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Course:

Basic Presentation of Available Factor Capacity Theory

Title of Assignment:

A Parade of Graphs of the UT Equation

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Parade of Graphs for the UT Equation

This brief paper will provide a series of graphs about the dynamics of the UT equation. Each graph will have a brief description with the equation that produced it.

The concept of UT is simple; it is the total unused capacity available in the economy for labor and capital. Available simply means that some unused capacity is unavailable. This equation gives the dividing line between what is available and what is unavailable. Simple concept, but the equation shows deep dynamics.



Graph #1: This first graph is a plot of capacity utilization against labor share of income since 1967. We see a general tendency for them to decline together. The equation that tracks the “core” of their descent is...

Capacity utilization = 0.78 \* labor share (green line)

Labor share (2005 = 100)

Note: All the graphs in this paper that are highlighted in yellow have been updated to this version of the equation. The other graphs are still based on capacity utilization = labor share – 22.6.

Is there a direct relationship between them? Is there a deeper relationship between them?

Can we see how this graph might show us the effect on economic growth?

The following graphs seek to show that there is a growth model that can be extracted from this graph.



Graph #2: The lines represent constraints to the movement of their respective terms. The actual values are normally found at a distance from their constraints, but do bump into their limits at times, when UT goes to zero.

These lines slide right and left along the x-axis as unused available capacity of labor and capital changes and as the variables themselves change.

Holding the other terms constant, ...

* If the actual unemployment rate increases, the yellow and pink lines move away from each other giving more space to the economy for adjustment. The unemployment lower limit won’t move. Because it is based on the actual values of capacity utilization and the labor constraint.
* If the actual capacity utilization rate increases, the blue and yellow lines slide to the right. The capacity utilization pink line doesn’t move.
* If the actual labor share constraint increases, the pink line increases and the blue line decreases. The combines effect is to key more room for capacity utilization to rise and more room for unemployment to fall. The labor share constraint line doesn’t move.

The broken vertical lines in the graph show the general paths of unemployment, capacity utilization and labor share constraint after the crisis. The variables move within and settle into their respective limits.

The height of the “constraint” lines are also vertical limits. The dynamic of the vertical part of the constraint lines is not being explained in this paper.



Graph #3: This graph is based on the UT equation...

  

 u = unemployment

 cu = capacity utilization

 ls = labor share

 cu(ls) = 0.78 \* labor share (labor share, 2005=100. This becomes an availability constraint on factor utilization.)

This equation incorporates capacity utilization and labor share from the graph #1: However it also includes the unemployment rate, something which might be perplexing. The question is asked, “How might labor share effect capacity utilization?” Through demand. What constitutes demand? The number of people working and the money they make. Capital share of income is in large part retained corporate profits and capital gains. Capital share contributes some to demand, but not all. 0.78 is a calibration in the equation which seeks to aggregate the ebb and flow between demand and income shares into a constant.

 The UT equation looks at utilization of factors of production, capital and labor. UT calculates available capacity of factors of production. As a consequence, once available capacity is used up, UT hits a zero lower bound that restricts it. There is resistance for UT to go negative, because the economy becomes less profitable and productive. The broken orange line marks a possible barrier of resistance at UT = 10%.The values for UT in this paper are approximations until further analysis. Also in the 1990’s, UT went below zero for many quarters. There is evidence of distortion in the government’s numbers for that decade. See graph #17 where the blue line and the pink line got separated by false data.

One note. Because of the square root, there is a sort of magnifying glass around the zero x-axis. It is hard mathematically to get close to the actual x-axis line. If UT goes negative, which it can do in bubble type economies, it jumps to the other side of the x-axis. The square root gives a measure of sensitivity for UT around its zero lower bound.



Graph #4: This graph is a dispersion plot between unemployment and the difference between actual capacity utilization and the labor share constraint on capacity utilization. From 1967 to 2009, the plot moved in the range of the blue dots. Then in 2010, the plot shifted upwards into a new territory.

The equation for this graph is...

