Macroeconomic Measurement 2: Value production and distribution

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Production

So far we have discussed what GDP is and how GDP is spent. Now we will briefly discuss how to measure the factors of production. In macro it is helpful to introduce the concept of aggregate production-function which is a useful way to think about the relation between product/value and the factors that are used to produce it. The aggregate production of value can be described by the following relation:

$$Y = AF(K, L)$$

Capital and labor are the factors of production, while A denotes the so called Total Factor Productivity (TFP). We will now briefly discuss how to measure K and L while we will talk about TFP in later classes.

The capital stock

The capital stock of a country represents the amount of **physical, productive** assets present in that country. Note that the US capital stock is not the same thing as US wealth as US wealth represents the total assets owned by US nationals. The capital stock today is the result of two forces, investment and depreciation. The accumulation of capital stock of a certain type of capital is described through:

$$K_t = I_t + (1 - \delta)K_{t-1}$$

where δ represents the depreciation rate. Suppose that at the beginning of time the capital stock was K_0 and that the depreciation rate is constant. Using the above equation repeatedly we get

$$\begin{aligned} K_1 &= (1-\delta)K_0 + I_1 \\ K_2 &= (1-\delta)K_1 + I_2 = (1-\delta)^2 K_0 + (1-\delta)I_1 + I_2 \\ &\dots \\ K_t &= I_t + (1-\delta)I_{t-1} + \dots (1-\delta)^{t-1} I_1 + (1-\delta)^t K_0 \end{aligned}$$

so the current capital stock is given by a weighted sum of all past investments, where the weights are decreasing with time. Investment far back in time have a smaller weight because they are more depreciated. Different capital goods have different capital depreciation rates, as shown in the table below:

Type of good	**Annual depreciation rate**
Computers (after 78)	.31
Computers (before 78)	.27
Trucks	.12
Ships	.06
Industrial buildings	.03
Residential housings	.01

Figure 1 shows the depreciation profile for an investment of 100 dollars in equipment for various goods. Note that here we attempt to measure physical depreciation that is not necessarily connected with the fiscal depreciation (i.e. how much depreciation of your capital you can write off as a business expense).

By summing up the value of the capital stock of all different goods we get the total capital stock of the US economy. In the table below we can see the composition of the US capital stock in 2001:

Composition of the US capital stock in 2010

	Total	Fixed private					Fixed Govt	Cons Dur.
		Tot	Non Residential			Resid.		
			Tot	Equip	Struc.			
Bill of $	49324	34200	16803	5739	11063	17397	10541	4581
% of total	100%	69%	34%	12%	22%	35%	21%	9%
% of GDP	335%		**114%**					

Notice that a large fraction of the US capital stock (44%) is held directly by consumers (Residential and Consumer Durables) and that the total stock of capital is about 3 times the GDP. Notice also that the ratio of capital stock of firms (Total non residential) was about 114% of GDP.

Measuring capital stock and the valuation of the stock market

Measuring the value of the capital stock in the US economy could give us information on the value of US equities (including the stock market). In a frictionless world the equity value of a firm should be equal to the value of its physical assets plus intangibles minus the debt. If, on aggregate, debt and intangibles are not very large

