Lecture 13
Unit Labor Costs , Productivity, and Okun's Law

October 11th, 2019

Optimal K/L Ratio? Look at labor vs machine costs

emerging economy					developed economy			
	original		round 2			original		round 2
	company		investment			company		investment
# of workers	4		4		# of workers	4		4
# of machines	2		8		# of machines	2		8
# of lawns/day	5		10		# of lawns/day	5		10
output per worker/day	1.25		2.5		output per worker/day	1.25		2.5
cost/worker/year	$5,000		$5,000		cost/worker/year	$35,000		$35,000
cost/machine/year	$20,000		$20,000		cost/machine/year	$20,000		$20,000
total labor cost/year	$20,000		$20,000		total labor cost/year	$140,000		$140,000
total capital cost /year	$40,000		$160,000		total capital cost /year	$40,000		$160,000
total cost/year	$60,000		$180,000			$180,000		$300,000
200 days per year	1000		2000		200 days per year	1000		2000
cost per lawn	$60		$90		cost per lawn	$180		$150

Unit Labor Costs?

- Labor works to produce stuff, OUTPUT.
- How much stuff do they produce each hour?

  Productivity=Output per hour
- How much did an hour's worth of stuff cost?

  Hourly Wage rate
- Changes in Unit labor costs roughly:

  %Δ hourly wage rates – %Δ output per hour

Should ULC be stable?
Should ULC rise at the π rate?
Should ULC increases exceed the π rate?

$$\frac{wages/_{hour}}{output/_{hour}} = \text{Unit Labor Costs}$$

	2020	2021
wages	$10/hour	
Hats	$3/hat	$3/hat
unit output	5 hats/hour	10 hats/hour
L.P. (real $/hr)	$15/hour	
total revenues	$15/hour	
profits	$5/hour	
ULC	67%	
wages/revenues	67%	
profits/revenues	33%	

Suppose societies goal is to share equally, between wages and profits, the gains achieved through higher labor productivity:

We imagine a leap for LP, and stable prices:

	2020	2021
wages	$10/hour	
Hats	$3/hat	$3/hat
unit output	5 hats/hour	10 hats/hour
L.P. (real $/hr)	$15/hour	$30/hour
total revenues	$15/hour	$30/hour
profits	$5/hour	
ULC	67%	
wages/revenues	67%	67%
profits/revenues	33%	33%

What do wages, profits and ULC do?

	2020	2021
wages	$10/hour	$20/hour
Hats	$3/hat	$3/hat
unit output	5 hats/hour	10 hats/hour
L.P. (real $/hr)	$15/hour	$30/hour
total revenues	$15/hour	$30/hour
profits	$5/hour	$10/hour
ULC	67%	67%
wages/revenues	67%	67%
profits/revenues	33%	33%

Again, suppose societies goal is to share gains equally, from higher productivity, but this time allow for modest gains for prices

We imagine a leap for LP, amid a 2%nd stable prices:

	2020	2021
wages	$10/hour	
Hats	$3/hat	$3.30/hat
unit output	5 hats/hour	10 hats/hour
L.P. (real $/hr)	$15/hour	$30/hour
total revenues	$15/hour	$33/hour
profits	$5/hour	
ULC	67%	
wages/revenues	67%	67%
profits/revenues	33%	33%

Wages, profits and ULC? To keep shares constant, ULC rises by the π rate, 10%

	2020	2021
wages	$10/hour	$22.11/hour
Hats	$3/hat	$3.30/hat
unit output	5 hats/hour	10 hats/hour
L.P. (real $/hr)	$15/hour	$30/hour
total revenues	$15/hour	$33/hour
profits	$5/hour	$10.89/hour
ULC	67%	73.7%
wages/revenues	67%	67%
profits/revenues	33%	33%

Now we consider the macro economy. Imagine steady slow growth.
For shares to stay constant, wage gains, w, rise at the same pace as Y_n .
Real wage gains w_r, rise at the same pace as LP.
ULC increases equal the increases prices, the π rate

	2020	2021	YOY%Δ
Y_n	100	104.5	4.5%
Y	100	103	3.0%
π	100	101.5	1.5%
LP	100	102	2.0%
hours	100	101	1.0%
w/hr	100	103.5	3.5%
W (total)	100	104.5	4.5%
w_r /hr	100	102	2.0%
ULC	100.00	101.5	1.5%

Suppose we set the minimum wage at $30/hour, and hourly wage gains surge, up 8%, YOY. What needs to happen to keep wage compensation constant as a share of GDP?

