

ECON B225: Economic Development
Bryn Mawr College
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Assignment: Problem Set

INSTRUCTIONS:

You must submit your own individual write up of your work. You must write the names of all the students with whom you collaborated in the process of completing this assignment.

You must show your work for credit.

1. National Development Metrics

Background: The first challenge of development economics is to measure poverty. Table 1 provides data on macroeconomic measures for 13 countries in sub-Saharan Africa. You will use this information to answer questions 1.a through 1.c in this section of the problem set. Question 1.d references separate data contained in Table 2.

1.a These countries are all former French colonies that now share a common currency called the *franc de la Communauté Financière Africaine*, better known as the CFA franc. This currency is pegged to the euro. The exchange rate between the CFA franc and the euro is 0.0015. The euro floats relative to the US dollar (USD) but currently trades at around 1.1 USD. Use this information to complete the empty columns in Table 1.

1.b Which country has the highest cost of living? Using GDP per capita (PPP), which country is poorest and which is richest? Why could your answer to this be different from the answer you would get to this question if we used GDP per capita unadjusted for PPP as our measure?

1.c Which country has the highest share of its population living below the 1.9 USD per capita PPP per day poverty threshold? Is this the same country that has the highest share of its population living below the nationally defined poverty threshold? Why does this not have to be the same country?

1.d. Table 2 provides a representative sample of people from a fictional country we'll call "Country X". Calculate the poverty gap for this country at the 1.9 USD per day PPP level and its headcount ratio. Why is the poverty gap measure different from the headcount ratio for this country? How is what they are measuring different? Hint: For the poverty gap you'll find it helpful to calculate the values for the third column in Table 2 before you proceed with the final calculations.

2. The Solow Model

Background: The Solow model is the core macroeconomic theoretical framework for all modern development economics. Robert Solow is still alive (97 years old) and won the Nobel Prize in Economic Sciences for this work in 1988. This question will work you through some of the nuances of this model.

2.a Consider a world where all countries have a production function of the following form,

$$Y_t = A \times F(K_t, L_t) \quad (1)$$

where Y_t is a country's total economic output in time t , L_t is a country's labor force in time t , K_t is a country's capital stock in time t , and A is a parameter for labor- and capital-augmenting technical change. Furthermore, you can assume that $f(\cdot)$ has the following Cobb-Douglas functional form,

$$F(K_t, L_t) = K_t^\alpha L_t^{1-\alpha}, \text{ where } \alpha \in (0,1). \quad (2)$$

You can assume that the population of each country is equal to its labor force and any other useful assumptions made by the Solow model in your answer. For simplicity, you may assume that the population growth rates for all countries is zero. Use this information, and what you know about the Solow model from class, to derive the per capita production function for countries in this world in terms of A , k , and α . In other words, find $f(k)$.

2.b Convert the equation of motion in the Solow model into per capita terms.

2.c Derive mathematically the steady-state levels of output per capita (y_t^*) and capital per capita (k_t^*). Your expression for each should **not** contain variables in the model (k_t , l_t , K_t , L_t), but should contain parameter values (A , α). Depict this in a chart with output per capita (y) on the y-axis and capital per capita (k) on the x-axis.

2.d Let's say you're an economic policy maker in a low-income country and you want to pass a law requiring everyone to save at a set rate because you think a change in the savings rate will help achieve a higher level of production per capita. Assuming that your savings rate is not maxed out at 1 or bottomed out at zero, would you lower it or raise it to increase per capita output in the steady-state equilibrium? Please refer to an equation you have derived to justify your response and explain your reasoning. Compare this conclusion to the role of the savings rate in the Harrod-Domar Model of Economic Growth. Does the savings rate play the same role or a different role in determining the growth rate? Explain.

2.e Show using your graph from 2.c how a policy maker would decide on how to set the economy's savings rate for the economy if that policy maker's goal is to maximize consumption per capita in the economy in the steady state.