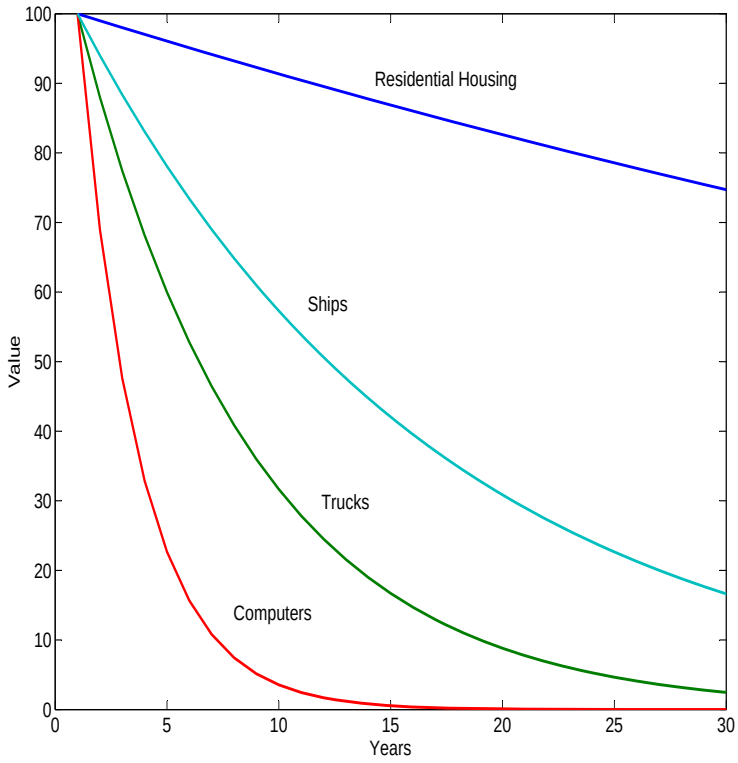

Figure 1: Depreciation of various types of capital

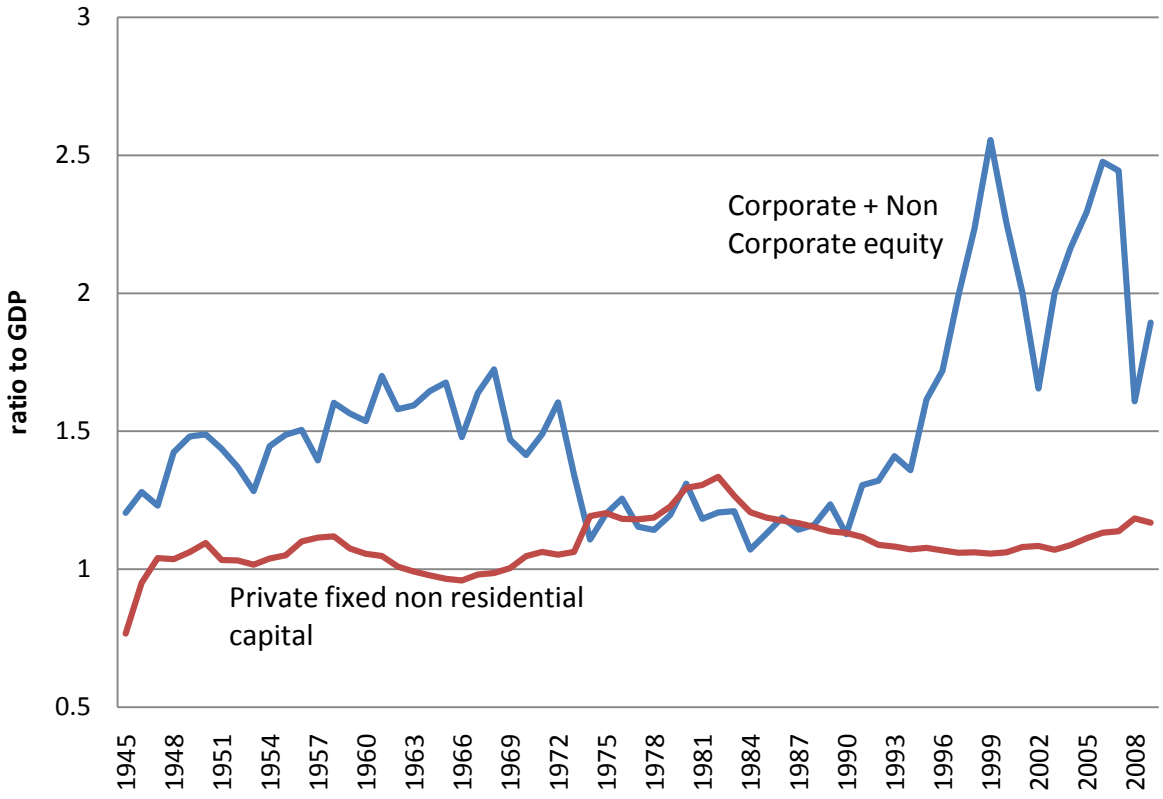

Figure 2: The Value of Equity and the Value of Capital Stock

components and do not vary too much over time, the aggregate value of the capital stock of the business sector should provide us a useful benchmark against which to judge the equity value of US businesses. Figure 2 plots, as a fraction of GDP, the value of fixed private non residential capital (equipment plus structures) and the value of total (corporate plus non corporate) equity (subtracting debt would change the picture very little). [1] Note that up until the 1990s the value of the capital stock and the value of the stock market do not stray too far from each other. But after the 1990s the value of equity has swingled wildly going from 2.5 times the value of the capital stock to 1.5 in the span of a couple of years.

Trying to understand these large discrepancies between the stock market and the value of the capital stock has recently been one of the most active lines of research in economics. The candidate explanations can be divided in two: the fundamental based ones, which try to find some structural reason explaining these wild swings, and the behavioral based, which view these swings as a sign of market "irrationality"

[1] Data on capital are from the BEA fixed assets tables while data on the total value of corporate and non corporate equity can be found in the Flow of Funds of the United States which is also an excellent source of aggregate assets and liabilities data.

and non-predictability.

Among the fundamentalists we have Nobel prize winner Edward Prescott and Minnesota based researcher Ellen McGrattan at the Federal Reserve Bank of Minneapolis that in the paper Taxes, Regulations, and the Value of U.S. and U.K. Corporations argue that the difference in equity valuations largely reflects changes in the tax structure on corporate distributions. They claim that changes in taxes, together with the growing international capital of US firms, can explain a large part of this long run change in equity prices both in US and in the UK.

Robert Hall from Stanford argues that these swings reflect uncertainty on the value of intangible assets, and this uncertainty is particular high (and thus can lead to large swings) in times when new technologies arrive. A related point is made by Boyan Jovanovic from New York University, who argues that the change in profitability of new and old firms due to the IT revolution is the main cause both of the fall of equity value in the 1970s and of the boom of the 1990s.

Others have explored the role of demographics and its impact on the aggregate demand for assets, concluding that it could not play a major role (see James Poterba at MIT).

One of main proponents of behavioral based explanation is Robert Shiller from Yale who believes that these swings are bubbles (i.e. deviations from fundamentals) due to irrational exuberance of investors. Figure picture from his book that reports the ratio between stock prices (SP 500 index) and a 10 year moving average of earnings for a very long time. Obviously we will not settle the debate in these notes, but it is apparent that understanding it better would be fairly important for, say, an individual young investor who is trying to decide whether to allocate its long term savings in stocks or bonds.

Measuring Labor Input and Unemployment

The other very important input of production is labor. Labor is more easily measured than capital and it changes more rapidly across time; importantly hiring decisions reflect the general outlook of firms about the future and thus employment figures are carefully monitored. The first Friday of each month the BLS releases the Employment Situation, which reports key labor statistics. On the class page you can find the employment situation in August 2012. For our purposes the two key tables are summary table A (household data) and summary table B (establishment data). The household data is a survey that each month asks members of the civilian non institutional population[2] questions about their working behavior.

[2]People 16 years of age and older residing in the 50 States and the District of Columbia who are not inmates of institutions (penal, mental facilities, homes for the aged), and who are not on active duty in the Armed Forces.

