Technology Accounts in the National Accounts

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Paper Abstract:

To make the system of national accounts (SNA) relevant to the economic and policy issues of the new era of globalization and digitization, this paper proposes that the future SNA creates technology accounts that can provide a consistent and improved measurement of the pace of technological progress across countries. Technological progress is the main driver of long-run economic growth. Economists have relied on the growth accounting framework to measure the multifactor productivity (MFP) growth, which serves as an indicator of a country's pace of technology progress. However, Griliches (1996) argues that the measurement of MFP growth is just a measurement of ignorance and economists have criticized that the MFP measurement is just a point estimate without a robustness check (Manski, 2014). Furthermore, as OECD countries have started capitalizing research and development (R&D) in national accounts, the change of the MFP growth after capitalizing R&D may cause more puzzles than reflect the true nature of technological progress across countries and across industries. For example, the change of U.S. new MFP growth between the period of 1998 to 2007 and the period of 2009 to 2012 are -0.20% for information technology (IT) producing industries, 0.05% for IT using industries, 0.51% for non-IT industries (Rosenthal et al., 2014). The latest result from the U.S. indicates that during the period of 1998 to 2012, the non-IT industries have experienced a faster pace of technological growth than the IT industries, which contradicts the general consensus.

Given that the MFP growth derived from the national accounts cannot provide a good indicator for the pace of technological progress, we propose to create technology accounts in the national accounts. The technology accounts can include key elements, such as R&D depreciation rates and high-skill immigration, related to technological progress. Currently, SNA has listed R&D as one of key capital assets, but the level of R&D investments cannot indicate a country's pace of technological progress, such as the case in China, and the growth rate of R&D capital stock depends on how reliable R&D depreciation rate is. Furthermore, to perform cross-country comparison, we need to have a consistent and reliable methodology to measure all key technology indicators.

For example, because most previous econometric models cannot provide a good methodology to estimate R&D depreciation rates, the OECD IPP manual recommends using expert opinions or surveys to estimate R&D depreciation rates (Peleg, 2012). The fidelity of past surveys has been seriously questioned. For example, a large scale survey on 39,968 U.S. firms in 2010 received an extremely low response rate of 2.45% (Li, 2012). The U.K. survey on 1701 firms in 2012 has shown very high uncertainty (Kerr, 2014). Expert opinions, on the other hand, can vary significantly from person to person, and no known method can reconcile the differences. Therefore, neither suggested method can provide a true solution. Considering these difficulties, the OECD also suggests that a single average service life of 10 years should be retained if no good solution can be found (OECD, 2012). This suggestion implies that both

developed and emerging countries have the same R&D productivity growth, which contradicts common sense. In addition, it is incorrect to assume that every country and industry have the same pace of technological progress.

Using R&D depreciation rates as an indicator of a country's relative technological status requires a consistent and reliable methodology for estimating the rates. In the U.S., we have developed a forward looking profit model to estimate R&D depreciation rates for all key industries (Li, 2012). The results are consistent with industry observers' observations, and can show the relative pace of technological progress and the degree of market competition across industries in the U.S.

Additionally, this new methodology and results have attracted increasing academic and industry interest not only in the traditional field of macroeconomics but also in other fields such as finance, innovation studies, and consulting. Academic scholars, such as Richard Freeman at Harvard and Rand Ghayad at MIT Sloan, have incorporated the materials and paper into their curricula.

Furthermore, the method has applied to Japan's data, and the results are consistent with the observations of Japan's technological progress in key industries relative to that of the U.S. (Li, 2014). During the data period of 1987 to 2012, R&D depreciation rates in the electrical machinery, equipment, and supplies industry are 33% for Japan and 30% for the U.S. Additionally, the rates are 30% for Japan and 29% for the U.S. in the information and communication electronic equipment industry. These findings indicate that, in those two industries, after considering standard error, the pace of technological progress and the degree of market competition in those two countries are close. However, the rates for the drugs and medicines industry, 10% for the U.S. and 13% for Japan, do show that the U.S. has a slight technological edge. This result is consistent with the U.S. International Trade Commission's report in the global medical device industry (U.S. International Trade Commission, 2007), where it finds that, in terms of technological advantage, the U.S. is ranked as the top in the world and Japan is close behind. Lastly, in the auto industry, Japan has a smaller R&D depreciation rate, 22%, than the U.S., 28%. This difference reflects the fact that Japan's auto industry has a clear technological edge and Japanese firms can better appropriate the returns from their investments in R&D. More cross-country comparisons, including time-varying estimates that can reveal the catch-up process, will be presented in the paper.

In the internet era, people are increasingly concerned about how technologies will affect their welfare. National accounts should have technology accounts composed of indices beyond the level of R&D investments and their impacts on the GDP and MFP growth rates, which cannot accurately inform countries' relative paces of the technological progress and technological environment. For countries to derive effective education and technology policies, it is important to establish reliable technology accounts for policy makers to assess where their countries stand in terms of the pace of technological growth and track their progresses.