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Advances in Technology and Global Welfare

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Abstract

The real impact of advances in technology on global welfare is an unresolved issue. According to a recent *Human Development Report*, globalization based on technical advances in information technology has not had a positive impact on economies of developing countries. While advances in technology have helped improve standards of living in industrialized countries, they have caused developing countries to further lag behind. Some other studies, however, have concluded that investment in technology is a critical factor in improving economic welfare of all countries. It is important to note that most of the empirical studies in the latter group have treated technology investment as an independent variable explaining growth in economic welfare.

In section one of this paper, we present logical reasons why technology in itself fails to create better standards of living in developing countries. In section two, we will use a cross sectional regression model to test the relationship between advances in technology and economic welfare in developing countries. The results of our empirical study confirm our arguments of section one that global technological advances have not helped the economies of developing countries.

Introduction

While some studies provide empirical evidence that advances in technology are critical in improving economic welfare in all countries, a recent *Human Development Report* suggests that globalization based on technological advances such as Internet, mobile phones, and fax machines is not creating a uniform distribution of welfare in the world economy. Instead, a narrow group of affluent countries receive the benefits of technological advances, while the majority lags behind. The major implication of this report is that forces of demand and supply do not seem to narrow the gap between these two worlds.

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While many studies have investigated the overall impact of technological advances on economic welfare, to the best of the author's knowledge, no simple economic reasoning of why global technological advances have failed to improve standards of living in developing countries exists in the literature. Furthermore, most of the above studies lack a simple cross-sectional test of the relationship between these variables. This paper focuses on these issues. In the first section, we provide economic reasoning to explain why global advances in technology have not led to higher standards of living in developing countries. In the second section, we will use a cross-sectional regression model to test the relationship between advances in technology and economic welfare in developing countries. The results of our empirical study confirm our arguments of the first section that global technological advances have not helped the economies of developing countries.

Why Have Advances in Technology Failed to Improve Living Standards in Developing Countries?

There is a belief supported by many studies that advances in technology lead to improvements in economic welfare. In addition to empirical analysis, many researchers use logical reasoning to justify the causal relation from investment technology to economic welfare. Bugliarello (1984), Freeman (1987), Stoneman (1983), and Pfouts (1995) use the so-called "compensation hypothesis" to support this causal relation. According to these studies, technological advancement enables countries to produce more at lower real cost. The resulting rightward shift in aggregate supply would lead to higher standards of living and economic growth. It is further argued that advances in technology should lead to stronger labor markets, higher corporate profits, and thus higher levels of income. This is because labor-saving technology increases the productivity of labor, which leads to higher wages. Higher wages increase the demand for consumer goods, and as a result, the demand for labor increases. With total labor cost falling, profits and thus income level will increase. According to these studies, technological unemployment would be offset by gains in employment that follow the changes in technology.

Although this argument may hold in industrialized countries, there are several reasons why it may not be applicable in developing countries.

First, even in industrialized countries, there is a time interval between the beginning of technological unemployment and the beginning of the offsetting effects. Experience shows that the labor-saving equipment will replace workers before the new industries completely develop to create new jobs for the unemployed. Especially if the economy is in a recession, the technological unemployment may exist for a long period of time. This could result in lost wages and a reduction in economic growth. The economic forces of supply and demand are more rigid in third world countries due to more government regulations and political interventions. Consequently, it takes longer for the labor force to shift from old jobs to new employment that is created by technological advancement. Also, the lack of unemployment insurance policies in most developing countries would add to the negative impact of technological advances. This would further deteriorate the purchasing power of the consuming sector and accelerate the decline in GDP and economic welfare.

Second, in most developing countries, there are not many opportunities for a technological-unemployed individual to undertake the necessary education or training to win a place in the new technological job market. The lack of sufficient training schools, expert instructors, and usually relatively high costs of education in these countries make it very difficult for transfer of labor force from old jobs to new technical jobs. What usually happens following a technological advancement in third-world countries is that a relatively small number of workers are able to shift to higher paying technological jobs. However, most technological-unemployed individuals will be forced to move from old high-paying jobs to unskilled low-paying work in which they do not need

to use advanced technology. This will lead to a class division and a more unequal distribution of income where the majority of the population becomes poorer. The poorer population will not have sufficient purchasing power to create demand for the technological-sector products, which can result in overproduction, more unemployment, and therefore a reduction in economic growth and welfare.

Third, according to the well-accepted rules of the growth theory, new technologies in themselves do not guarantee increased productivity and economic growth. Growth of output and improvements in standard of living require a simultaneous increase in inputs, stock of capital, and skilled workers. In most undeveloped countries, these major factors must be imported from industrialized countries. For example, due to poverty and lack of domestic investment, these countries heavily depend on foreign investment. However, political uncertainties create a strong barrier for foreign investment. Uncertain future rates of return and imbalances between risk and return cause foreign investors to walk away from investing in some developing countries. In addition, lack of free trade and existence of economic sanctions imposed on some undeveloped countries would add to the difficulty of obtaining required inputs. Skilled labor, another prerequisite for economic growth, is another major issue in these economies. According to UNDP's *Human Development Report,* while in the industrialized countries of Europe, North America, and Japan there are more than 14 scientists and technicians per every 100 people, in the developing countries there is only one scientist or technician per every 100 people. In addition to the above economic shortfalls, developing countries would also need a deep attitudinal and organizational change and a lengthy process of social learning about the new culture of technological economy. However, struggle for survival in poor economic conditions would make this learning process difficult if not impossible. These barriers and difficulties should further explain why imported technological advances have not led to an enhancement of economic welfare in developing countries.