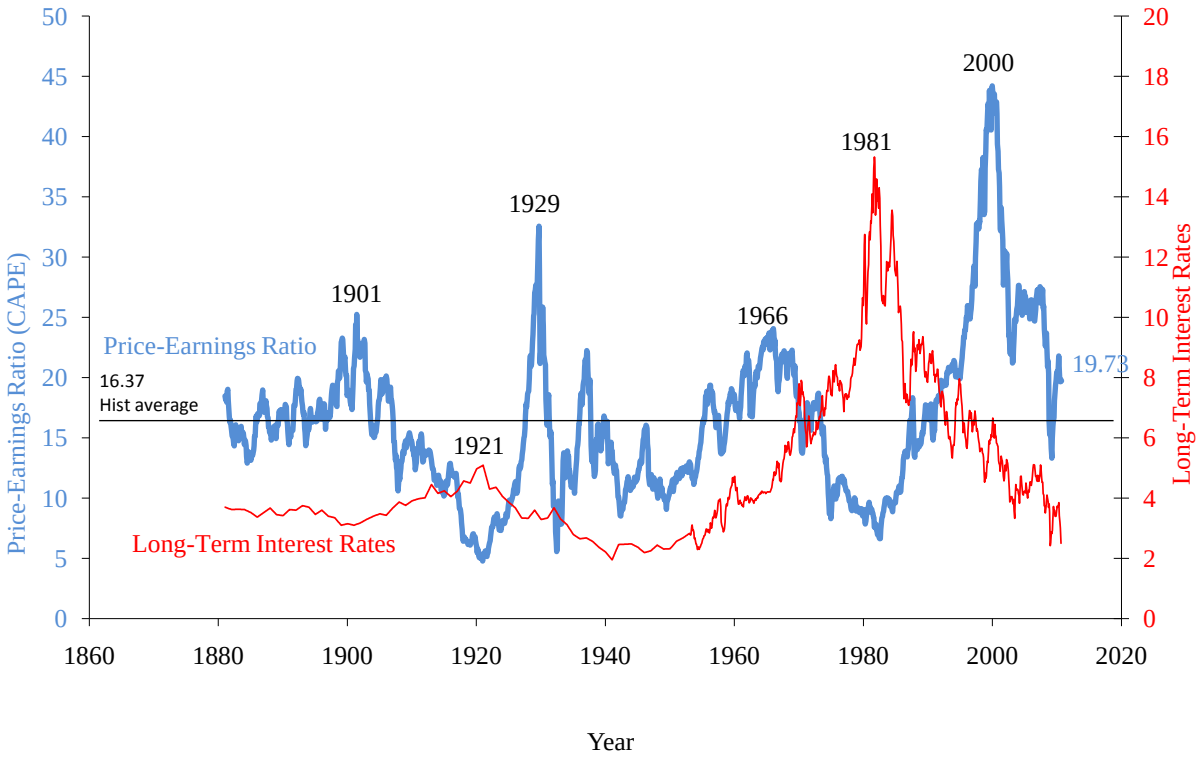

Figure 3: Long Run Swings in Price-Earning Ratios

The civilian non institutional population can in turn be divided in three groups: employed[3], unemployed[4] and out of the labor force i.e. none of the above. So people out of the labor force include students, retirees, housekeepers, beach bums. The unemployment rate (U) is the ratio between the person that are unemployed(U) and the labor force (LF).

$$UR = \frac{U}{LF} = \frac{LF - E}{LF} = 1 - \frac{E}{LF}$$

Notice that changes in the unemployment rate are not necessarily given by changes in the number of people working but they can be caused by changes in labor force (females entering the labor force, discouraged workers leaving the labor force), so the unemployment rate is not necessarily the best measure of the intensity of labor input in an economy. Figure 4 shows the path of unemployment rate in the US post-war.

A related measure of how many unemployed workers are out-there is the number of people that in a given week file for unemployment benefits for the first time. This is different from the unemployment measure above as it is not based on self-reporting status but on the actual people who file for benefits. The measure is available weekly but is very noisy so often analysts take a four weeks moving average. Figure 5 reports a time series of this statistic

An alternative measure of labor that is based on the household survey and that has received attention lately is the employment population ratio, which is just the ratio between the persons who are employed and the civilian non institutional population. Figure 6 shows that this ratio now around 58% in the United States in 2012, down from an historical high of around 65% in the late 1990s. One troubling fact that emerges from this picture is that the ratio now is about the same as it was 30 years ago where female labor force participation was much lower than it is today.

Another measure of employment which is often looked at is the total non-farm employment from the establishment survey (i.e. table B from the Employment Situation), which is based on a survey of employers rather than households. In particular analysts often watch the net number of jobs that are being added to the US economy in a given month (see figure 7).

[3]Persons are counted as employed if during the reference week, they did any work at all as paid employees, in their own business, profession, or on their own farm, or who worked 15 hours or more as unpaid workers in an enterprise operated by a member of the family, and (b) all those who were not working but who had jobs or businesses from which they were temporarily absent because of illness, bad weather, vacation, child-care problems, maternity or paternity leave, labor-management disputes, job training, or other family or personal reasons, whether or not they were paid for the time off or were seeking other jobs. Each person is counted only once, even if he or she holds more than one job.

[4]Unemployed persons are all persons who had no employment during the reference week, were available for work, except for temporary illness, and had made specific efforts to find employment some time during the 4-week period ending with the reference week. Persons who were waiting to be recalled to a job from which they had been laid off need not have been looking for work to be classified as unemployed