 Cu – cu(ls) .... cu – (0.78 \* ls)

The y-intercept of the equations in the graph represent the normal unemployment rate when capacity utilization is equal to its labor share constraint. This point where cu = cu(ls) is important because it represents the limit to capacity utilization if unemployment was 0%. In the bottom equation, we see that unemployment instead of having a rate of 0% has a rate of 5.8%.. This is one way to measure a natural rate of unemployment, or full employment rate.

We can see in the top equation for data since 2010, that the natural rate of unemployment when cu=cu(ls) has shifted up to 9.4%. This is evidence that we have moved into a sub-optimal state.



Graph #5: This is another perspective of graph #4. Here we have a dispersion plot of the unemployment rate against the value of UT since 1967. We can see that the plot moved in the area of the blue dots before 2010. The y-intercept of the trend line equation shows a natural rate of unemployment of 4.3%.

Why is this rate different from the natural rate of unemployment in Graph #4? In graph #4, we measured unemployment when cu - cu(ls) = 0. Now we are measuring unemployment when cu -cu(ls) + u = 0, which happens when UT is equal to 0 (zero).

In graph #4, the natural rate of unemployment was measured at a theoretical point described as if there was no unemployment in the economy; all labor being utilized. Any unemployment over that theoretical number of 0% shows a natural level of unemployment.

In this graph, we measure the natural rate of unemployment where all available capacity for capital and labor is being utilized, not just labor. When UT is equal to zero, the economy is said to have used all its available capacity for labor and capital. In a sense, this is maximum available production of the economy within its constraints, according to the UT equation. Thus, when UT = 0, the economy is said to be at full capacity utilization of labor and capital. Theoretically, neither capacity utilization, nor unemployment can improve. The data support this claim.

We can also see in this graph that the natural rate of unemployment jumped up to a new rate. It jumped from 4.3% to 6.7%%. In both graphs, the natural rate of unemployment increased. In this graph, it jumped up +2.4% approximately.



Graph #6: This graph uses the same variables as in graph #5, unemployment and UT. We can see the same curved line reaching its bottom at the zero lower bound of UT and then heading back up as UT goes negative.

The equation used for this graph is...



When we compare graph #5 with this graph #6, we see a tendency of unemployment to reach a bottom around the UT zero lower bound. The actual data reflects the theoretical equation. However, the slopes and rates of change are different. That is because there are many other factors affecting the relationship between employment of labor, unemployment, and utilization of available capacity for labor and capital.

We can see a simulation of where current data would point to on the graph. We still have available capacity and the unemployment rate is still trickling downward, but we can see that according to this equation, unemployment has a minimum limit, at which point, if the economy tried to push more production, unemployment would actually stay steady or even begin to rise again. We can see actual evidence of this in graph #5.

The rest of the graphs in this paper explore the some of the other factors affecting the movement of the unemployment rate as the economy expands and contracts.



Graph #7: This graph incorporates new variables in the UT equation. Here is another form of the UT equation...

 $UT= \sqrt[ ]{1+u-\frac{r}{r\_{u}}-rK/Y}$

u = unemployment

r = rate of profit

ru = rate of profit of capital goods in use

K = value of capital goods in economy

Y = net income, GDP in the economy

UT, total unused capacity available for capital and labor, is now a function of the profit rate, productivity, income, capital goods themselves, and a measure of productive capacity (ru). (Bowles 2005) The UT equation is now much more useful. We can rearrange this equation to solve for r...

 $r=(1+u-UT^{2})/(\frac{1}{r\_{u}}+\frac{K}{Y})$

When all other variables are held constant, and we solve for r with various values for UT, we get this graph. The graph says that the profit rate reaches a peak at the UT zero lower bound. Data from the 3Q of 1997 shows that the profit rate peaked when UT reached its lowest point. (Bowles 2005, p 456)

We can see in the graph that current data would point to a place on the curve where there is still some room for the profit rate to increase, but the UT equation says there is a limit (16.3%) beyond which the dynamics of the economy won’t go. Profit rates will begin to stall and business “as a whole” won’t be able to increase their profit rates.