Empirical Analysis

One major conclusion of our discussions in the previous section is that advances in technology cannot explain changes in living standards in developing countries. In this section, we use a cross-sectional regression model to test for the impact of technological advances on living standards in developing countries. Our sample consists of countries that the World Trade Organization (WTO) recognizes as "least developed" countries and that the United Nations has designated as least developed countries. There are currently 30 least developed countries on the UN list which to date have become WTO members. These countries are Angola, Bangladesh, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Congo, Democratic Republic of the Djibouti, Gambia, Guinea, Guinea Bissau, Haiti, Lesotho, Madagascar, Malawi, Maldives, Mali, Mauritania, Mozambique, Myanmar, Niger, Rwanda, Senegal, Sierra Leone, Solomon Islands, Tanzania, Togo, Uganda, and Zambia. Seven additional least developed countries are in the process of accession to the WTO. These are Cambodia, Cape Verde, Laos, Nepal, Samoa, Sudan, and Vanuatu. Furthermore, Bhutan, Ethiopia, and Yemen are WTO observers.

Our sample includes cross-sectional data in year 2000 for these 40 countries. We use a multiple regression model in which the dependent variable is the living standard. Living standard is measured by real per capita GDP (PCGDP) and the annual growth rate of real per capita GDP (GPCGDP). The first independent variable in our model is technological advances, measured by the number of main line phones (MP) and number of mobile cellular phones (CP). Other independent variables include electricity consumption (E) and percentage of GDP in agriculture (AG). We hypothesize that in developing countries, technological advances do not have a positive impact on economic welfare. The slope of the relationship is therefore hypothesized to be

statistically zero or negative. Data for all variables in this study are obtained from World Fact Book 2002 on the Internet (www.odci.gov/cia/publications/factbook).

Tables 1 through 4 present the regression test results. Tables 1 and 2 display the results of the regression in which real per capita GDP is the dependent variable. Tables 3 and 4 show the results of the regression in which the annual percentage growth rate of real per capita GDP is the dependent variable. With respect to the statistical significance of test results, it is evident that measuring standard of living by per capita GDP produces the same results as measuring it by the growth rate of per capita GDP. Also, as is shown in Tables 1 and 3 versus Tables 2 and 4, the same statistical results are obtained whether mail line phones or cellular phones are used to measure advances in technology. In all four regression tests, the estimated *t* values for the slopes of number of phone lines and number of mobile cellular phones are significantly below the 5 percent critical *t* value. This implies that all regression slopes related to advances in technology are statistically zero. The low values of F statistic and adjusted R^2 confirm this inference. These test results conform well to our hypothesis that technological advances in themselves can not improve economic welfare in developing countries.

Lack of current and relevant time series data makes it impossible to conduct a deeper analysis of the long-term relationship between technological advances and economic welfare in developing countries. When such data become available, other statistical analyses can further determine if these variables have a stable and long-term relationship.

TABLE 1. PCGDP= $a+b_1$ (MP) $+b_2$ (E) $+b_3$ (AG)

b_1	b_2	b_3	Adjusted R^2	F
-0.0019	0.21	-7.23	0.029	1.72
(-0.19)	(.071)	(-1.15)		

TABLE 2. PCGDP= $a+b_1$ (CP) $+b_2$ (E) $+b_3$ (AG)

b_1	b_2	b_3	Adjusted R^2	F
-0.006	0.20	-7.34	-0.05	0.92
(-0.89)	(1.35)	(-0.92)		

TABLE 3. GPCGDP= $a+b_1$ (MP) $+b_2$ (E) $+b_3$ (AG)

b_1	b_2	b_3	Adjusted R^2	F
-0.000001	0.00003	-0.005	-0.02	0.92
(-0.63)	(1.01)	(-0.25)		

TABLE 4. GPCGDP= $a+b_1$ (CP) $+b_2$ (E) $+b_3$ (AG)

b_1	b_2	b_3	Adjusted R^2	F
0.000001	0.00004	-0.007	0.08	1.92
(0.58)	(1.01)	(-0.29)		

Notes: Numbers in parentheses are t values for slope coefficients; PCGDP = Dollar value of real per capita GDP; GPCGDP = Percentage annual growth rate in real per capita GDP; MP = Number of main line phones; E = Electricity consumption in millions of Kwh; AG = Percentage of GDP in agriculture; CP = Number of mobile phone cellular.

Concluding Remarks

Globalization based on technological advances such as the Internet, mobile phones, and fax machines has not led to improvements in economies of developing countries. Instead, it has widened the gap between standards of living in developed and developing countries. In this paper, we attempted to articulate some economic reasons why technological advances in themselves could not improve living standards in developing countries. We also conducted a regression analysis and examined the cross-sectional relationship between economic welfare and technology in 40 least developed countries. Our test results supported our hypothesis that no strong and stable relationship exists between these variables. To achieve higher standards of living, developing countries should focus their efforts on educating and training their labor force. Advances on technology would become a key factor in raising living standards only if the labor force has the skill and education to use it. In addition to skilled workers, economic growth requires increases in the amount of inputs and stock of capital. Finally, developing countries need a deep attitudinal and organizational change and a lengthy process of social learning about the new culture of technological economy.

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