	2020	2021	YOY%Δ
Y_n	100	109	9.0%
Y	100	103	3.0%
π	100	106	6.0%
LP	100	102	2.0%
hours	100	101	1.0%
w/hr	100	108	8.0%
W (total)	100	109	9.0%
w_r /hr	100	102	2.0%
ULC	100.00	106.0	6.0%

Now imagine a technology driven boom for labor Productivity:

	2020	2021	YOY%Δ
Y_n	100	107.5	7.5%
Y	100	106	6.0%
π	100	101.5	1.5%
LP	100	105	5.0%
hours	100	101	1.0%
w/hr	100	106.5	6.5%
W (total)	100	107.5	7.5%
w_r /hr	100	105	5.0%
ULC	100.00	101.5	1.5%

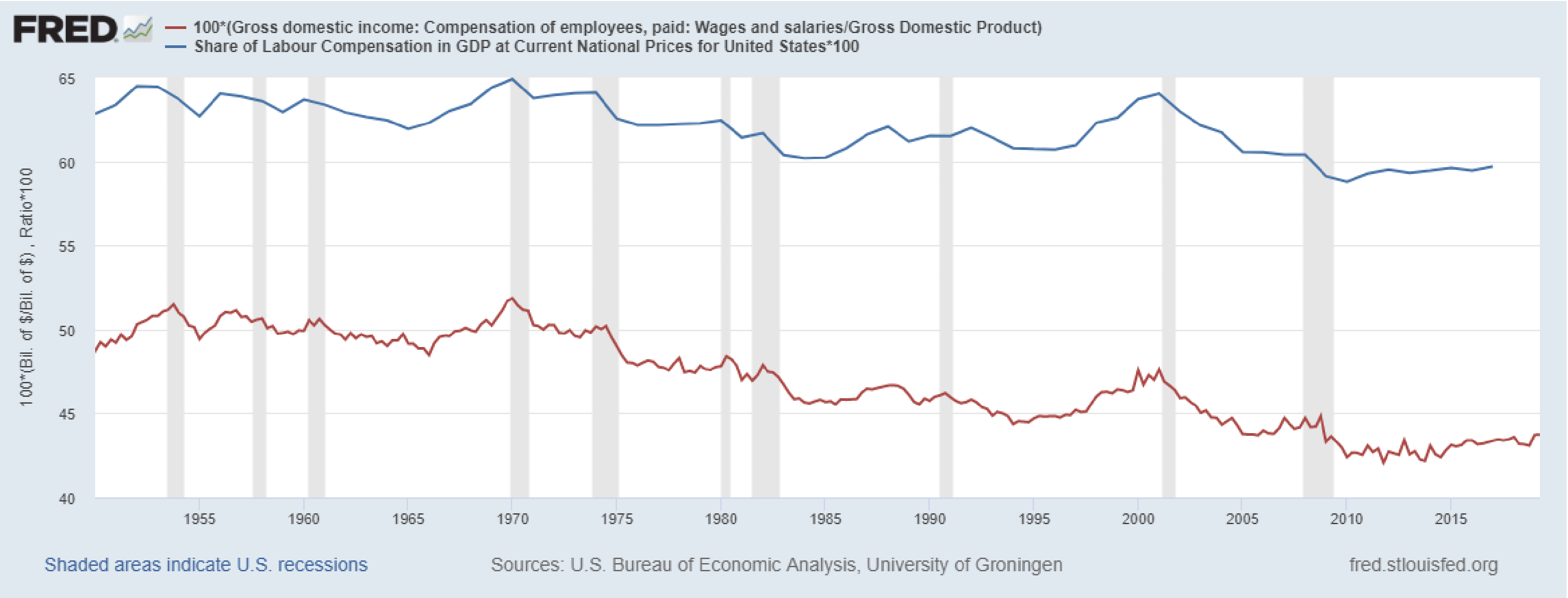
What happens when real wages rise more slowly than LP?