Graph #8: This graph tracks profit rate since 1967. The equation used is...

r = (1 – cu(ls)) \* Y/K

r = profit rate

cu(ls) = labor share constraint on capacity utilization (cu(ls)=0.78 \* ls

Y = real GDP

K = total value of capital. (Capital based on real values of non-residential private and government fixed assets... <http://www.bea.gov/iTable/iTable.cfm?ReqID=10&step=1> ... table 1.1. 2005 = $21650.2 billions)

The graph shows that the profit rate peaked when UT would hit its zero lower bound through the years.

In spite of peaking through the years, the profit rate has continued to rise overall, since the mid-1980’s. The increasing profit rate is related to both lower labor share of income and increased productivity of capital.

The value Y/K has increased from 49% (1970) to 57% (2012). Added to that, the labor share constraint (cu(ls)) has decreased from 86% (1970) to 72% (2012). Both these effects have caused the profit rate to increase over the years. Still the profit rate peaks when total unused available capacity for labor and capital hits its zero lower bound. The economy then makes a readjustment through a contraction and picks up where it left off to rise to a higher profit rate.

We will see later on that increasing real GDP in combination with lower labor share of income puts the economy into a risky situation where capacity utilization becomes unable to keep the economy in productive equilibrium. The increasing profit rate looks good for business but it carries the potential risk of pushing the economy into a sub-optimal trap. We will see evidence of that in later graphs.



Graph #9: (This graph has not been updated with recent developments in the UT equation, but the principles behind the graph are still the same.) This graph shows what happens to capacity utilization as UT falls past its zero lower bound, holding all other variables constant. The equation used for this graph is...

 

As UT falls to zero, it makes sense that employed capital would increase too. But when UT goes past zero and into negative territory, capacity utilization would actually start to decrease. This may not make sense to some people. Some would think that if the economy began to use unavailable capacity somehow, that capacity utilization would keep increasing. But the UT equation has built in constraints according to how income is shared between labor and capital.

So what are the dynamics of the UT equation that cause capacity utilization to fall beyond the UT zero lower bound? As more capacity of capital is utilized, UT naturally goes negative at an increasing rate. Thus, mathematically, cu(UT) drops.

But what is the dynamic in the economy that would cause capacity utilization to actually fall if more capital was tried to be utilized? The profit rate falls. Since capacity utilization is equal to r/ru,  profit rates fall. As capacity utilization reaches a limit, an economic pressure is exerted to lower capacity utilization. Other variables make adjustments too. The limit on capacity utilization is around 79%.

This graph also includes the progression of capacity utilization quarterly data since 2nd quarter, 2010 (pink dots). The yellow line was the UT equation for the conditions in 2Q-2010. Since then the “constraint” curve has fallen as UT, total unused available capacity, is used up. We can see the pink dots move as the UT constraint curve falls. The pink dots move up and to the left. We can also see that the UT constraint curve presses down as UT goes to zero.

The light blue curve shows what would happen if unemployment dropped to 5.5% (the currently accepted natural rate of unemployment).UT would actually go negative. Consequently, the UT constraint curve would keep pushing down on the negative side of the zero lower bound. The result would be that capacity utilization would actually fall instead of rise based on declining profit rates.



Graph #10: If all other variables were held steady, net income, real GDP (Y), in the economy would fall to a low as UT went to zero. Think of this curve as a utility function for the economy. The y-intercept marks the level of “utility” according to how much labor and capital is still unused. However, it is not quite that simple... Let´s look at the equation used here...

 

As UT passes zero and goes negative, the denominator in the equation, (1+u-UT2-r/ru), decreases. However, the numerator, r\*K, stays the same as its values are held constant.. What is r\*K? It is profits or capital income, as opposed to labor income. Thus as UT goes negative, and net output begins to rise, capital income stays constant, but the denominator,  decreases. What is the denominator? It is Capital share of income. Thus, as UT goes negative, capital share of income decreases, which means that labor share of income goes up. Business owners are not going to like this scenario for long and will make efforts to lower production.

We then see that the UT equation not only has built in constraints, it also has built in incentives that accompany those constraints. These incentives for business to protect its profits lead to a contraction in the economy as a reaction to UT going negative.

It is very unlikely that real GDP would actually fall as UT is decreasing. UT normally rises, but the other terms reach their limits.



