NYU STERN

The Global Economy
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Group Project #3: Sources of Country Performance

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1. *Japan and Korea.* Japan and Korea are two of the most remarkable economic success stories in human history. Having experienced unusually rapid economic growth over long periods of time, they have moved from the ranks of developed countries to developed and middle income countries, respectively. In Japan, per capita GDP rose from 30% of the US in 1870 (similar to Mexico today) to about 75% today. In Korea, GDP per capita rose from about 10% of the US in 1960 (similar to the Philippines at the time) to over 50% today. Your mission: to determine the sources of the remaining differences between the two countries — capital, productivity, and anything else that you think is relevant.

   The data for 2003 (the most recent year for which all of these numbers are available):

	POP	Y/POP	L/POP	K/Y	Education	Hours
Japan	127.7m	24,036	0.534	4.003	9.6	1801
Korea	47.5m	17,600	0.494	3.366	11.0	2434

   POP is population (millions), Y is GDP (2000 US dollars), K is capital (2000 US dollars), Education is years of school, and Hours is annual hours worked. Y and K are PPP-adjusted. Education and Hours are from the OECD's *Employment Outlook*; the other variables are from the Penn World Tables.

   (a) Compute output per capita, output per worker, and output per hour worked. How do they differ? (20 points)

   (b) What are the primary sources of the difference in output per capita? (20 points)

   (c) Using whatever resources you think appropriate, comment on the likely performance of the two countries over the next decade. What do you see as the major opportunities? Challenges? (10 points)

   Answer. Per capita output is higher in Japan than Korea, but why? Is the Japanese economy more productive? Other reasons? What would it take for Korea to catch up?

(a) Calculations are reported below. The most striking difference in the numbers: a large difference in average hours worked means that Japan's 26% advantage in output per worker increases to 71% in output per hour. In words: Korea's gap in GDP per worker would be substantially larger if they didn't work so much.

Country	GDP Per Capita	GDP Per Worker	GDP Per Hour
Japan	24,036	45,011	24.99
Korea	17,600	35,628	14.64
Japan/Korea	1.37	1.26	1.71

(b) The idea is to dig a little deeper, introducing (for example) capital and productivity. You could do this in a variety of ways; one is to use

$$Y \;=\; AK^{\alpha}(hL)^{1-\alpha}$$

to account for the difference in output per hour worked. A little multiplying and dividing gives us

$$Y/POP \;=\; (Y/L)(L/POP) \;=\; (L/POP)A(K/L)^{\alpha}h^{1-\alpha}.$$

This isn't the only possible line of attack on this problem, but it's a reasonable one. It tells us we can attribute differences in per capita GDP to differences in: participation (L/POP), total factor productivity (A), capital per worker (K/L), and average hours per worker (h). The math implies

$$\begin{aligned}
\frac{(Y/POP)_J}{(Y/POP)_K} &= \left[\frac{(L/POP)_J}{(L/POP)_K}\right]\left[\frac{A_J}{A_K}\right]\left[\frac{(K/L)_J}{(K/L)_K}\right]^{\alpha}\left[\frac{h_J}{h_K}\right]^{1-\alpha} \\
&= \left[\frac{.534}{.494}\right]\left[\frac{0.0538}{0.0511}\right]\left[\frac{180.2}{119.9}\right]^{1/3}\left[\frac{1801}{2434}\right]^{2/3} \\
1.37 &= (1.08)(1.37)(1.15)(0.82).
\end{aligned}$$

Where does the 37% difference in GDP per person come from? Most of the answer is capital: Japan has only an 37% TFP advantage, and its higher capital per worker would (on its own) adds another 15% to the difference. But hours worked, as we've seen, goes the other way: higher in Korea.

Education also plays a role here. Since average years of school are higher in Korea, this will increase the difference in TFP (what's left). One approach (mentioned in the notes) is to measure H by S. Then a term $(H_J/H_K)^{2/3} = 0.913$ will be added above. Or you could approximate H by $\exp(0.07 \times S)$, which would give you a somewhat different answer (0.937). Depending on your choice, the TFP difference will change, since TFP is (by construction) whatever's left.

(c) This part is up to you. One possibility is to look at measures of institutional quality and discuss the role you think they'll play in the future. Institutions, on the whole, are good indicators of the future, since they tend not to change very quickly.