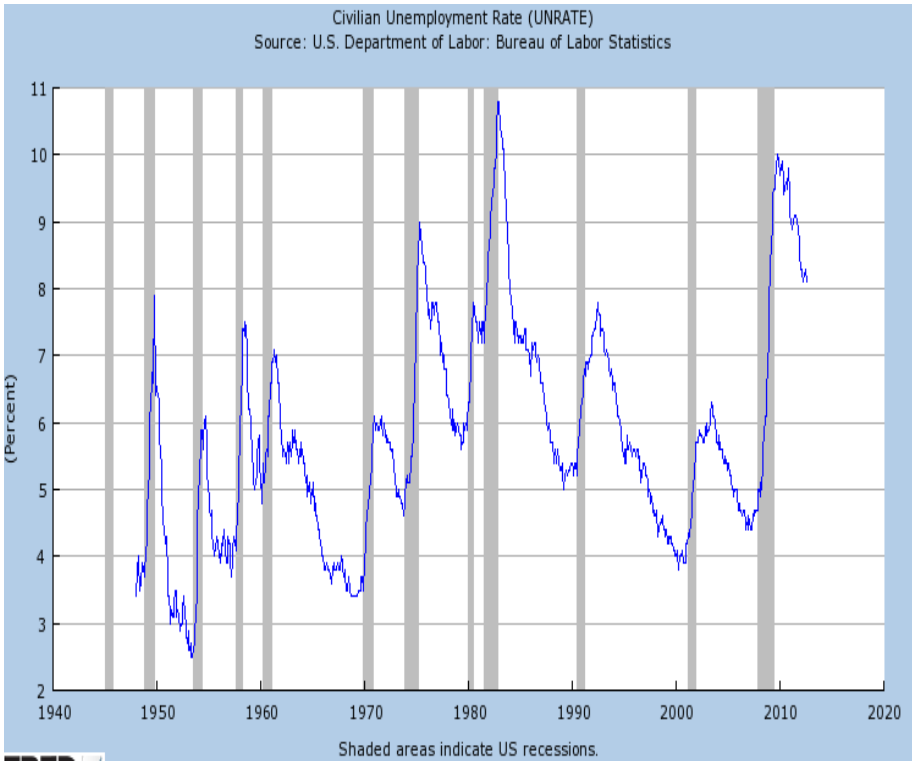

Figure 4: Unemployment in the US, 1948.1-2012.8

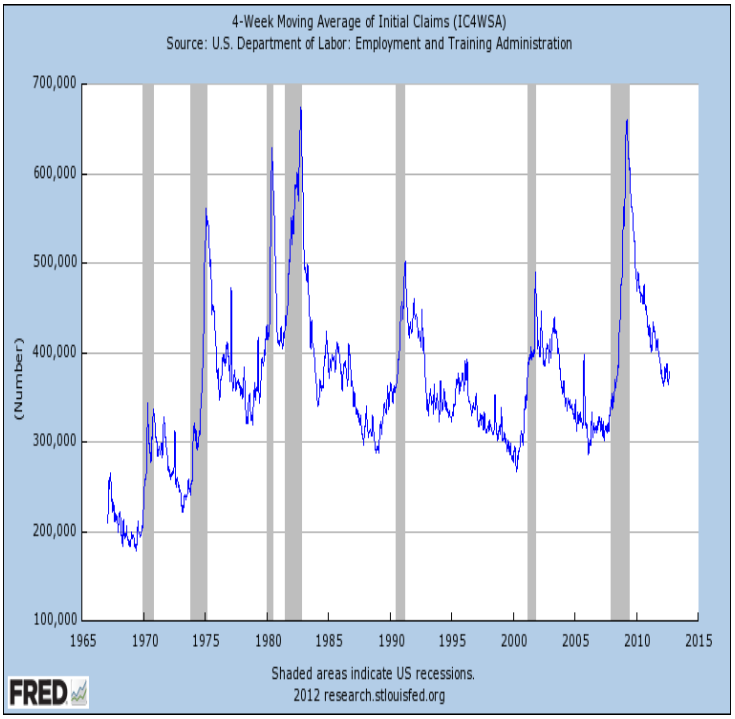

Figure 5: Initial Claims for Unemployment Benefits, 1948.1-2012.8

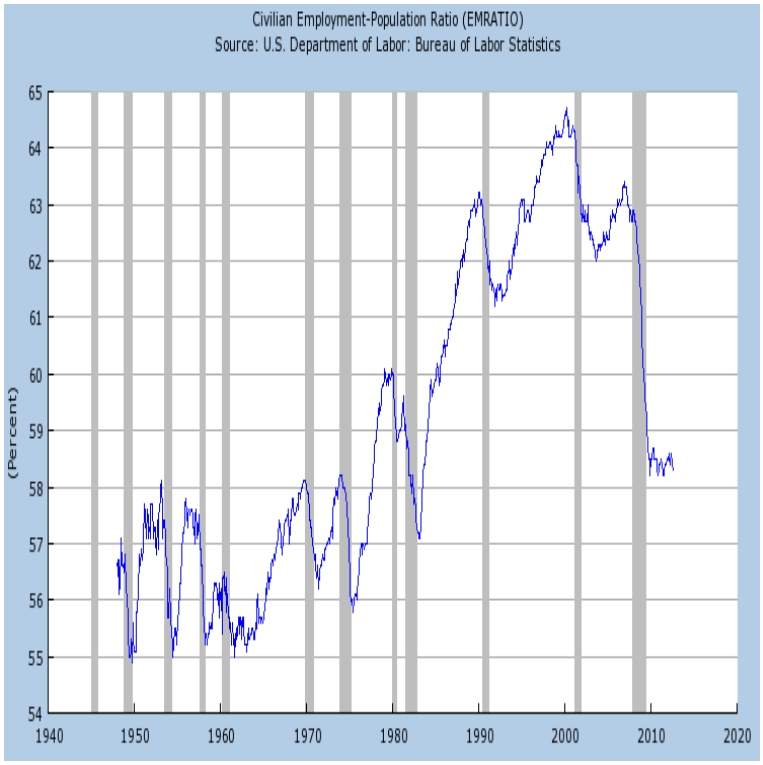

Figure 6: Employment population ratio in the US, 1948.1-2012.8

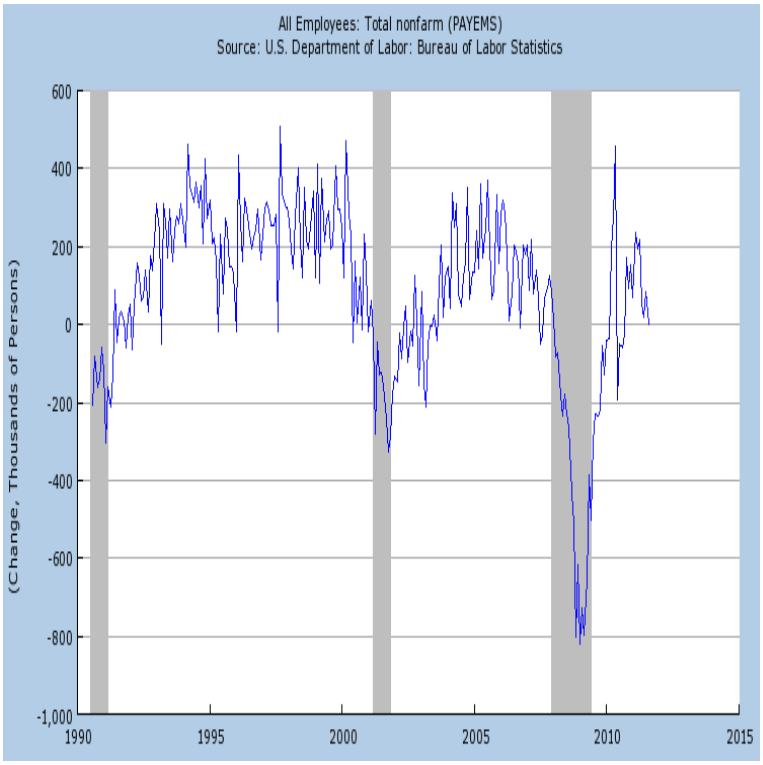

Figure 7: Change in employees

Figure 8 shows the two series since 1948 and it shows that, over the long run, they move closely together. Figure 9 though shows that in the short run there can be significant differences between the two measures. The household survey clearly displays more short run noise and so we should put less importance in its month to month movements. But, more interestingly, the establishment survey has displayed a much more robust growth during the 90s expansion and a much more severe job loss after the 2001 recession. Note that the non farm payrolls came back to the 2001 peak only in early 2005, while the civilian employment reached it much earlier in late 2002. Another interesting case is provided by the August 2011 employment situation where employment in the household survey actually increased by 300000 units while the one in the establishment survey was un-changed. Analysts are still trying to fully understand the diverging pattern, and whether it is based on the statistical differences between the two series, [5] or whether it is based on the fact that many new establishments are usually created after recessions and the survey only picks them up with a lag.