Graph #11: (This graph has not been updated with recent developments in the UT equation, but the principles behind the graph are still the same.) When all other variables are held constant and UT goes to zero and then negative, the value of capital goods reaches a maximum and then decreases. The equation used for this graph is...

 

It makes sense that the value of capital goods would have to rise in relation to a static level or factor utilization. There is only so much capital goods that can be utilized if employment and capacity utilization are held constant. Also as available capacity is being used up; more capital is being used with no improvement in profits.

The denominator in the equation is the profit rate (r). So the profit rate decreases relative to the numerator. But that is not all. Here is another version of the equation...

 

 

Thus, if K is decreasing as UT goes negative, total profits will decrease. And if the profit rate doesn´t change, there is an incentive to lower production. This lowering production can snowball and lead to a contraction of the economy.

One message of the UT equation is that an over expanded economy, meaning a negative UT, creates incentives that lead to a contraction of the economy. If businesses try to expand or are pushed to expand beyond the UT zero lower bound, say by government programs or union demands, profits will decrease and businesses will react creating a contraction in the economy.



Graph #12: (This graph has not been updated with recent developments in the UT equation, but the principles behind the graph are still the same.) Holding all other variables constant, as total available unused capacity in the economy is used up, the rate of profit of capital goods in use goes down. The equation for this graph is...

 

The denominator increases as UT goes to zero. The denominator is actually just equal to capacity utilization...

 Capacity utilization = r/ = 

Thus this equation then becomes the mirror image of graph #9. As  decreases, it is the same as capacity utilization increasing in graph #9.

In the scenario of this graph, the only variable changing is the rate of profit of capital goods in use. The most direct explanation for this graph is that as the rate of profit of capital goods in use decreases, there is consequently less available capacity for labor and capital in the economy, unless other variables compensate to avoid this.

The rate of profit of capital goods in use is also a calculation of the rate of profit at productive capacity (100% capacity utilization). If the rate of profit of capital goods in use falls, then productive capacity falls through implication. If productive capacity falls, relative capacity utilization will increase. The indirect effect is to use up available unused capacity, UT.

Productive capacity will actually rise as UT goes negative. Seems illogical doesn’t it? As the economy tries to use unavailable capacity for labor or capital, capacity utilization will drop relative to productive capacity. Productive capacity will seem to grow faster than the portion being utilized.



Graph #13: (This graph has not been updated with recent developments in the UT equation, but the principles behind the graph are still the same.) This is a plot of unemployment against actual capacity utilization. The equation for this graph is...



All variables were held constant, while various values for capacity utilization (cu) were applied to the equation. We can see that currently, the plot shows a position above a limit. A limit is a constraint of the equation. Unemployment is not going to “want” to fall below that line. The economy will not function well, and as we have seen, there are incentives to produce a contraction in the economy if unemployment were to fall below that line.

So what will happen as unemployment hits that line? If you follow the path to the right, unemployment will start to rise again to maintain balance with the rise in capacity utilization. The meaning is that the utilization of labor must balance the utilization of capital within the constraints of the equation. When UT hits its limit of zero, what you gain in utilizing capital, you lose in utilizing labor and vice versa.

Now if you follow the path to the left and allow unemployment to continue to fall, then capacity utilization will fall to compensate. The elasticity of the equation at this point seems to favor a fall in capacity utilization (4%) as compared to unemployment rising again (7%). Most likely, the instant dynamic in the economy would be a drop in capacity utilization... triggering an economic contraction.



Graph #14: (This graph has not been updated with recent developments in the UT equation, but the principles behind the graph are still the same.) This is a plot of the rate of profit (r) against Net output, real GDP, (Y). The equation used for this graph is...

 $r=(1+u-UT^{2})/(\frac{1}{r\_{u}}+\frac{K}{Y})$

All variables were held constant while values for Y were inputted in the equation. The current data shows that as the rate of profit increases, so will net output (net income). This looks good and promising. One would naturally think that we could just keep moving up the line working our way through the obstacles of economic adjustment. And it appears possible...

But when you apply graph #7 to this graph, you realize that the equation has a constraint on profit share of 16.3% (a value taken from graph #7). So it may appear that the economy could keep expanding profits, but there is a hidden limit within the dynamics of the UT equation that will stop further profits.