2. *Argentina and Chile.* Argentina and Chile have experienced both dramatic economic growth and painful reversals over the last century. Argentina was one of the richest countries in the world in 1900, but mixed economic performance since then has dropped it back into the world of emerging markets. Chile suffered a traumatic change in government in the 1970s, but emerged a decade later as a fast-growing democracy and now has the highest per capita GDP in Latin America. Your mission is to tell us how — and maybe why — their experiences have been different.

Country	Year	POP	Employment	Y/POP	K/POP
Argentina	1960	20.6m	8.1m	7,838	12,713
Argentina	2004	39.1m	16.2m	10,939	24,343
Chile	1960	7.59m	2.55m	5,086	16,666
Chile	2004	15.67m	6.57m	12,678	29,437

POP is population (millions), Employment is the number of people working (millions), Y is GDP (2000 US dollars), and K is capital (2000 US dollars). Y and K are PPP-adjusted. Data are from the Penn World Tables.

(a) Compute the (average annual continuously compounded) growth rates of GDP per capita and GDP per worker in the two countries. (15 points)

(b) Use our growth accounting methodology to allocate growth in output per worker to TFP and capital per worker. Which factor has been most important over the last 40+ years? (20 points)

(c) Using whatever resources you think appropriate, comment on the differences in performance in the two countries and their likely performance over the next decade. Which do you think grow faster? (15 points)

Answer. We've seen that GDP per capita in Chile has gone from 35% below Argentina in 1960 to 16% above in 2004. How did this happen? Most of this problem is concerned with aggregate data: how much comes from capital, TFP, etc? The last part is an opportunity to look further into features of the two economies that might account for what we find in the data analysis.

(a) The (continuously compounded annual) growth rate of GDP per capita for Argentina is

$$\gamma \;=\; \log(10,939/7,838)/(2004-1960) \;=\; 0.76\%.(!)$$

Refer to the discussion of growth rates in "Sources of Growth" if you're not sure why this works. A similar calculation gives us 2.08% for Chile. GDP per worker is GDP per capita times the population then divided by the number of workers. Its growth rates are 0.64% (Argentina) and 1.57% (Chile). Bottom line: faster growth in Chile.

(b) We use the production function

$$Y/L \;=\; A(K/L)^{1/3},$$

so TFP is $A = (Y/L)/(K/L)^{1/3}$. In growth rates, with the adjustment for employment, this translates into

$$\gamma_{Y/POP} \;=\; \gamma_{L/POP} + \gamma_A + \alpha\gamma_{K/L},$$

which allows us to divide growth in per capita GDP into components due to the employment rate, productivity, and capital per worker. A few calculations give us

	Y/POP	L/POP	A	K/L
Argentina				
1960	7,838	0.393	626	32,332
2004	10,939	0.414	679	58,754
Growth rate (%)	0.76	0.12	0.19	1.36
Contribution to growth (%)	0.76	0.12	0.19	0.45
Chile				
1960	5,086	0.336	412	49,616
2004	12,678	0.419	733	70,210
Growth rate (%)	2.08	0.50	1.31	0.79
Contribution to growth (%)	2.08	0.50	1.31	0.26

Here "growth rate" is computed as in (a). "Contribution" modifies these growth rates as they occur in the formula: the growth rate of K/L gets multiplied by 1/3 (its exponent in the production function). The numbers tell us that almost all of the difference in growth comes from TFP.

(c) Almost all of the institutional indicators are stronger for Chile than Argentina, so perhaps it's not surprising that economic performance has been better. Much of this has come in the last 25 years, as Chile has reestablished a stable democracy with sensible economic policies, no matter who's in power. Argentina continues to fluctuate between policies that favor long-term performance and those that focus on the short term.

(d) Your call. My own opinion is that the strong economic and political foundations Chile has laid will continue to generate higher growth than we'll see in Argentina. For one thing, we've had different parties in power over the last 20 years, yet the same basic economic policies are followed. One that

I find intriguing is a privatized social security system, which helped build a domestic capital market. A temporary factor is copper prices, which are unusually high right now. It's a tricky measurement issue, but this tends to show up as high GDP and therefore high TFP. History tells us that probably won't last.