2.f Consider the following three countries, all of whom have the same values of α in their respective production functions ($\alpha = 1/4$ for each country), but different levels for their savings rate, depreciation rate, and total factor productivity. These are listed in Table 3 or each country. What is the order from richest to poorest of each country in their steady-state equilibria? Show your work and each country's steady-state level of output per capita. (Hint: You don't need any initial value for the capital stock to complete this question. You have all the information you need to complete this if you correctly answered 2.c).

2.g Leaders in the poorest country you identified in 2.f are dissatisfied with their level of production per capita in the steady-state equilibrium. Suppose there is a costless way for them to intervene and improve their country's total factor productivity. What percentage change in their total factor productivity would the country need to achieve in order to have the steady-state level of production per capita as the richest country you identified in 2.f?

2.h The Lewis Model implies that at some point capital accumulation will stop and the economy will stop growing. How is this point similar to, and different from, the Solow model's steady state equilibrium?

3. Falling Off the Growth Path

Background: While the Solow model describes long-run growth processes, it doesn't have anything to say about how countries fall off the growth path, which is a phenomenon we see in the real world very frequently. Although less frequent now, it was common over the period from 1950 to 2000 to see poorer countries struggle economically and descend into full-scale economic crisis. The Australian model can help us to think about these processes. This set of questions will work you through an application of this model.

3.a Consider a small and open economy as defined by the Australian model, which has sectors in tradables and in non-tradables. The real exchange rate (RER) is defined as follows,

$$RER = \frac{p_t}{p_n}, \quad (3)$$

where p_t is the price of tradables and p_n is the price of non-tradables in the country. Plot supply and demand curves for the non-tradable market and the tradable market in the country with RER on the y-axis and quantity on the x-axis. Explain the slope of the demand curve in the non-tradables' sector.

3.b Absorption equals gross domestic expenditure. When gross domestic expenditure increases, domestic demand increases systematically for all levels of the RER. Use the charts you derived in 3.a to answer the following questions. If the government of a small and open economy increases

absorption, what is the effect on the equilibrium RER from the effect on the tradables' sector? What is the effect on the equilibrium RER in the non-tradables' sector?

3.c The relationships you showed in 3.b can be used to derive the Australian model's phase diagram, which I have recreated in Figure 1 below. Consider a country with a small and open economy with no domestic manufacturing sector that is initially operating in equilibrium in external balance and internal balance.

Coltan is a highly rare metallic ore. It is extremely desirable because it is a necessary raw material for the construction of many modern electronics, including smartphones. What would happen to this country's internal and external balance if this country suddenly discovered a large deposit of coltan under the ground? Use the phase diagram to explain your answer. Be very clear about the various effects and the order in which they would occur. Based on your analysis, what actions should the country take to return to equilibrium? Is the country better or worse off from the discovery? You can assume some level of stickiness in local prices in this country.

(Hint: It will help for you to be familiar with Perkins et al.'s discussion of "Dutch Disease" on page 564 when answering this question)