When I hear economists talking about keeping the current expansion going without any reference to the limitations of profits and profit rate, I realize they don’t have this equation in their toolkit. And if it turns out that the profit rate gets stuck as UT nears its zero lower bound, this equation will help us understand the dynamics behind it.



The limit of real GDP at the UT zero lower bound

Graph #15: (This graph has not been updated with recent developments in the UT equation, but the principles behind the graph are still the same.) This is a plot of Real GDP and UT. (refer to graph #10 for explanation.) First, the equations used for this graph are...

 

 $UT= \sqrt[ ]{1+u-\frac{r}{r\_{u}}-rK/Y}$

At the height of the crisis UT was large at 43%. The yellow line represents how far the curve for net output was pushed out. The y-intercept (full capacity potential) was pushed down to around 7000 (billions of dollars or 7 trillion). The yellow curve shows that a lot of capacity of labor and capital was going unutilized. The yellow curve shows a low “utility” of the economy.

The question arises... Why wasn’t real GDP pushed way down as the crisis hit? The answer comes in looking at the second equation above. The term for capacity utilization, r/ru, crashed to 66%. The term r fell by 9%, but the term ru actually rose by 9%. Capital in use became more profitable most likely due to increasing returns from low utilization of capital. Then we look at the term for capital income, r\*K/Y. As r fell 9%, Y fell 4.7% and K rose 5%. This means that capital share of income didn’t really change. And this is true from 2007 to 2009. So most of the drop in utilization that occurred came from profit rates and less so from a real GDP drop.

 Now as the economy “recovered” from 2009 to the present, profit rate (r) rose 21% and profit of capital in use actually rose to 4.6%. Thus capacity utilization came back. As for the term for capital share of income, r rose 21%, K rose 8.8% and Y rose 7.3%. All in all, capital share of income has risen because of higher profit rates. We see this in the fact that labor share of income (as determined by labor share (2005=100) – 22.6) has fallen from 77% to 72%. To reiterate, this decline is due to a high profit rate.

What causes the real GDP constraint line to rise?... Bringing labor and capital back into production and increasing the profit rate. The problem now is that the real GDP constraint line (dark blue) has little leverage to be pushed up because there is little unused “available” capacity, UT, and because profit rates are peaking. This graph implies that the trend line for potential real GDP has decreased.



Graph #16: This graph shows Real GDP plotted against UT since 1967. We can see how the blue dots march onwards and upwards through expansions and contractions. The blue line rarely backtracks much. But then we look at the top end of the blue line for the data right after the crisis. The line actually fell as UT rose. The plot line had never fallen like this since 1967. This is evidence that real GDP has fallen to a lower level. And that implies that potential GDP has gone down with it.

Why is this evidence of a lower potential real GDP level?

UT shows us that there is little room for expansion to get real GDP back up to its previous trend line. In the past, whenever UT gets close to zero, real GDP holds its level as a recession comes. Real GDP tends to grow during expansions; when UT is heading toward zero. If you look close at the graph, you will see that most of the growth in real GDP occurs between UT of 10% and UT of 30%. There is a sweet spot where the economy has room to maneuver; thus room for adjustment during growth.

The graph also implies that we would have to go through another recession before we can raise real GDP again.

The message is clear on this graph; this crisis was different than others before it. The UT equation shows that the natural rate of unemployment has risen, and now it is giving evidence that potential real GDP has backtracked to a lower level.



Graph #17: This graph calculates the difference between potential real GDP and actual real GDP. The blue line is the official numbers from the US government calculated this way...

y = potential real GDP – actual real GDP (quarterly basis)

The pink line is how the UT equation would calculate the same difference. The equation of the pink line is...

y = (cu(ls) – cu)/cu(ls) \* 3000

This equation looks at the difference between capacity utilization and its labor share constraint and sets as a percentage difference from the labor share constraint. This percentage is then multiplied by 3000. The lines surprisingly match up very well. We can see that in the 90´s, the government lost a level of calibration between its numbers. It looks as though maybe the government made a decision to keep potential real GDP on its long term trend. This created a distortion in the data, which could explain the apparent dipping of UT into negative territory during the 1990’s. However, in 2003, the government got back on track and the lines started moving together again.