	2020	2021	YOY%Δ
Y_n	100	105	5.0%
Y	100	103	3.0%
π	100	102	2.0%
LP	100	102	2.0%
hours	100	101	1.0%
w/hr	100	103.5	3.5%
W (total)	100	104.5	4.5%
w_r /hr	100	101.5	1.5%
ULC	100.00	101.5	1.5%

Consider the last 44 years:

			average
			annual
	1974	2018	growth
national income	1346	17546	6.01%
compensation	888	10928	5.87%
wages	772	8888	5.71%
benefits	115	2040	6.75%
corporate profits	126	2075	6.57%
	1974	2018	
compensation	66.0%	62.3%	-3.7%
wages	57.4%	50.7%	-6.7%
benefits	8.5%	11.6%	3.1%
corporate profits	9.4%	11.8%	2.5%

A look:



FRED
100*(Gross domestic income: Compensation of employees, paid: Wages and salaries/Gross Domestic Product)
Share of Labour Compensation in GDP at Current National Prices for United States*100
100*(Bil. of $/Bil. of $) , Ratio*100
65
60
55
50
45
40
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Shaded areas indicate U.S. recessions
Sources: U.S. Bureau of Economic Analysis, University of Groningen
fred.stlouisfed.org

Can we relate our expectations for U3 to an opinion about growth for Y?

$Y \equiv$ flow of real GDP = flow of real income

$\%\Delta Y = \%\Delta$ GDP

- $\Delta U = \Delta$ unemployment rate

- Art Okun, economist from the 1960's, came up with a relationship between $\%\Delta Y$ and ΔU.

A KEY input
Long Term Sustainable Growth

- Okun's Law requires that we estimate a sustainable growth rate for U.S. GDP.

- This growth rate, LTSG, is the $\%\Delta Y$ that the economy can sustain over the 'long haul'.

- Think of it as the growth rate for the economy that doesn't get it into trouble.

Long Term Sustainable Growth?

- How fast a pace should you embrace, if you run a marathon?
- 5 minutes per mile?
- 6 minutes per mile?
- 8 minutes per mile?
- 10 minutes per mile?

What is the USA LTSG?

- We will spend next Wednesday investigating LTSG
- The simple answer: we can grow as fast as the sum of the growth rate for
  - the labor force and
  - labor productivity

What is the USA LTSG?

- Consensus today asserts that labor force grows 0.5% per year.
- Consensus today asserts that labor productivity grows 1.5% per year.
- LTSG = 0.5%+ 1.5% = 2%

What is the Okun formula?

$$\left(\frac{Change}{InOutput}\right) = \left(\begin{matrix} L.R. \\ S.G \end{matrix}\right) - OkunCoefficient\left(\begin{matrix} ChangeIn \\ Unemployment \end{matrix}\right)$$

Okun's law, using symbols

$$\%\Delta \boldsymbol{Y} = \boldsymbol{LTSG} - \mathbf{2}(\Delta \boldsymbol{U})$$