Yet another measure of employment which is also closely watched as it comes out in different dates (usually a couple of days before the BLS report) and is also based on (private as opposed to private and public) establishment hiring is the National Employment Report from private firm ADP (Automated Data Processing). Figure 10 shows how the two series track each other over the long run but in any given month can display quite different patterns.

A final remark about employment measures is that all these measures focus on bodies, i.e. on the "extensive" margin of employment and do not take into account the "intensive" margin i.e. the fact that sometimes individuals change the number of hours they work (for example they go from full to part time). The BLS provides a measure of labor input that takes this margin into account, reported in figure 11, which instead of measuring total bodies measures total hours worked. This measure, like all the ones we have seen before, suggests that even though we are two years into

[5] The key differences are the following

1. The household survey includes agricultural workers, the self-employed, unpaid family workers, and private household workers among the employed. These groups are excluded from the establishment survey.
2. The household survey includes people on unpaid leave among the employed. The establishment survey does not.
3. The household survey is limited to workers 16 years of age and older. The establishment survey is not limited by age.
4. The household survey has no duplication of individuals, because individuals are counted only once, even if they hold more than one job. In the establishment survey, employees working at more than one job and thus appearing on more than one payroll would be counted separately for each appearance

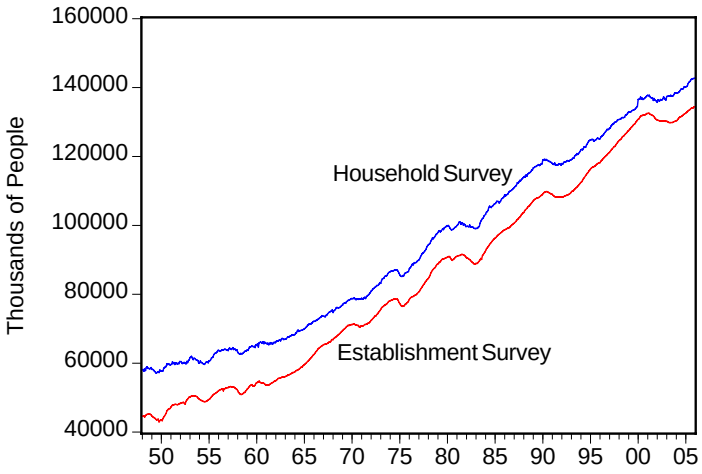

Figure 8: Employment in the US, 1948-2005

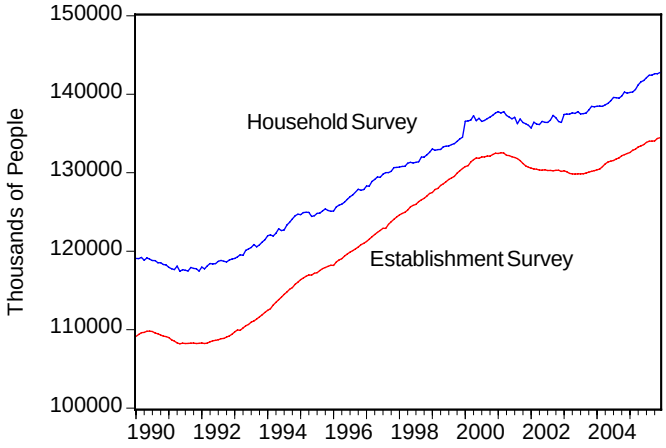

Figure 9: Employment in the US, 1990-2005

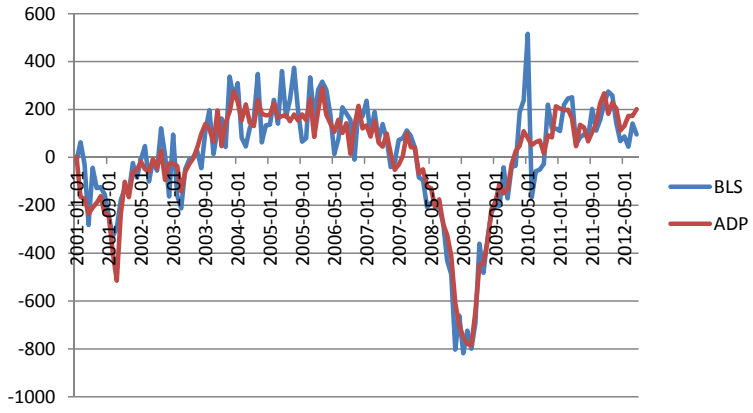

Figure 10: Changes in Employees (in '000s): BLS v/s ADP)

