

## Stanley Fischer: The relationship between economic growth and science and technology

Remarks by Professor Stanley Fischer, Governor of the Bank of Israel, at the Rehovot Conference for Science and Technology, Rehovot, 9 June 2005.

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Esteemed Minister of Finance, Mayor of Rehovot, President of the Weizmann Institute, President of the Israel Academy of Sciences and the Humanities, Director General of the Ministry of Science and Technology, honored guests, ladies and gentlemen:

It is a great pleasure for me to be here today, especially since this important event, the first Rehovot Conference for Science and Technology, is being held at this eminent and illustrious institution, the Weizmann Institute.

When the organizers of the conference asked me for a topic on which I would lecture today, I decided to speak about the topic of "Is Economics a Science?" Later on, I realized that the Academy of Science and the Humanities had already made a decision about this matter when it chose my friend, Professor Menahem Yaari, to be its president. I concur with the Academy, of course: economics is indeed a science!

Therefore, I will speak today not about the theme that appears in the conference program but rather about several results of economic research on the relationship between economic growth and science and technology. In this matter, it is natural to begin with work performed by the Nobel Prize laureate, Professor Robert Solow, almost fifty years ago. It is possible to write a production function showing that the level of production is the result of levels of use of factor inputs - especially of labor and capital - and of the level of technology. Solow asks, "What did greater use of labor and capital contribute to growth in the United States in the 1909-1949 period, and how much did technological progress contribute to growth during that time?" His famous answer was that more than 80 percent of growth during that period traces to the technological changes in the economy during those years. Solow's answer was robust enough to have withstood many tests since then.

In Solow's work, the level of technology is an exogenous factor, meaning that it is determined outside the economy. In the 1960s, economists began to investigate the origins of the technological level, but in the 1970s, when immense macroeconomic problems began to crop up in almost every corner of the world, we economists turned our attention to problems other than growth. Since the 1980s, economic research has made a focused and intensive attempt to include the factors that affect the increase in productivity, within the framework of economic models, in what is known as "the new theory of economic growth."

The results of this new theory of economic growth are spelled out at length in an excellent book that my friend, Professor Elhanan Helpman, published in 2004 under the title *The Mystery of Economic Growth*.

Allow me to present several of the main findings in capsule form:

1. International comparison shows that the main result of Solow's work is correct. There is evidence that the differences in total productivity among countries - differences that originate in different levels of technology - explain more than 60 percent of the differences among these countries in per-worker income and growth rates.
2. Although growth has its ups and downs in the course of the economic cycle, the average growth rate of the global economy has been accelerating over time. By inference, the rate of increase in technological level in global economies has also been accelerating over time.
3. Education plays an important role in explaining the differences in growth rates and per-worker income from country to country and over time.
4. One important result: society earns a much higher return on an investment in research and development than the investor earns.

Allow me to insert a parenthetical remark. There is a substantial difference between the marginal improvement of existing technologies and the development of new technologies that can serve many purposes - what we call multipurpose technologies. These are general-

purpose technologies - such as mechanization, electrification, and computerization - from which other technologies derive many uses. The contribution of these technologies to productivity is large and long-lasting. However, it can take many years for an economy to assimilate multipurpose technologies. Furthermore, at the beginning of the process the rate of productivity growth in a given economy may even decline as the new technology crowds out antiquated technologies. Fifteen years ago, this led Robert Solow to postulate that the computer revolution is taking place in every part of the economy except for the productivity data. This situation, however, began to change in the middle of the 1990s.

5. Economists emphasize the importance of the openness of an economy for its growth rate. There is no economy in the world, in the modern era, that has managed to grow rapidly over a lengthy period without increasing its exports and its imports steeply.

And on the technology side, countries have become interdependent due to the crossing of knowledge among them.

It has been found the more a country's trading partners invest in research and development, the more the country's total productivity will increase. It is encouraging to see how greatly less-developed countries are benefiting from the R&D investments of the industrialized countries. These results, however, have a negative side: the investment in technological innovations may widen the gap between rich countries and poor ones.

How can this outcome be prevented? Only by making a focused effort to rise to, and stay at, the forefront of global technology. And how can this be accomplished? By investing in education and by providing support for general and applied science-including research and development. This, however, is a complicated thing. Almost everywhere in the world, direct government intervention in R&D is regarded as a failure. There are two exceptions - Finland and Israel. The Office of the Chief Scientist in our country has been a success - even though it is necessary to continue investigating the factors that are responsible for our success and to draw inferences for possible changes in the future.

Let me sum up this part of my remarks:

1. Increasing productivity is crucial for sustainable economic growth.
2. Being at the forefront of knowledge and of technological innovation is crucial for economic growth.
3. Countries that wish to stay at these forefronts must make sure that their pool of technological knowledge expands steadily.
4. Evidence from around the world speaks clearly about the importance for Israel of enhancing human capital in education and technological infrastructure, so that we stay at the forefronts of knowledge and technological innovation. These will lead to increases in productivity and per-capita growth. To bring this about, it is important to establish a correct set of incentives and a correct institutional structure. It is important to develop a set of incentives that will promote education, with emphasis on technological education, for the entire population. Concurrently, it is important to create various forms of incentives for processes that promote innovation and invention.
5. If I may, I would also like to address the relationships between growth and inequality and between inequality and poverty. The first result in regard to the relationship between growth and inequality is called the Kuznets curve. The data in Kuznets' possession led him to believe that inequality rises at the beginning of the growth process and afterwards starts to fall. However, the data available back then were very scanty. It is now clear that there is no simple relationship between growth and inequality. The reason for this is simple: a. Inequality may be influenced by means of economic policy, including the education system. b. The relationship also depends on the origins of the growth, for example, the kind of technological progress on which the growth is based.

As for the difference between reducing inequality and reducing poverty, we have to realize that poverty may decline even as inequality rises. This is happening, for example, in China. There may be a short-term substitution relationship between reducing poverty and reducing inequality. If such a relationship exists, then society has to decide where it wishes to be in the short term.

I conclude by quoting remarks that my late friend, Professor Yoram Ben-Porath, wrote in 1986 in a book titled *The Israeli Economy: Maturing Through Crisis*: "The potential is there. Israel has a reservoir

of human capital and a scientific infrastructure that can be used to increase productivity and expand exports. Its national determination, used to achieve political independence and self-defense, could also be harnessed to achieve economic independence. Thus, economic maturity may still prove to be a starting point for a new phase of sustained growth”.

In fact, we are already on the right path. If we stay on it, we will be able to attain our potential fully and to take up a position alongside the most developed countries in the world.