Why does the difference between cu and cu(ls) work so well? Real GDP rises and falls around potential GDP. Capacity utilization rises and falls around its constraint in a similar way. A rising capacity utilization matches a rising real GDP. But then that leads to the question, How does potential real GDP match up with the labor share constraint? The answer is that potential GDP points to a level of equilibrium employment in the business cycle. As capacity utilization is crossing its labor constraint, this also is a theoretical point of equilibrium full employment.

But to see the lines match up so well in form and patterns means that the UT equation can be used to double-check the numbers coming out from the government. Being able to double-check the coherence of different numbers would benefit the government and business.

It is very interesting to look at the most recent data. The UT equation is saying that potential real GDP is actually below real GDP, since the pink line has gone negative. As the pink line goes negative, it eventually reaches a limit set by the unemployment rate in the UT equation. The pink line is reaching that limit now and is signaling that an economic contraction is at hand.



Graph #18: This is a graph of various calculations of real GDP. The pink line behind the others is the official US government potential real GDP. The blue line is potential real GDP as calculated using variables from the UT equation. The equation to calculate “UT” potential real GDP is...



This equation comes from the previous graph’s equation...

UT potential real GDP – real GDP = (cu(ls) – cu)/cu(ls) \* 3000

UT potential real GDP = (cu(ls) – cu)/cu(ls) \* 3000 + real GDP

It is not surprising that the lines move together since real GDP is leading both calculations for potential GDP. Or is it? Real GDP is leading the UT calculation for potential real GDP because potential GDP is figured as the difference around real GDP. But... the official potential real GDP from the government is independent of real GDP. It is based on historical trends and full employment.

The problem is that the UT equation is calculating a rise in the natural rate of unemployment and revealing limits to the rise in capacity utilization, such that real GDP won’t be able to return to the potential real GDP number as given by the government. Also as we will see in a later graph, there is a dead-weight loss locked into the economy now which must be calculated to lower potential real GDP. Thus according to the UT equation, the official potential real GDP number is an illusion.



Graph #19: The blue line in this graph has the equation...

f(cu) = (cu(ls)\*cu – 0.5\*cu2)/cu(ls)\*3000 + real GDP \* cu

What is this blue line? First let´s realize that the UT calculation for potential real GDP is its derivative. This is the pink line.

f ‘(cu) = potential real GDP = (cu(ls) – cu)/cu(ls) \* 3000 + real GDP

We can now understand that the rate of change at each point along the blue line is potential real GDP as capacity utilization changes. Data for 3Q-2012 is being used to plot the graph.

The green line is the absolute limit of 100% capacity utilization. Beyond that point is impossible. The red dot is where the economy was 3Q-2012. The white dot is the equilibrium point where real GDP is equal to the productive returns of the economy.

We can see that to the right of the white dot, productive returns is above potential real GDP. The economy here uses more combined capacity of labor and capital more than would be used at equilibrium. As we will see in the next graph, when the economy moved in this area, inflation was an issue.

To the left of the white dot, potential real GDP is above productive returns. The economy here is using less combined capacity of labor and capital than would be used at equilibrium. Even so, real GDP rises. However, there is a danger of falling to a sub-optimal state in the economy if real GDP rises too far to the left of equilibrium.

The yellow line is the limit for capacity utilization according the labor share constraint, cu(ls). (refer to graph #9 for 81% cap on capacity utilization.) Realize for a second that the red dot won’t be able to go past the yellow line to get back to equilibrium. The next graph shows this situation has been going on for more than 10 years already.



Graph #20: In this graph, the blue line plots the productive returns of GDP (see blue line in the previous graph). The pink line is UT potential real GDP (see pink line in previous graph). The yellow line is real GDP (quarterly basis).

When the pink line and the blue line are close in this graph, the economy is moving at the productive equilibrium point in the previous graph. We can see that the economy moved in range of this equilibrium for many years. In the 60’s and 70’s, productive returns was above potential real GDP. This represents being to the right of the equilibrium point in the previous graph. Inflation was an issue back then. Since 1980, productive returns has been consistently lower than UT potential real GDP. This has been a time of low inflation pressure.