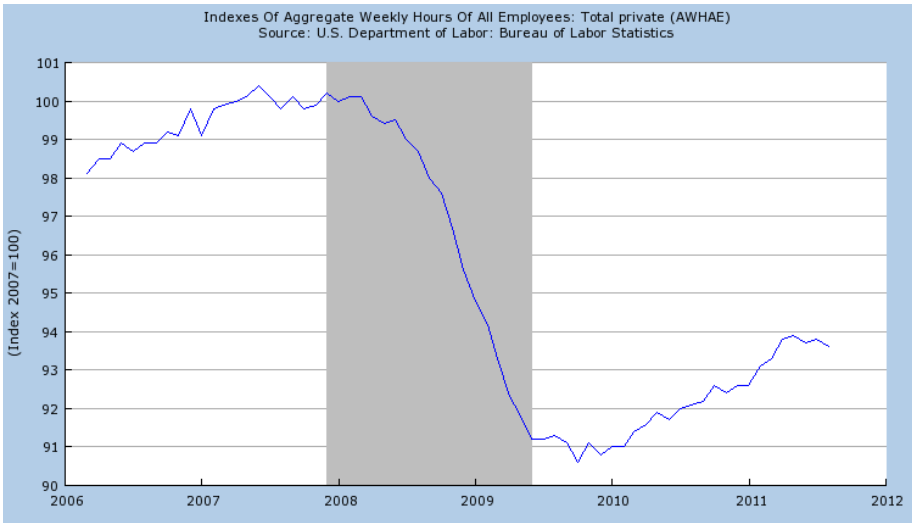

Figure 11: Total hours worked

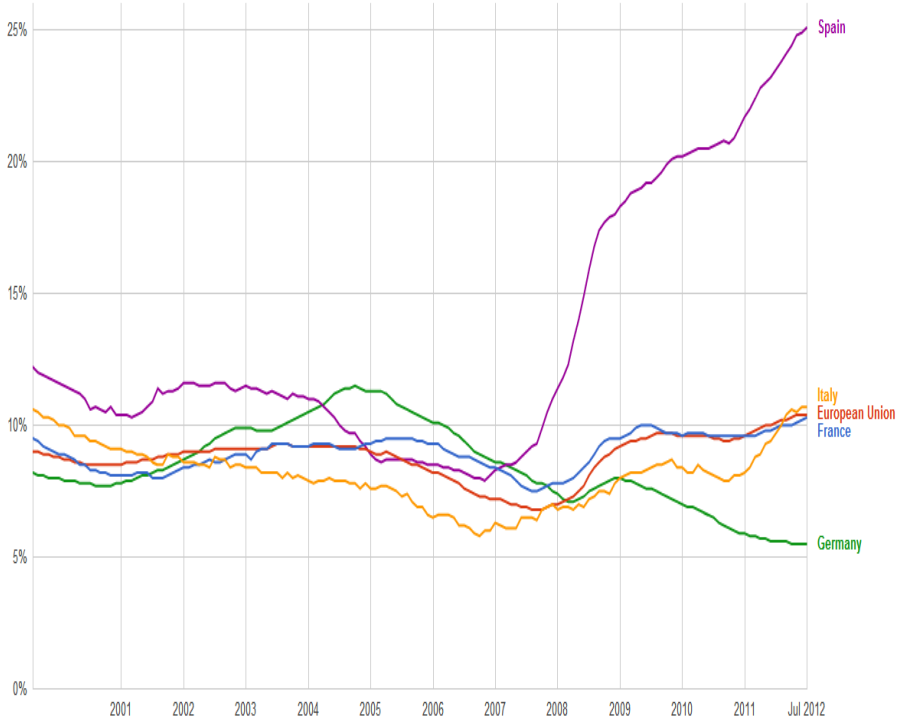

Figure 12: Unemployment in Europe, 2000-2012

the recovery the US labor market is still depressed relative to where it was before the 2008 crisis.

Unemployment in Europe

So far we have discussed employment statistics in US but, for exactly the same reasons we discussed above, these stats are also closely watched in Europe (and other countries). The main source for European Employment numbers is EuroStat and the figure below shows figures for unemployment in some European countries over the last decade. The figure shows rather clearly how European labor market have been deteriorating rapidly over the period 2011-2012 and also how this deterioration has not been uniform: indeed Germany has fare way better than US, countries like Italy or Spain way worse. These figures are at the heart of the debate of the stability and the future of the Euro.

Employment and human capital

All the measures of labor input we have considered so far have the potential problem that not every worker is equally productive, i.e. they do not take into account of what economists call "human capital". An hour of a skilled worker is more efficient (can produce more output) of an hour of an unskilled worker. Economists try to measure these differences using the concept of efficiency units that are contained in an hour of a worker. In order to measure efficiency units we can use information on the worker wage. If, for example, a brain surgeon is paid 100 dollars per hour while a burger flipper is paid 5 dollars per hour, this suggests that an hour of the brain surgeon contains 20 times more efficiency units (or human capital) than the one of the burger flipper. Notice that, in order to measure this, we need to make the assumption that there is a direct connection between the wage paid to labor and the actual output produced by labor (this needs not to be the case and in class I will give some examples of how can this be). Another possible way of correcting for efficiency units is to use additional information about the worker, such us her education or age or experience. It turns out that correcting for efficiency units does not impact much the cyclical variation in labor input in the US but it can have a very strong impact on the measure of labor input across countries.

The distribution of value

In the previous class we have established that GDP measures the total amount of resources produced in a country in an interval of time. Beside total or average creation of value one might be concerned about how this value is distributed across people or households. For example, in 2004 the median per capita income was around $24000 (meaning that 50% of the US population lives in households where income per household member is below $24000), about 10% of US population lives in household in which the income per member is below $8000, which is below the so-called poverty-line and 90% of the US population lives in household with a income per member less than $50000. At the other extreme individuals in the top 1% of the income distribution earn more than 15% of the total income.

More precisely, how evenly income is distributed among people is measured by inequality indexes. There are various inequality indexes but a popular one is the Gini index. Start by constructing a Lorenz curve $L(x)$, which tells you the share of income earned by the bottom x% of the population. On one extreme (the society in which everybody makes the same) $L(x) = x$ that is, for example, the bottom 50% of the income distribution makes exactly 50% of the total income. Subtracting the actual Lorenz Curve from this hypothetical benchmark, and summing up the differences we obtain the Gini index. The Gini Index has its minimum at 0 (a society in which everybody makes the same) and its maximum at 1 (a society in which one person

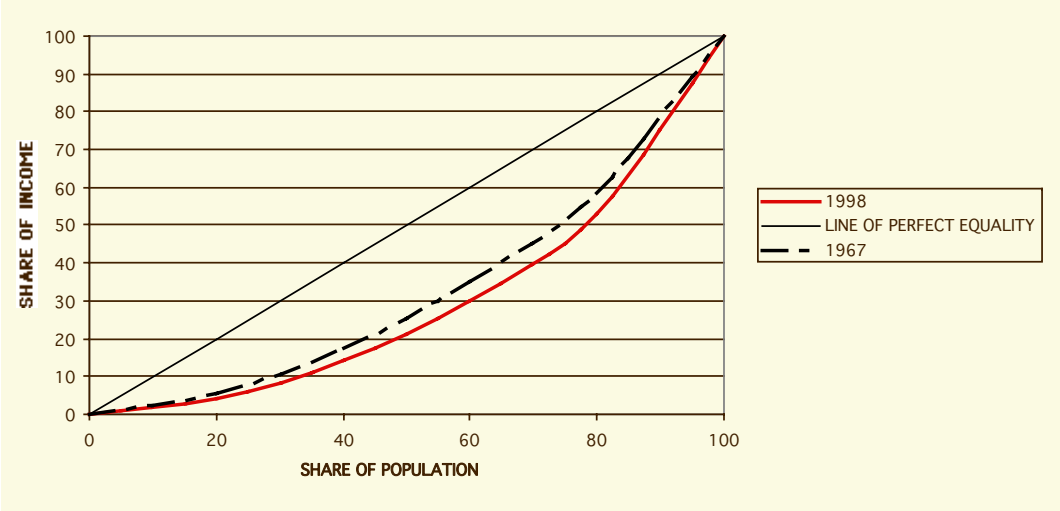

Figure 13: US Income Lorenz Curves

earns all the income and the rest of the society earns nothing). The US Gini index in 2003 was 0.37. Figure 13 shows two Lorenz curves for the US in two different years. For more details on the Gini you can check the Gini Coefficient and Lorenz Curve on the Wikipedia.

