Nanotechnology and Microelectronics:
The Science, Trends and Global Diffusion

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ABSTRACT

For many centuries, the gross world product was flat. But as technology penetrated many economies, over time, the world economy has expanded. Technology will continue to shape the future of commerce, industry and culture with likes of nanotechnology and microelectronics directly or indirectly playing major roles in redesigning the global economic structures. These technologies will drive other industries and will be central to a new international economy where technology capability will determine national competitiveness. Technology-intensive firms will emerge and new innovations will evolve a new dawn in wealth creation. Nations that create or adopt and then diffuse these technologies will profit. Those that fail to use technology as a means to compete internationally will find it difficult to progress economically. This article provides insights on global technology diffusion, the drivers and impacts with specific focus on nanotechnology and microelectronics. It also discusses the science of these technologies along with the trends, realities and possibilities, and the barriers which must be overcome for higher global penetration rates.

Keywords: *Intellectual Property Rights (IPRs), Knowledge Economy, Micromics, Nanomics, Penetration Rates, Science, Technology Diffusion, Technology Index, Technology Transfer, Trends*

INTRODUCTION: THE GLOBAL TECHNOLOGY DIFFUSION

Within the last two centuries, technology has emerged as a key determinant of sustainable growth and poverty reduction. It has become central to many modern developments across the globe and the most important competitive factor in the international economy. Before technology began to drive business operations and processes, global economic growth was flat for centuries and the world did not experience substantial progress in productivity. In other words, generations that lived more than three centuries apart might not have experienced substantial changes in their per capita incomes. But with the evolution of technological advancements shaping global commerce and industry, the world is experiencing new dimensions in wealth creation and productivity. Technology drives the modern world and national competitiveness is anchored on technological strength and innovation which encompasses the social and economic fabric of any economy (Chinn, 2006). It is the major factor that separates the rate and level of incomes between developing and developed nations.

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Furthermore, the classification of nations into different categories of developments, advanced, emerging, and developing nations, indirectly translates into their different stages of technology capabilities. The state of global technology diffusion shows that developed nations continue to create the bulk of the new knowledge while developing countries depend on adoption and adaptation for technological progress as the latter lack inventive capacity (World Bank, 2008a). Nations have different abilities to process technological inputs, even as they have many ways of developing technological competence. For the developing nations, trade and importation of foreign technology goods creates local awareness and brings exposure to new technology (IMF, 2006). Most especially, their skilled diasporas contribute immensely in technology adoption and diffusion. Also, when multinational corporations (MNCs) invest locally through FDI, they bring knowledge of vital technologies and international markets. According to World Bank (2008a), the diasporas population is an important resource for their home country—a "brain bank"—that contribute to technology transfers by strengthening trade and investment links with advanced economies, providing access to technology and capital which contributes to domestic entrepreneurship and investment. They also provide technology and marketing know-how, facilitate FDI, and expand banking and other financial services in their home economies.

Historically, not many successful technologies have been transferred across the globe, provided technology transfer is not said to have occurred when an adopting nation imports technology products from innovating ones. Such a narrow context may erroneously imply that many developing nations have adopted steam engine by merely importing trains from developed economies. Technology transfer involves imparting knowledge, skills, capabilities and techniques which are involved in the whole production cycle. Where technology has been effectively transferred, changes in the production system and its compatibility with system needs, institutional framework, skills, financial capacity, and support of endogenous capacity with appreciation of the natural environment of the recipient country are visible (Dabic, 2008). For the adopting nations of technology, the prospects for progress will involve innovation system through their institutions, citizens, universities and research institutions (World Bank, 2009). Adapting existing technologies to meet local needs will be important and technology penetration rate can accelerate globally if low-income nations modernize their educational and trainings structures for efficiency and accountability (Hassan, 2007). This modernization is vital as sustainability depends on the development of knowledge citizens to lead the efforts for acceleration of adoption and adaptation stages. Efficient and new models of education designed collaborations between schools and firms are urgently needed while also allowing market to be the driver of technological improvements.

From the World Bank Knowledge Economy Index (KEI), there is a positive correlation between education, technology, innovation and GDP per capita of nations (World Bank, 2008b). Nations with high KEI show higher competencies in technological advancements while those with very low KEI are mainly non-innovating nations. These latter nations must depend on adoption and adaptation for technological growth and advancement since they lack the capacity to create new knowledge owing to poor facilities, small economies (lacking large scale advantage for funding) and human capital. These problems point out the fact that radical steps must be taken by developing nations if they expect a convergence in technology advancement between them and the developed economies. Their rates of technological advancements could be faster than high-income nations since they have lots of rooms to grow but convergence of technology penetration rates with advanced economies will require major policy changes from them. From the World Economic Forum (WEF, 2009a & 2009b) reports, technology innovation correlate positively with income levels; the more nations advance in technology creation and penetration, the more the incomes levels in those nations. This can also explain