Even with all the expansions and contractions over the years, the blue line and the pink line stayed close. But then in 1997, they separated and have not re-united since. What is happening? First we know that the economy has moved to the left of equilibrium in the previous graph and has stayed there. We know this means that the economy is using less combined capacity of labor and capital than would be used at equilibrium.

Why doesn’t the economy go back to equilibrium?... It hasn’t been able to because the constraints from low labor share of income are now between the economy and its equilibrium. We have been shut out from equilibrium and can’t get back. This is seen by the yellow vertical line in the previous graph.

Something very interesting is happening though. Real GDP stays with potential real GDP (pink line). We can see this in the equation for real GDP...

Real GDP = potential real GDP - (cu(ls) – cu)/cu(ls) \* 3000

Potential real GDP rises in relation to the equilibrium point as the economy uses less capacity of labor and capital. This scenario is like a tax on the economy that produces a dead-weight loss to society. The dead-weight loss would be the triangle bounded by the pink, blue and yellow lines in the previous graph. This dead-weight loss is permanent unless labor share of income rises.



Graph #21: This is a very important graph. First, let’s refer back to graph #19, where the two lines crossed at an equilibrium point for real GDP. At this equilibrium point, factor utilization is maximized in the economy. When the economy is close to this point, it is healthy or at least able to recover from sicknesses. The point is described by capacity utilization on the x-axis and real GDP on the y-axis.

In this graph, the blue line represents the value of capacity utilization that was needed to keep the economy at equilibrium since 1967. The green line is the actual capacity utilization since 1967. The equation for equilibrium capacity utilization (the blue line) is...



Equilibrium cu\* is determined by the labor share constraint (cu(ls)), real GDP (Y) and the equilibrium constant of 3000. It is important to realize that a rising real GDP increases cu\*.

We can see that capacity utilization is falling short of the needed equilibrium value since 1997. This is not good for the economy. It represents loss of jobs and loss of productive capacities.

We can see that from 2005 to 2008, the green line hit a plateau and stayed level unable to rise. During this time, UT was very close to its zero lower bound, which means capacity utilization was unable to rise. The factors of low labor share and even low unemployment were constraining capacity utilization, even though it was a time of a credit boom.

Since 2011, UT has once again been hitting its zero lower bound and we see another plateau forming, which caps capacity utilization from rising more. But now, unemployment is higher because of this loss of productive capacity. Higher unemployment allows capacity utilization to go higher over its labor share constraint, but labor share of income has now dropped so low that even a higher rate of unemployment can’t allow capacity utilization to get back to equilibrium.

The economy is in trouble and will be until labor share of income rises substantially. The last few decades have been guided by an economic view to increase profits, capital share of income. This graph shows it was a narrow view of the economy. The wiser view is to maintain labor share of income high enough to allow capacity utilization to stay within range of equilibrium.



Graph #22: **The UT growth model**. This graph explains the basic problem in the economy that has been developing for decades. First, the green line is simply cu = cu(ls), capacity utilization equal to its constraint. The blue line is cu\* for real GDP, Y = $13.6 trillion using this equation...

The yellow line traces the actual values of cu\*, capacity utilization equilibrium, from 1967 to 2012 as a function of the actual cu(ls), the labor share constraint.

The green line represents balanced growth for utilizing labor and capital in a productive economy, when we consider the constraints of the UT equation. Ideally, as real GDP grows pushing the blue line up, the yellow line should move up and to the right along the green line where the blue and green lines cross. Labor income ideally rises as an economy matures. Instead we can see that the yellow line moved at almost a right angle across the green line. This is not wise.

The yellow line stayed within striking range of the green line for decades. But recently the yellow line has moved far away from the green line... apparently a fragile condition for the economy, because now we see by looking at the purple dot, that the economy has dropped way below the blue line and won’t be able to return back to the blue line because of constraints. The economy has fallen into a sub-optimal trap. The constant in the above equation of 3000 may have changed to 6000, which would signify a sub-optimal state and a permanent loss of factor utilization.