Although the Gini index has some interesting statistical properties it has the disadvantage that is hard to interpret. How much more unequal is a society going from a Gini of 0.3 to 0.4? For this reason an alternative measure of inequality is the so called 90/10 ratio, that is simply the ratio between the income earned by the person at the exact top 10% of the income distribution and the person at the exact bottom 10% of the income distribution. In US in 2004 the 90/10 ratio was around 6, meaning that the person at the top 10% of the income distribution was making about 6 times the income of the person at the bottom 10%.

To give you a sense of how inequality in the US compares to inequality in other countries table B reports inequality indexes for various countries

Table B. Income inequality in various countries

Country	Year	90/10	Gini
Czech Rep	1992	2.4	0.20
	1996	3.0	0.26
Sweden	2000	3.0	0.25
Germany	2000	3.3	0.26
Canada	2000	3.8	0.30
Taiwan	2000	4.0	0.30
US	2000	*5.5*	*0.37*
China	2000	na	0.41
Russia	2000	8.3	0.43
Mexico	2000	10.4	0.49
Zambia	1996	na	0.52
Brazil	1989	na	0.6

Sources: Luxembourg Income Study, World Income Inequality Database

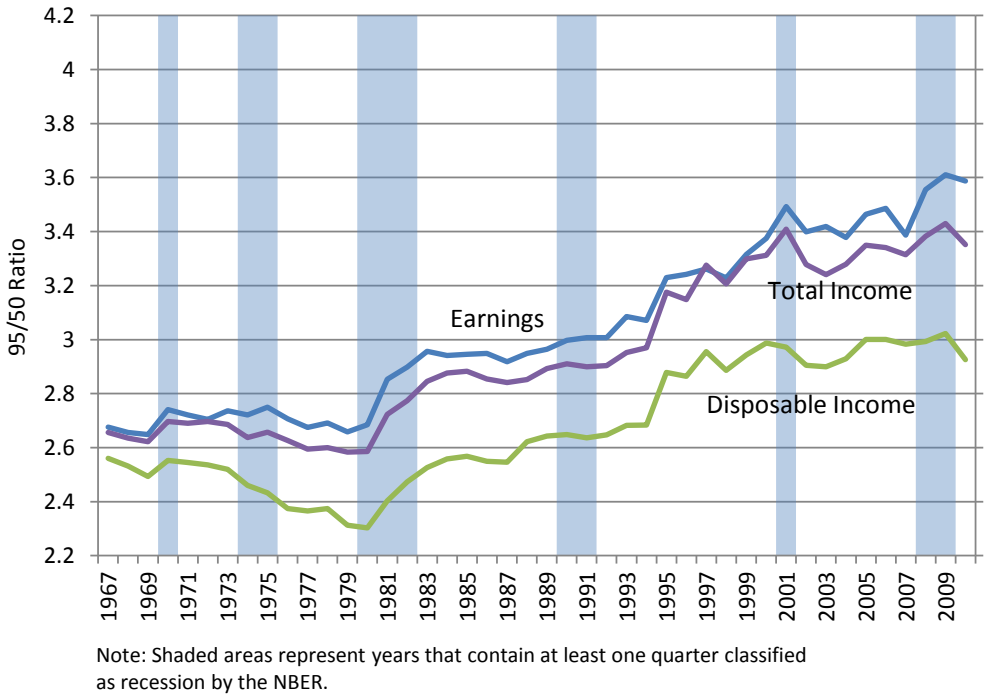

Figure 14: US Inequality at the top

Tho related measures of inequality are the 90-50 ratio and the 50-10 ratio which reflect the ratio between the top and the middle of the income distribution, and bewteen the middle and the bottom respectively: in a sense these measure decompose total inequality in inequality "at the top" and inequality "at the bottom". Figures 15 and 14 below show how these two measure in US can differ quite sharply. We'll disccuss more about this in class but if you like to read more about inequality in US during the last 2007 crisis you can check this Paper

Is inequality bad or good? Should the government do something about it? These are important question in economics on which unfortunately we do not know too much. We do know that too much inequality can be bad for a variety of reasons. First of all, keeping average income constant, if there is a lot of income inequality there are going to be people with very little income. That is bad for them but can be bad for the economy as a whole as it can fuel social unrest and breakdown of economic and social interaction.

On the other hand too little inequality can adversely affect incentives. If the government taxes everybody at 100% rate and gives back to everybody the same amount of money very few people would bother working and although the society will be very equal, everybody will be equally poor. Some commentators are very critics toward the large concentration of income or wealth in the hands of a relatively small number

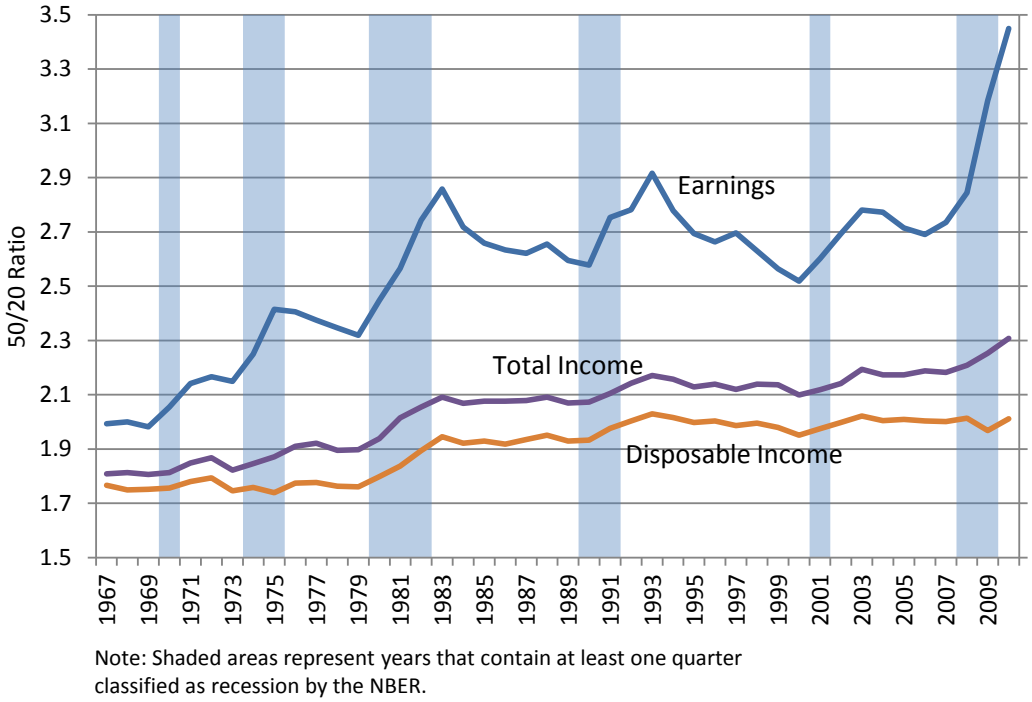

Figure 15: US Inequality at the bottom

of people (for example the income share of the top 0.1% in the US exceeds 6%). But others argue that these large differences between rich and poor, between doing well and not doing well, could be necessary to provide the incentives for people to work and most importantly to invest on their future and the one of their descendants.

