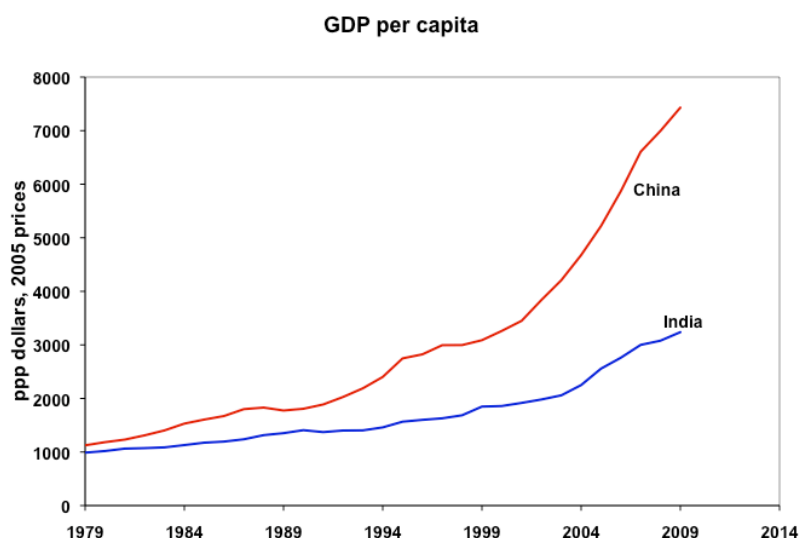


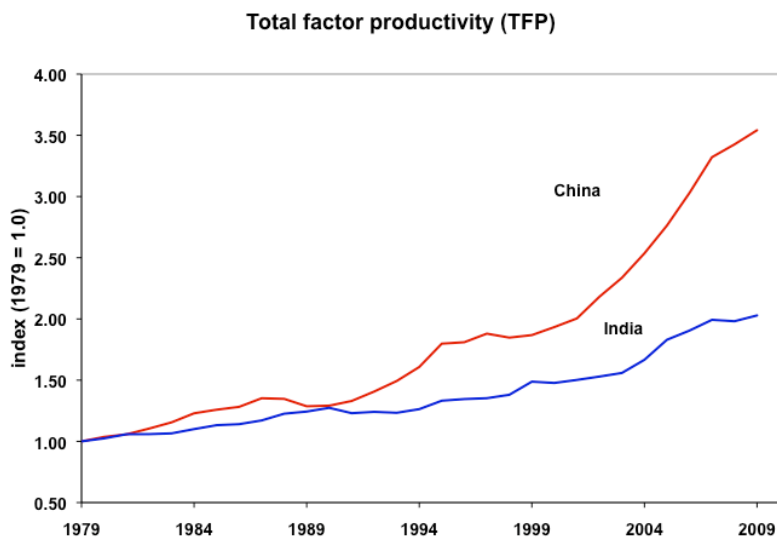
## Problem Set #2

### Due: beginning of class October 15

1. **Growth accounting in China and India (50 points):** You have been asked to provide an analysis of aggregate growth in China and India. The research department has compiled data on labor, capital, population and output. (workbook PS2Data.xls, available on Blackboard) They also report that payments to labor make up two-thirds of GDP in both countries, i.e.,  $1 - \alpha = 2/3$ .
  - a. How has GDP per capita evolved in the two countries? Turn in a well-labeled graph that plots GDP per capita for China and India (4 points).



- b. Compute TFP for each year. Create a TFP index for each country by dividing the value of TFP in each year by the value of TFP in 1979. Turn in a well-labeled graph showing the two TFP indices. (6 points)



- c. Based on the index results, separate each country's growth experience into two periods: 1979-1990 and 1990-2009. Decompose growth in output per capita into contributions from TFP, capital per worker, and workers per capita for these two periods. Report your findings in a table similar to the ones we used in class. (20 points)

China	Y/N	$\alpha$ K/L	L/N	TFP
1979-1990	4.31	1.01	0.97	2.33
1990-2009	7.44	1.95	0.19	5.31

India	Y/N	$\alpha$ K/L	L/N	TFP
1979-1990	3.21	0.86	0.15	2.20
1990-2009	4.38	1.65	0.29	2.45

- d. Write a short analysis (no more than two paragraphs) of growth in China and India, highlighting the differences between the two countries (including any differences that arise in the two periods). Include a discussion of possible reasons for the evolution of productivity in these two countries. (20 points)

[Note: The answer below is too long! I've allowed it to run over the two-paragraph rule because I want to identify many of the issues that could have been discussed. All of what follows was not needed to earn full credit.]

China's growth rate of GDP per capita averaged more than 6 percent annually since 1979, while India's growth was about 4 percent. These growth rates notably exceed the long-run annual pace of about 2 percent in the relatively rich countries in Western Europe and North America. TFP gains accounted for the largest share of the expansion in both countries.

In both countries, the pace of per capita GDP growth and of TFP growth were faster in the second period, but the acceleration in China was notably larger. Indeed, Indian TFP growth was fairly stable over the long run. Again, in both countries, the share of the employed population rose over the long run, but the pickup was larger in China in the first subperiod. The share of the employed population in India remained markedly lower than in China. In both countries, the pace of capital accumulation accelerated in the second subperiod. China has enjoyed a persistently higher ratio of capital per worker, and this advantage has widened.