- The % change in output =

    the economy's trend growth rate minus

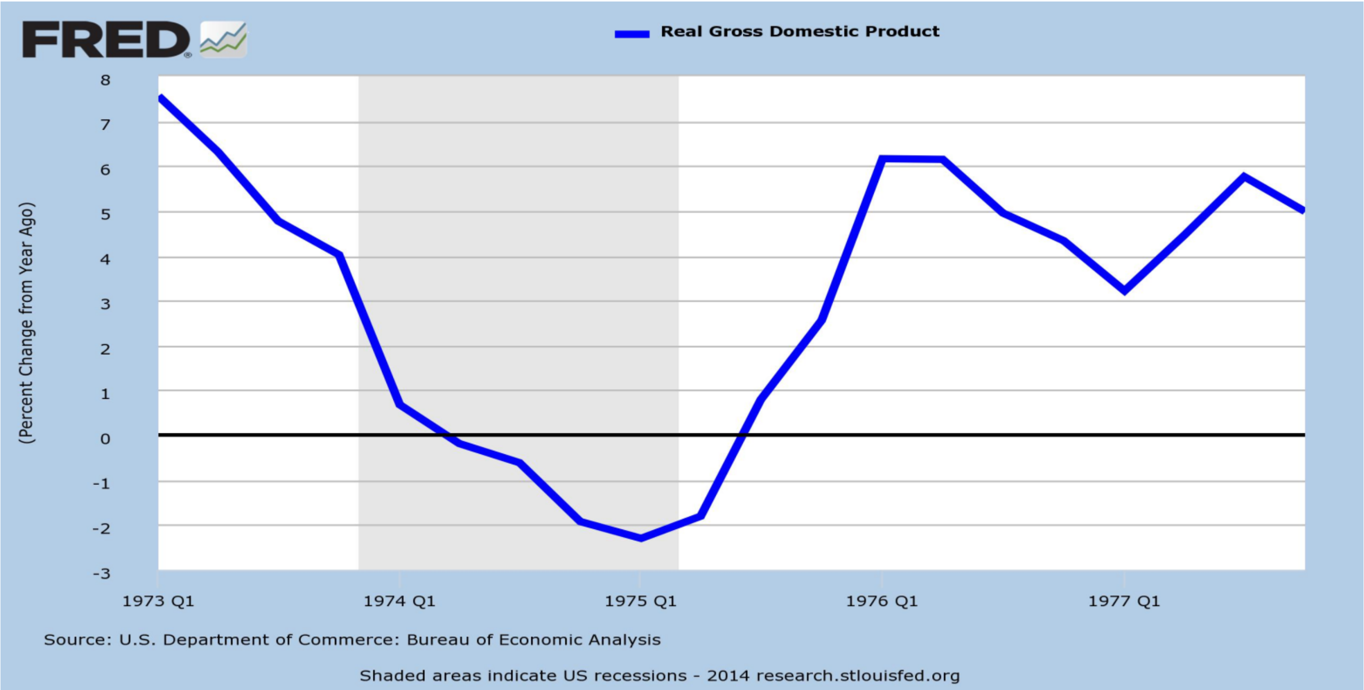
    2 times the change in the Unemployment rate

Okun's Law and long term equilibrium

- $$\Delta \boldsymbol{Y} = \boldsymbol{LTSG} - \mathbf{2}(\Delta \boldsymbol{U})$$
- Imagine the economy is growing at its long run sustainable speed (LTSG).
- By definition, it creates just enough jobs to absorb labor force growth.
- The unemployment rate, therefore, is steady.
- $\Delta \boldsymbol{U}$, therefore, is zero.
- $\Delta \boldsymbol{Y} = \boldsymbol{LTSG}$

Okun's Law and economic recovery

- A traditional recovery exhibits strong economic growth.



Okun's Law and economic recovery

- Strong recoveries are associated with strong productivity.
- Strong recoveries are associated with rebounds for the labor force participation rate

The Okun Coefficient: Two reasons, historically, it was bigger than ‘1’

$$\%\Delta \boldsymbol{Y} = \boldsymbol{LTSG}(\%) - \mathbf{2}(\Delta \boldsymbol{U})$$

A fall for unemployment of 1 percentage point, delivers MORE THAN a 1% rise for employment, if LFPR is rising.

A pop for productivity, above its trend rate, means output will grow faster than LTSG rate.

Labor productivity: Very Pro-cyclical

IV Cyclical vs. Secular					
Labor Productivity					
Year Ending In:	**96-04**	**86-94**	**76-84**	**56-64**	
6	2.5	2.2	2.9	0.2	
7	2.0	1.2	0.6	2.7	
8	2.7	1.3	2.6	3.9	
9	3.4	0.5	-1.4	1.2	Recession
0	2.1	1.3	0.7	-0.1	Area
1	3.3	3.1	0.2	6.5	
2	3.5	4.0	0.6	3.5	
3	5.5	-0.3	5.2	3.7	
4	2.7	1.0	1.0	1.5	
Average	*2.9*	*1.6*	*1.5*	*2.5*	

Mid-2014 to Mid-2019
Let's test Okun's Law

- Let's test the formula over the last 20 quarters:

- **2014:Q2** unemployment = 6.2%

- **2019:Q2** unemployment = 3.5%

Let's calculate what %ΔY should be, given ΔU:

- $\boldsymbol{\%\Delta Y = LTSG - 2(\Delta U)}$

LTSG = 2%/yr $\quad$ $(1.02^5) - 1 = 10.4\%$ over 5 years

- $\%\Delta Y = 10.4 - 2(3.5 - 6.2)$
- $\%\Delta Y = 10.4 - 2(-2.7)$
- $\%\Delta Y = 10.4 + 5.4$
- $\%\Delta Y = 15.8\%$
- 15.8% over 5 years = 3.0% per year

$((1.158)^{(1/5)} - 1) = 3.0\%$

Now lets look at actual $\%\Delta Y$:

- 2014:Q2 real GDP = $16,841

- 2018:Q2 real GDP= $19,022

- $\%\Delta Y$ = (($19,022/$16,841)-1) X100
- $\%\Delta Y$ = 13%
- What was the annualized growth rate for Y?
- $((1.13)^{(1/5)})-1 = 2.5\%$

Okun's Equation is too optimistic over the past five years.

- Based upon a fall to 3.5% from 6.2%, real GDP should have grown much faster than LTSG
- (that is what the "2" value for the Okun constant suggests)
- Growth of 3%/yr. is expected
- Instead we had growth of only 2.5%

Over the full 10 years of expansion, to date, how did Okun's law perform?

(2009:Q2 to 2019:Q2?)

- Great Recession ended, 2009:Q2
- Real GDP level, 2009:Q2: $15.1 trillion
- Real GDP level, 2019:Q2: $19.0 trillion

$$\mathbf{\left(\frac{19}{15.1}\right) - 1 = 25.8\%}$$

- Thus real GDP grew by 25.8% over past 10 years.

Compare the 2009-2019 annualized growth rate to our estimate of L.T.S.G.

- What was the annualized real growth rate?

25.8% OVER 10 YEARS

$(1.258\%)^{(1/10)} = 2.3\%$ per year

Note: $\left(\frac{\mathbf{25.8\%}}{\mathbf{10}}\right) = 2.58\%$

Why does it only take a 2.3% growth rate to deliver a ten year advance of 25.8%?

(Hint: Einstein's favorite mathematical CONCEPT)

THE MAGIC OF COMPOUNDING:

YEAR	0	1	2	3	4	5	6	7	8	9	10
Compound Interest of 2.3%	100	102.3	104.7	107.1	109.5	112.0	114.6	117.3	120.0	122.7	125.5
yearly interest paid		2.30	2.35	2.41	2.46	2.52	2.58	2.64	2.70	2.76	2.82
Simple interest of 2.3%	100	102.3	104.6	106.9	109.2	111.5	113.8	116.1	118.4	120.7	123
yearly interest paid		2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30

An Okun's law calculation for U3, over the 2009-2019 period:

LTSG = 0.5% LABOR FORCE + 1.5% LABOR PRODUCTIVITY = 2%

1.02% GROWTH for 10 years, $(1.02)^{10} = 21.9\%$

$\%\Delta Y = LTSG – 2(U_{2019} – U_{2009})$
$25.8 = 21.9 – 2(U_{2019} – U_{2009})$ Note: $U_{2009} = 9.3$
$3.9 = -2(U_{2019} – 9.3)$ $1.2 = U_{2019} – 9.3$
$U_{2019} = 7.35\%$

Okun's law suggests the jobless rate should have fallen much more modestly, to 7.35%, not 3.5%.

What happened? Consider Productivity & LFPR in this Cycle

- How did Unemployment fall to 3.5%, alongside weak real GDP growth?
- Labor productivity, 10-year annualized rate of 1%, well below our estimate, of 1.5%, in our LTSG numbers, and well below historical averages. trend.
- LABOR FORCE PARTICIPATION RATE FELL, RATHER THAN ROSE, OVER THE PERIOD:
- Q2:2009 LFPR = 65.7
- Q2:2019 LFPR = 62.8

Labor productivity:

2009:Q2: 95.3

2019:Q2: 107.5

$\left(\frac{107.5}{95.3}\right) - 1 = 12.8\%$ $1.128^{(1/10)} = 1.2\%/yr.$