One fact that you might have heard is that income inequality has increased significantly in the US over the past 30 years: the rich are getting richer and the poor are getting poorer. Should it be a motive for concern? The picture below reports the evolution of various measures of income inequality in US over the last 30 years together with the evolution of consumption inequality. Notice that income inequality has increased over time but consumption inequality, and thus the distribution of well-being, has remained fairly constant. Can you think of an explanation for the diverging path? Clearly the explanation has to rely on the idea of social mobility, i.e. on the fact that people with low income have the possibility of having high income in the future and this allow them not to reduce their consumption today. This picture also might explain some findings and evidence regarding how Americans (as opposed to Europeans) do not seem to be overly concerned about the increase in inequality.

But even if you do not care about inequality from a social welfare point of view, it might be very relevant for you from a business perspective. Many goods and services are mainly consumed by individuals in specific parts of the income distribution so

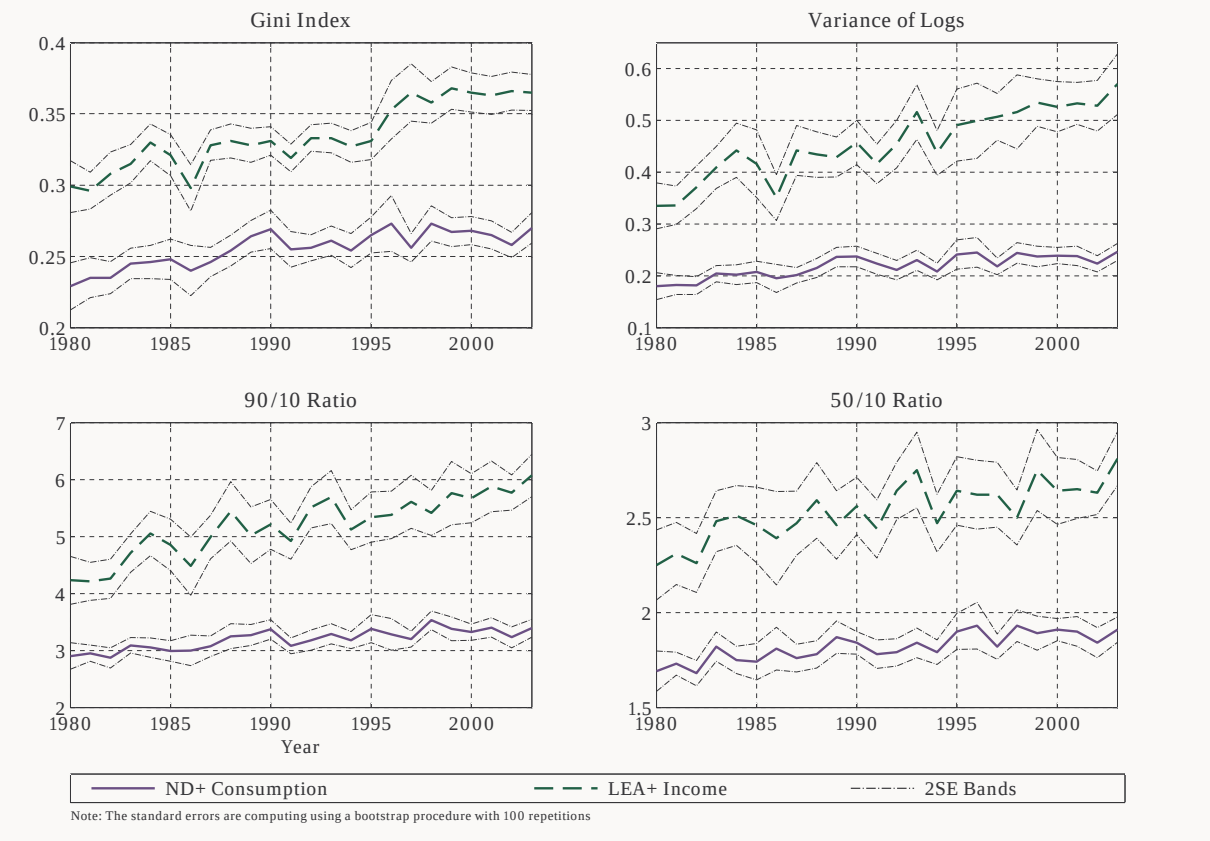

Figure 16: Trends in Income and Consumption Inequality in the US

knowing how income is distributed in a certain country might give you a much better idea of the potential demand for your product in that country. For example, keeping average income constant, you might have a higher demand for a luxury car in a country in which income is unequally distributed while you will have higher demand for a compact car in a country in which income is more evenly distributed.

For all these reason inequality is closely monitored (The Bureau of Census has a wealth of indicators of inequality for the United States in its Income Statistics). Here you can find a summary of the recent research on inequality in the US, while an excellent non technical review article on recent advances in inequality research appeared recently on a Minneapolis FED periodical called the Region.

Concepts you should know

1. Capital stock, depreciation
2. Employment, Unemployment and Labor Force
3. Inequality, Gini Index, 90/10,90/50,50/10 ratios

Review Questions

1. Is the stock of government debt included in measures of the US Capital Stock? How about the Brooklyn bridge? How about my microwave?
2. Is it possible to have both unemployment rate and civilian employment going up in a given month?
3. Suppose a society has a Gini index of income inequality 0. What is the 90/10 ratio in that society?

Answers

1. Government debt, No. Brooklyn Bridge Yes, Microwave, Yes. They are all assets but government debt is not physical nor it directly contributes to the production of goods or services. The Brooklyn bridge and my microwave are obviously physical and contribute directly to the production of transportation services and food.
2. Yes, if there is an increase in the labor force that exceeds the increase in employment
3. If a society has a Gini index of 0 then the household at the top 10% earns the same as the household at the bottom 10$ so the 90/10 ratio is 1.