We can see that in 1967, the economy was to the right of the green line. Basically labor share was too much for productive balance. The supply-side economic vision of that time (giving more income to capital) made sense. But since the 90’s, a continued push for supply-side economics took us farther away from balance and into a sub-optimal trap. This UT equation provides a much needed measure of macro-economic balance for guiding the economy back to health.



Graph #23: We now go full circle and bring the plot from graph #1 into the previous graph. Remember the first graph that plotted capacity utilization against labor share of income? The equation, cu(ls) = 0.78 \* ls (labor share 2005=100), was obtained from that graph. The green line in this graph represents the same line. We can now see the original plot of graph #1 in a light blue line that moves within the constraint set by the unemployment rate.

The end of the blue line shows where the economy is now. It is heading toward the constraint which represents the UT zero lower bound (blue dotted line). The light blue line cannot rise any further beyond the constraint. Now, this is a big problem. Why? Well, the yellow line represents balanced and optimal utilization of factors of production, cu\*. When the yellow line breaks out of the boundaries and separates itself from what the economy is capable of, we get a dead-weight loss. Labor and capital will simply be used at lower rates of utilization. It’s a poor country dynamic.

What does this “permanent” distance separating the optimal yellow line from the economy mean? Well, unless labor share of income increases, the dead-weight loss translates to a higher natural rate of unemployment and a lower capacity utilization. The higher natural rate of unemployment was shown in a previous graph.

The economy should have been growing up the green line as real GDP increased. This is wise and good economics for society. However, we see that the economy actually grew down the line. (light blue line) Declining labor share of income caused a fracturing of the economy. The real GDP determines cu\*, the dark blue curved line. Real GDP has decreased to a lower trend line. (See graph #18) But real GDP does not have to keep falling so that the yellow line moves back within the unemployment boundaries. Real GDP can stay at a distance above. The economy simply has to accept higher unemployment and lower capacity utilization as the tradeoff.

There will be higher social costs of marginalized workers. How will those costs be paid?



Graph #24: And finally, this is a graph of the Federal Reserve’s interest rate and how the UT equation calculates it using the Taylor rule. The pink line is the actual Fed funds rate since 1988. The blue line is what the UT equation calculates should have been the fed funds rate using the Taylor rule. The Taylor rule uses potential real GDP as one of the terms in its equation. And as we have seen in the previous graphs, the UT equation calculates a different potential real GDP than the US government. The yellow line shows the Taylor rule using the official US government number for potential real GDP.

First the Taylor rule...

i = inflation + real interest rate + 0.5(inflation – target inflatin) + 0.5(log(real GDP) – log(potential real GDP))

The UT calculates potential real GDP with this equation...

UT Potential real GDP = (cu(ls) – cu)/cu(ls) \* 3000 + real GDP

The UT equation bases its calculation on capacity utilization and the labor share constraint. We can see in the graph (using a 2.5% inflation target) that the UT blue line moved close to the other lines for in many years. In some years the UT calculation was closer to the fed funds rate and in other years it was pretty much the same as the yellow line which uses the official US government rate for potential real GDP. One could say that with a 2.5% inflation target, the UT calculation would have performed as good as the traditional calculation over the years.

However, since the beginning of the economic “crisis”, the UT calculation for the fed funds rate has shown itself to be different. It did not drop as much as the official calculation using the Taylor rule. In fact, in 2011, the UT equation would have called for a slight rise in the fed funds rate. Since 2011, the calculation has dropped back close to a zero % interest rate again. (Slightly positive, +0.16% for 3Q-2012)

An advantage of using the UT variables in the Taylor rule for the Fed funds rate is being able to project the constraints, peaks and troughs that affect the movement of real GDP. Because of this feature, the UT equation could be a useful complement for analyses projecting the Fed funds rate. Since 2011, the economy is once again near the UT zero lower bound. The UT equation again...



The ultimate message of the UT equation is that declining labor share of income has become a harsh and costly constraint on the available capacity to utilize capital and labor in the economy. The standard of living in the United States has been taken down a big notch because of it.

If labor is paid less, we face economic consequences. One has to only travel to some third world countries to view how the dynamics of this equation work.

The UT equation shows the risks of low labor share of income.

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