Problem Set 5: Review, Public Goods, and Economic Growth

1) **Public Goods**: Suppose that weather forecast systems require funding in billion-dollar chunks, and that each billion dollars invested in weather forecasting doubles your odds of getting the forecast right—that if you spend nothing your forecast, pure chance, has only a 50% chance of being right; that if you spend $1B your forecast has a 75% chance of being right, that if if you spend $2B your forecast has a 87.5% chance of being right, and so forth.

a) Suppose that for an average person the cost of getting the weather forecast consistently wrong over the life of the system is $100. If there are a million people in the area, how much should the government spend on weather forecasting?

$0. The costs of getting the forecast wrong are only $100M—that's less than the cost of setting up a forecasting system

b) Suppose that for an average person the cost of getting the weather forecast consistently wrong over the life of the system is $1000. If there are five million people in the area, how much should the government spend on weather forecasting?

If there is no forecasting system, the weather forecast is wrong half the time, and total costs are $2.5B. Invest $1B in the system, and the forecast is still wrong quarter of the time, and the costs are $1.25B. So the investment of the first $1B reduces losses on net by $0.25B and is a good idea.

Investing the second billion in the forecasting system reduces costs from $1.25B to $0.625B by $0.625B—but that is not worth the billion-dollar cost of the second tranche of investment in the weather forecasting system.

So $1B is the right amount to invest in the weather-forecasting system

c) Suppose that someone decided it would be a good idea to privatize the weather forecasting system—to have a private company broadcast the forecast over media and internet, and collect money by subjecting people to annoying ads while they listen to the forecast. Would this be sustainable equilibrium or not?

Almost surely not: you could enter the market, simply listen to the broadcast, and rebroadcast the forecast over your own channel while subjecting your listeners and viewers to fewer annoying advertisements, and so make money because you would not have to

invest in the forecasting system. Weather-report pirates would thus eat away and eliminate the profits of the people actually doing the work of monitoring the atmosphere and making the forecast.

2) **Review: Minimum Wages:** In lecture we set down rough numbers for California's forthcoming ongoing choice to raise the minimum wage to $15/hour in 2023—to a level that represents an increase from a level in 2014 that, relative to productivity and given current inflation, would correspond to $10.50/hour. Suppose that in 2023 there will be 4 million low-wage workers in California affected by this policy.

a) If the demand curve for low-wage workers in 2015 is:

P = 10.50 - 20(Q - 4)

and the supply curve is:

P = 8,

what will be the shift in price and quantity from the equilibrium (P, Q) = (10.50, 4) to the new price-floor equilibrium as a result of this policy? What will be the change in consumer and producer surplus?

The price-floor higher-minimum-wage equilibrium will be P = $15/hr, Q = 3.775 million workers.

Consumer surplus (i.e., cost to employers and to their customers) will fall by the area of the trapezoid: 4.50 x (3.775 + 4)/2 = $17.449M/hr

Producer surplus (i.e., gain to low-wage workers) will rise by 4.50 x 3.775 = $16.9875M/hr

b) In what units are your answers to (a). If you wanted to express them in terms of dollars per year, how would you go about doing that and what would your answers be?

You would have to multiply the numbers in (a) by the average number of hours per year that a typical low-wage workers works.

c) How would you go about thinking whether this minimum wage increase was a good policy or not?

You would start by thinking about whether the current distribution of income and wealth is "fair"—whether it accords with desert and also with societal utility: are there good reasons for the distribution of income and wealth to be what it is? If there are, then the policy looks like a loser: there are no particular reasons to value the gains to the winners more than the losses to the losers, and the losses outweigh the gains by about $0.45M/hr. Thinking of workers working an average of 1500 hours year, that is a net loss to the California economy of about $675M/year.

If you think the distribution of income is unfair—if you think that from society's point of view a dollar of real wealth to employers and customers generates less than 97.36% as much true well-being as does a dollar of real wealth to low-wage workers—then it looks like a good policy. But then you have to also ask yourself: is there a better policy that will perform good redistributional ends without generating economic inefficiency?

d) If, instead, the demand curve for low-wage workers in 2015 is:

P = 10.50 - 20(Q - 4)

and the supply curve is:

Q = 4 (i.e., the opportunity cost of a low-wage worker is zero up to the point where 4 million are employed, and there are no additional low-wage workers available at higher wages)

what will be the shift in price and quantity from the equilibrium (P, Q) = (10.50, 4) to the new price-floor equilibrium as a result of this policy? What will be the change in consumer and producer surplus?

The price-floor higher-minimum-wage equilibrium will be P = $15/hr, Q = 3.775 million workers.

Consumer surplus (i.e., cost to employers and to their customers) will fall by the area of the trapezoid: 4.50 x (3.775 + 4)/2 = $17.449M/hr

Producer surplus (i.e., gain to low-wage workers) will rise by 4.50 x 3.775 - 0.225 x 8 = $15.1875M/hr

e) In what units are your answers to (a). If you wanted to express them in terms of dollars per year, how would you go about doing that and what would your answers be?

You would have to multiply the numbers in (d) by the average number of hours per year that a typical low-wage workers works.

f) How would you go about thinking whether this minimum wage increase was a good policy or not?

You would start by thinking about whether the current distribution of income and wealth is "fair"—whether it accords with desert and also with societal utility: are there good reasons for the distribution of income and wealth to be what it is? If there are, then the policy looks

like a loser: there are no particular reasons to value the gains to the winners more than the losses to the losers, and the losses outweigh the gains by about $2.3M/hr. Thinking of workers working an average of 1500 hours year, that is a net loss to the California economy of about $3450M/year.

If you think the distribution of income is unfair—if you think that from society's point of view a dollar of real wealth to employers and customers generates less than 87.04% as much true well-being as does a dollar of real wealth to low-wage workers—then it looks like a good policy. But then you have to also ask yourself: is there a better policy that will perform good redistributional ends without generating economic inefficiency?

3) **Economic Growth:** Consider once again our very long-run global economic real GDP growth and prosperity table from lecture:

In the Shadow of Malthus

Year	Population (Millions)	GDP per Capita ($2015)	Total World GDP ($2015 Billions)
-8000	5	$750	$4
-1000	50	$750	$38
0	170	$750	$128
1500	500	$750	$375
1800	750	$1000	$750
1900	1500	$2000	$3000
2000	6200	$7700	$47740
2015	7400	$10000	$74000

Assume that, going forward, world population peaks at 10 billion people in 2050 and then stabilizes. Assume that growth in world real GDP continues at its current 21st century pace.

a) The global well-off today—the top 10%—receive about 40% of global GDP as income. What is the average income of the global well-off? In what year will the average person on the globe be as well off as the typical member of the global well-off today?

$40,000/year per capita. 2074

b) The global rich today—the top 1%—receive about 15% of global GDP as income. What is the average income of the global rich? In what year will the average person on the globe be as well off as the typical member of the global rich today?

$150,000/year per capita. 2119

c) The global super-rich today—the top 0.01%, the top 740,000—receive about 3% of global income. What is the average income of the global super-rich? In what year will the average person on the globe be as well off as the typical member of the global super-rich today?

$3,000,000/year per capita. 2223

d) The global plutocracy today—the top 0.0001%, the top 7,400—receive about 1% of global income. What is the average income of the global plutocracy? In what year will the average person on the globe be as well off as the typical member of the global plutocracy today?

$100,000,000/year per capita. 2345