

Some basic data concepts and transformations

- percentage change / log differences
- annualized levels and rates of change
- seasonal adjustment
- price indexes
- converting nominal to real
- exchange rate conversions

Percentage change / log differences (repeated from overheads on Solow article)

Numerical example, with $\alpha=1/3$, illustrating that log differences are approximately percentage growth:

	A	K	N	$Y=AK^{1/3}N^{2/3}$
t	10	200	100	1260
$t+1$	10.2	206	106	1349
ratio $t+1/t$	1.02	1.03	1.06	1.071
% growth	2%	3%	6%	7.1%
$\Delta \ln$.020	.030	.058	.068

Apart from rounding,

$$.068 = .020 + (1/3)(.03) + (2/3)(.058)$$

(Mathematical reason log difference is approximately the same as percentage change: a mean value expansion can be used to show that $\ln(1+x) \approx x$ for x near zero. So for growth in A, for example, $\ln(1.02) \approx .02$.)

Annualized levels and rates of change

Virtually all national income and product account data are

- collected and released quarterly
- expressed at annual rates
- seasonally adjusted
- released in both nominal and real terms

(Other collection and release frequencies are possible:

- annually: certain surveys of manufacturers
- monthly: consumer price index and industrial production
- daily or even minute by minute: financial data such as stock prices)

<http://www.bea.gov>

Real GDP

% change from previous quarter, SAAR

2007:4	2008:1	2008:2	2008:3
-0.2	0.9	2.8	-0.5

SAAR = “seasonally adjusted at annual rates”

- annual rates

Quarterly data (nominal): constructed by multiplying actual values by 4

GDP 2008:3 (SAAR) = \$14,413 billion

Actual GDP (seas. adjusted) = $\$14,413/4 = \$3,603$

Monthly data: multiplicative factor = 12

- Seasonal adjustment

Removes predictable quarter to quarter (or month to month) variation in a series.

Most aggregate data are seasonally adjusted. Exceptions: financial data (interest rates, exchange rates, stock prices); certain countries.

Seasonal adjustment (continued)

Why seasonally adjust?

Illustrate with U.S. nominal GDP data. (Nominal rather than real because U.S. does not publish real data, seasonally unadjusted. 2006 rather than 2007 because seasonally unadjusted 2007 figures are not yet available.)

	Nominal GDP			
	% change from previous quarter			
	2006:1	2006:2	2006:3	2006:4
Seas. adj.	8.6	5.5	3.6	3.7
Not seas. adj.	-10.6	16.6	9.4	8.7

The fall of -10.6% from 2005:4 to 2006:1 does not indicate a recession, but rather the usual effects of the Christmas induced spike in retail sales in quarter 4, as well as the effects of cold weather on construction, agriculture, etc.

- Price index

Prices in a “base year” are set to 100. If prices rise by (say) 0.8 per cent the first quarter of the next year, the price index is set to 100.8.

U.S. national income and product account data currently use a base year of 2000.

- Nominal to real

“Real” means effects of inflation are removed.

To convert nominal to real:

$$\text{real} = \text{nominal} \times 100 / \text{price index}$$

Nominal GDP (SAAR) in 2007:4 =	\$14,031 billion
Implicit price deflator =	120.8
Real GDP (2000-\$) = $100 \times \$14,031 / 120.8 =$	\$11,613 billion

Example #2, using indexes and deflation:

S and P 500 stock price index

Index, 1941-43 = 10

Recent December values (<http://finance.yahoo.com>)

2001	2002	2003	2004	2005	2006	2007	2008
1148	879	1112	1212	1248	1418	1468	903

The index is constructed from the actual dollar value of the 500 stocks that comprise the index.

2001	2002	2003	2004	2005	2006	2007	2008
1148	879	1112	1212	1248	1418	1468	903

To interpret these values: Had you owned all 500 stocks in the index, the value of your portfolio would have fluctuated as follows, in two representative years:

- risen by 26.5% in 2003 (because 1112 is 26.5% bigger than 879)
- risen by 3.0% in 2005 (because 1248 is 3.0% bigger than 1212)
- fallen by 38.5% in 2008 (because 903 is 38.5% smaller than 1468).

(These figures exclude dividend payments.) That is, the nominal return was 26.5% in 2003, 3.0% in 2005, and -38.5% in 2008.

rate of increase during 2005 = $1248/1212 = 1.030$

nominal return = 3.0%

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To compute the real return in 2005, using the implicit price deflator for GDP:

implicit price deflator = 114.5 in 2005:4

= 110.7 in 2004:4

Method 1:

S and P, deflated, Dec. 2005 = $100 \times 1248 / 114.5 = 1090$

Dec. 2004 = $100 \times 1212 / 110.7 = 1095$

real rate of fall = $1090 / 1095 = .9955$

real return = -0.45%

Method 2 (approximate, but easier to understand)

rate of price increase = $114.5 / 110.7 = 1.034$

rate of inflation = 3.4%

real return \approx nominal return - inflation

= 3.0% - 3.4% = -0.4%

(In this case, the approximation is almost exact.)

rate of increase during 2003 = $1112/879 = 1.265$

nominal return = 26.5%

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To compute the real return in 2003:

implicit price deflator = 107.2 in 2003:4

= 104.9 in 2002:4

Method 1:

S and P, deflated, Dec. 2003 = $100 \times 1112 / 107.2 = 1037$

Dec. 2002 = $100 \times 879 / 104.9 = 838$

real rate of increase = $1037/838 = 1.238$

real return = 23.8%

Method 2 (approximate, but easier to understand)

rate of price increase = $107.2/104.9 = 1.022$

rate of inflation = 2.2%

real return \approx nominal return - inflation

= 26.5% - 2.2% = 24.3%

$$\text{rate of fall during 2008} = 903/1468 = 0.765$$

$$\text{nominal return} = -38.5\%$$

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To compute the real return in 2008:

$$\begin{aligned}\text{implicit price deflator} &= 123.1 \text{ in 2008:3 (2008:4 data not yet available)} \\ &= 120.8 \text{ in 2007:4}\end{aligned}$$

For the sake of illustration, assume the deflator will also be 123.1 in 2008:4.

Method 1:

$$\text{S and P, deflated, Dec. 2008} = 100 \times 903 / 123.1 = 734$$

$$\text{Dec. 2007} = 100 \times 1468 / 120.8 = 1215$$

$$\text{real rate of fall during 2008} = 734 / 1215 = .604$$

$$\text{real return} = -39.6\%$$

Method 2 (approximate, but easier to understand)

$$\text{rate of price increase} = 123.1 / 120.8 = 1.019$$

$$\text{rate of inflation} = 1.9\%$$

$$\text{real return} \approx \text{nominal return} - \text{inflation}$$

$$= -38.5\% - 1.9\% = -40.4\%$$

