CHAPTER 10
PRODUCTIVITY, TECHNOLOGY AND EFFICIENCY

1. As seen in class, we suppose that the level of total factor productivity A depends on the levels of technology T and efficiency E in the following manner $A = T \times E$. We observe that the productivity level in Country X is twice as high as that of Country Z. If the technology level in Country X is four times that of Country Z, how do the efficiency levels of the two countries compare?

According to the question, we have the following data: $A_X = 2A_Z$ and $T_X = 4T_Z$. If we assume that productivity depends on efficiency and technology as per the following equation $A = T \times E$, the data implies that

$$T_X \times E_X = 2 \times T_Z \times E_Z, \tag{1}$$

$$\Rightarrow 4 \times T_Z \times E_X = 2 \times T_Z \times E_Z, \tag{2}$$

$$\Rightarrow E_X = \frac{2 \times E_Z}{4} = \frac{E_Z}{2}. \tag{3}$$

Country Z is twice as efficient as Country X.

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2. According to the data, we have $A_{X,2007} = 0.5 \times A_{USA,2007}$ and $T_{X,2007} = T_{USA,1987}$. Also, technology grows at rate $g = 1\%$ per year. As a result, we have

$$T_{USA,2007} = T_{X,2007}(1.01)^{20} \tag{4}$$

$$\Rightarrow \frac{T_{X,2007}}{T_{USA,2007}} = (1.01)^{-20} = 0.82, \tag{5}$$

and thus

$$\frac{A_{X,2007}}{A_{USA,2007}} = \frac{T_{X,2007}}{T_{USA,2007}} \times \frac{E_{X,2007}}{E_{USA,2007}}, \tag{6}$$

$$\Rightarrow 0.5 = 0.82 \times \frac{E_{X,2007}}{E_{USA,2007}}, \tag{7}$$

$$\Rightarrow E_{X,2007} = 0.61 \times E_{USA,2007}. \tag{8}$$

The efficiency level in Country X is 61% that of the USA.

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3. We assume that $E_{INDIA} = E_{USA}$ and that all of productivity growth in the USA is due to technological progress only. We have $A_{INDIA2009} = 0.31 \times A_{USA2009}$. Moreover,

$$\frac{A_{INDIA,09}}{A_{USA,09}} = \frac{T_{INDIA,09}}{T_{USA,09}} \times \frac{E_{INDIA}}{E_{USA}} = \frac{T_{INDIA,09}}{T_{USA,09}}. \tag{9}$$

Hence, $T_{INDIA,09} = 0.35 \times T_{USA,09}$.

Now if technology grows at rate 0.54% per year, we have

$$T_{USA,09} = T_{USA,09-G}(1.0054)^G \tag{10}$$

$$\Rightarrow T_{USA,09-G} = \frac{T_{USA,09}}{(1.0054)^G}. \tag{11}$$

We are thus looking for the value of G such that

$$T_{USA,09-G} = \frac{T_{USA,09}}{(1.0054)^G} = 0.31 \times T_{USA,09} \tag{12}$$

$$\Rightarrow \frac{1}{0.31} = (1.0054)^G, \tag{13}$$

$$\Rightarrow \ln \frac{1}{0.31} = G \times \ln 1.0054, \tag{14}$$

$$\Rightarrow G = 217. \tag{15}$$

The upshot is that if India and the USA were equally efficient, India would have to be 217 years behind the USA in its technology level in order to explain its lower productivity level. Clearly, such a long technological lag is impossible. We thus conclude that India must be less efficient in its use of factors and technology as compared to the USA.

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4. Brief examples of real-world inefficiencies for each category are given below.

Unproductive Activities: In addition to theft and political lobbying activities, wars are generally extremely unproductive. Another example would be black market activities such as drug dealing.

Idle Resources: Many economic fluctuations reduce efficiency and make people and capital lay unused. Recessions, currency crises, and labor strikes are instances that result in idle resources.

Misallocation of Factors Among Sectors: Often, labor mobility is impeded across borders because work permits, licenses and credentials do not extend universally. Marginal products will not be equalized, resulting in a misallocation of factors among sectors. The minimum wage is another example that may cause a misallocation of factors among sectors.

Misallocation of Factors Among Firms: Many government subsidized or financed industries throughout the world regularly exhibit this form of inefficiency. In addition, certain industries, such as the airline industry, exhibit oligopolistic behavior, preventing more efficient firms from entering.

Technology Blocking: The recent ban on stem cell research in the United States is a form of technology blocking.