraneous variable, such as age.

An example – of an observation in need of standardization:

- Crude mortality rate in Florida (1988) = 10.6 deaths / 1,000
- Crude mortality rate in Alaska (1988) = 3.9 deaths / 1,000
- Ratio = 2.7 !
- (US 1988 mortality rate = 8.8/1,000)



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Age-Specific Mortality Rates/100,000

Florida		Alaska	
• <5	284	• <5	274
• 5-19	57	• 5-19	65
• 20-44	198	• 20-44	188
• 45-64	815	• 45-64	629
• 65+	4425	• 65+	4350

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DIRECT STANDARDIZATION

The **directly** standardized mortality rate is:

The sum of the products of age-specific mortality rates for the populations being standardized times the age distribution of a "standard" population

$t_s = \sum_a (t_a P_a)$

Standardization

Formula for direct standardization:

$$t_s = \sum_a (t_a P_a)$$

t_s = standardized rate
t_a = ASDR (proportion of persons dying at age a)
P_a = proportion of standard population that is age a

Florida Standardization

Age	ASDR	P_S	Product
<5	2.84	.074	0.210
5 – 19	0.57	.216	0.123
20 – 44	1.98	.399	0.790
45 – 64	8.15	.187	1.524
65+	44.25	.124	5.487
			8.134

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Alaska Standardization

Age	ASDR	P_S	Product
<5	2.74	.074	0.203
5 – 19	0.65	.216	0.140
20 – 44	1.88	.399	0.790
45 – 64	6.29	.187	1.176
65+	43.50	.124	5.394
			7.703

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- Unstandardized death rates (crude death rates)
  - Florida (1988) = 10.6 deaths / 1,000
  - Alaska (1988) = 3.9 deaths / 1,000
  - Ratio = 2.7 !
  - (US 1988 mortality rate = 8.8/1,000)
- Standardized death rates
  - Florida (1988) = 8.13 deaths / 1,000
  - Alaska (1988) = 7.70 deaths / 1,000
  - Ratio = 1.06
  - (US 1988 mortality rate = 8.8/1,000)

Example 2:

Marriage of native and foreign-born in 1900