China's rapid productivity gains partly reflect the improvements of its institutions that allocate resources. For example, reforms to the banking sector as well as the influx of foreign investment have provided financing to more productive projects. China's technological growth also was buttressed by the country's initial distance from frontier technologies. China's manufacturing expansion has shifted labor into more productive sectors of the economy (and away from agriculture). China was able to "leap-frog" many of the intermediate stages of technology that exist(ed) between the technologies that it had been using and the modern technologies being adopted today. The enormous capital investments made in the last 20 years likely embody significant technological improvements. Lastly, China is benefiting from the increase in organizational and production know-how being brought to the country by foreign managers,

investors and citizens who have trained abroad. Techniques originally been brought to bear on a particular project can spill over favorably to other projects.

Many of these considerations also apply to productivity gains in India. However, compared to China, the data suggest that Indian institutions are more rigid, so that the economy adjusts less flexibly to changing economic conditions. India's most dynamic sectors have been in services, rather than manufacturing. Other factors – such as demographics (the share of the dependent population) – also likely play a role. As a result, the shift of resources to more productive use in India has been more gradual. While India began the period with a level of GDP per capita only moderately below China, it has fallen far behind.

2. **Argentina and Germany (50 points):** In the 1940s, Argentina and Germany had similar levels of per capita GDP. By 1970, Argentina's GDP per capita plunged to 48 percent of Germany's and by 2009 that number had fallen to 37 percent. What accounts for these differences? You are presented with the following data.

	GDP	Capital	Employment	Population
Argentina	187	458	9,993	23,962
Germany	1,263	4,962	33,268	77,783

Table 1: Data are for the year 1970. GDP and capital stocks are in billions of ppp adjusted, constant price dollars. Employment and population are in thousands of persons.

	GDP	Capital	Employment	Population
Argentina	489	1,108	19,570	40,914
Germany	2,659	7,610	41,665	81,838

Table 2: Data are for the year 2009. GDP and capital stocks are in billions of ppp adjusted, constant price dollars. Employment and population are in thousands of persons.

- a. Complete the following table for 1970. In the third row, compute the ratio of the values in the first two rows. Use  $\alpha = 1/3$ . (10 points)

	Y/N	A	$(K/L)^\alpha$	L/N
Argentina	7804	522.9	35.79	0.417
Germany	16237	715.9	53.03	0.428
ARG/GER	0.481	0.730	0.675	0.975

- b. Complete the following table for 2009. In the third row, compute the ratio of the values in the first two rows. Use  $\alpha = 1/3$ . (10 points)

	Y/N	A	$(K/L)^\alpha$	L/N
Argentina	11952	650.7	38.40	0.478
Germany	32491	1124.8	56.74	0.509
ARG/GER	0.368	0.579	0.677	0.940

Note: In the calculations for parts a and b, I have multiplied out all of the units, but this wasn't necessary if we only wanted to compare the numbers across the countries. In the answer key workbook, I have computed the tables both ways. Notice that the ARG/GER ratios are the same: the units cancel out.

- c. Based on your calculations in parts a and b, summarize your findings. Discuss what attributed to the divergence in output per capita between Argentina and Germany. Which of these components is most important? (10 points)

The Argentine and German economies have diverged further since 1970. GDP per capita in Argentina was 48 percent of that in Germany in 1970; by 2009 it had fallen to 37 percent. The deterioration appears unrelated to the level of capital per worker, which rose similarly in both countries. The driving force was productivity, which grew more rapidly in Germany. TFP in Argentina was 73% of that in Germany in 1970, but fell to 58% by 2009. Labor force participation had relatively little to do with Argentina's relative deterioration, as participation in the two countries evolved in a similar way over the 30-year period.

- d. Discuss (no more than three paragraphs) how the institutions in the two countries compare. Two great sources of (succinct) background reading are available in the World Bank's *Doing Business* reports and *Governance Indicators*. (Links to these documents can be found on Blackboard.) Where do these differences show up in your growth accounting? (20 points)

You have a lot of room for discussion here, but I would probably focus on the differences in opening firms, cross-border trade, the supply of credit, enforcement of contracts, corporate tax rates, and government effectiveness.

The striking difference in the evolution of these two countries is their productivity path. While it is difficult to pinpoint the exact causes, differences in government institutions and the business environment are likely to show up in aggregate TFP. We discuss some of these differences below.

The governments in the two countries are remarkably different. Germany is one of the best governed countries in the world; its 91.9 percentile rank in government effectiveness<sup>1</sup> nudges out countries like the United States (89.0) and Japan (86.7). Argentina, in contrast, ranks at the 39.5 percentile, notably worse than Brazil (57.6), Chile (85.7), and Mexico (60.5). Among other things,

<sup>1</sup> As measured by the World Bank's Worldwide Governance Indicators, which can be found at <http://info.worldbank.org/governance/wgi/index.asp>.

these measures capture the quality of the civil service and the extent to which it is independent from political pressures. As an example of how these differences affect businesses, it is relatively easy for a business to deal with construction permits in Germany, but very difficult in Argentina.

A second major difference between the two countries is the business environment. In particular, we worry about institutions that stifle innovation by making businesses difficult to create and that tax away the gains from success. While starting a business is not easy in Germany, it is more challenging in Argentina, according to the World Bank data. While the direct profit tax in Argentina is low, the total tax rate on profits exceeds 100 percent, compared to 48 percent in Germany. The time cost associated with these tax payments is burdensome as well: in Argentina a firm can expect to devote 453 hours per year on tax-related activities compared to 215 hours in Germany. This gap certainly reflects some of the differences in the quality of the governments noted above. Finally, Germany is far more open to trading across borders and more effective in the provision of business credit. In this class, we will see that trade allows economies to shift production to more efficient sectors. The supply of business credit often reflects the ability to enforce contracts (an area where Germany is among the global leaders).