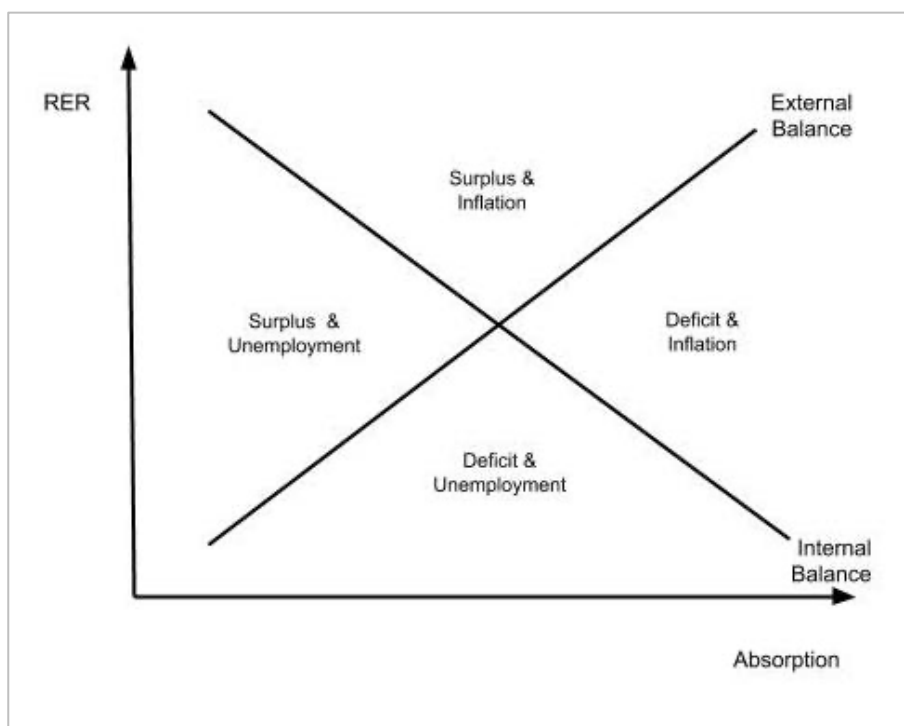


Figure 1: Australian Model Phase Diagram

Table 1: Macroeconomic Data for Selected sub-Saharan African Countries

Country	Population	GDP in Local Currency Units (CFA Franc)	Purchasing Power of the CFA Franc to USD	GDP per Capita USD (@ the exchange rate)	GDP per Capita USD PPP	Population Living Below 1.90 USD PPP	Headcount Poverty Ratio at 1.90 USD PPP	Population Living Below National Poverty Threshold	Headcount Poverty Ratio with National Poverty Threshold
Cameroon	23,298,368	10,500,919,273,446.40	219.1445691			4,659,674		3,960,723	
Chad	14,110,975	4,925,964,985,312.50	205.8267726			2,257,756		2,681,085	
Congo, Dem. Rep.	76,244,544	54,892,122,212,620.80	231.1023368			11,436,682		12,961,572	
Gabon	1,947,686	372,314,786,545.00	308.9399359			350,583		311,630	
Mali	17,438,778	8,000,641,045,341.00	210.8557063			4,010,919		2,615,817	
Niger	20,001,663	21,899,640,803,733.00	171.5838101			4,400,366		3,000,249	
Congo, Rep.	4,856,095	4,016,066,805,691.50	235.3699253			1,019,780		485,610	
Côte d'Ivoire	23,226,143	198,358,020,027,613.00	209.7381232			4,877,490		3,019,399	
Central African Republic	4,493,170	21,967,939,366,450.00	243.4728562			1,082,854		808,771	
Senegal	14,578,459	4,940,547,910,808.30	232.7880738			2,915,692		2,040,984	
Burkina Faso	18,110,624	7,757,885,007,264.00	211.2069761			3,622,125		3,078,806	
Benin	10,575,952	2,245,333,834,931.20	222.1970957			1,797,912		1,586,393	
Togo	7,323,158	3,896,330,885,163.80	219.785689			1,684,326		1,098,474	

Notes: PPP indicates adjusted for purchasing power parity

Table 2: Representative Sample of Respondents from Country X

Individual ID	Income	Distance to 1.9 USD per Day PPP
1	0.415	
2	1.35	
3	1.169	
4	0.156	
5	0.769	
6	1.661	
7	0.405	
8	0.883	
9	0.155	
10	0.341	
11	0.651	
12	1.891	
13	2.007	
14	0.431	
15	0.28	
16	1.637	
17	0.423	
18	0.709	
19	0.034	
20	1.13	

Notes: None

Table 3: Country Parameter Values

	A	δ	s
Country 1	1	.1	.3
Country 2	2	.05	.1
Country 3	3	.2	.05