USING KNOWLEDGE FOR ENHANCED ECONOMIC EFFICIENCIES – FUELING INNOVATION THROUGH INVESTMENT IN RESEARCH AND DEVELOPMENT

Erdil Şahin observes that *"In the world of globalisation, economic growth is associated with the amount of innovation created.* ***The expenditures on new product development, thus research and/or development (R&/orD), is the main factor for the economic growth of both developed and developing countries****. R&D expenditures are in the center of new growth theories. The countries that produce technologically advanced products have the ability to compete internationally and show progress in production levels and qualities."*[1] This observation is strongly supported by the Organisation of Economic Co-operation and Development's G20 Innovation Report for 2016, where expenditures in R&/orD and innovation are found to be pro-cyclical being positively related to an economy's level of activity.

But what do we mean when we refer to "innovation", a term brandied around so frequently that its power and dynamism has been largely lost? Innovation, be it frugal, social, incremental, radical or open in nature, refers simply to a new (to the world, to the country or to the company) or improved product, process or service that is introduced to the market in one way or another. The appreciation for the impact of innovation on an economy grew during the 1980s, with a movement away from the general consensus that innovation just "happened" with little influence from government policy, to the realisation that innovation could indeed be shaped by public policy.

Innovation as a driver for socio-economic growth becomes even more important as we gaze down the barrel of the fourth industrial revolution where anticipated technological advancements are taking place as predicted globally and articulated by the founder and Executive Chairman of the World Economic Forum (WEF), Klaus Schwab[2]: *"We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before…. the response to it must be* ***integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society****."*

These technological advancements are currently unfolding before us and as an emerging economy on a developing continent we need to be in a position to respond,

[1] Şahin B, Erdil (2015) **The Relationship Between R&D Expenditures and Economic Growth: Panel Data Analysis 1990-2013** *EY International Congress on Economics II "Growth, Inequality and Poverty" November 5-6, 2015, Ankara/Turkey*

[2] https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/; published 14 January 2016

to adapt and where necessary lead. In the current climate where clean and sustainable are more than just buzzwords, we need to harness the immense power of the human brain as we move into an era where innovation will be increasingly shaping our future. The question hot on our lips is thus, as an emerging economy, how do we address our immediate burning aspirations set out in the National Development Plan: Vision for 2030 while dealing with the triple challenges of unemployment, inequality and poverty, but equip ourselves to respond as the Fourth Industrial Revolution unfolds!

Innovation by its very nature is inherently uncertain and highly contextual and alone is not the answer to faster growth and inclusive development, however, it remains a significant and vital source and catalyst. So the question begs, what it the South African Government doing to catalyse enhanced economic efficiencies and, in particular, what policy instruments are in place to this end. The Department of Science and Technology has been resolute in this regard, actively promoting and supporting R&D while also working to ensure that investments in R&D should result in outputs, outcomes and positive impacts in society.

The target for Gross Expenditure on R&D (GERD; which covers all expenditures for R&/D performed on national territory in a given year) expressed as a percentage of gross domestic product (GDP) has been boldly set at 1.5%, with the National Research and Development Strategy, 2002, and the Ten-Year Innovation Plan 2008-2018 providing a focused framework and making provision for, amongst others, the institutional arrangements, funding instruments and human capacity development requirements to give effect to this target. The most recent data shows that South Africa has GERD/GDP of 0.77%. 1.5% remains an elusive target and one which we are unlikely to achieve by 2019. But it is worth analysing the factors contributing to a GERD of 0.77% (as a percentage of GDP) and and to further compare this with other international jurisdictions. It is not surprising that the innovation-driven economy of Singapore, which ranks number 2 on the Global Competitive Index (GCI) has a GERD (expressed as a percentage of GPD) of 2% in 2013. Denmark's figure is significantly higher at 3.08% but this jurisdiction finds itself at position 14 on the GCI. Greece has a GERD (as a percentage of GDP) of 0.81% yet it finds itself at position 81, with South Africa at position 56. This snapshot indicates that while we drive for the increase in the quantum of the investment we also need to be mindful that a plethora of factors including the rate of efficiency of use of the available funds are important.

When dissecting our R&D funding, reflecting on the split between government and business sector contributions, it is apparent that the South African government continues to be the largest funder of R&D activities at 43.9%. Contributions from the business sector amounted to 40.8% of R&D, with the balance including foreign sources at 12.5%. A constant trend remains that most of the R&D activity is taking

place in the fields of engineering (18.7%) and medical and health sciences (18.6%), with growth observed in the fields of biotechnology (5.4%) and nanotechnology (2.8%), open source software (2.8%), materials sciences (3.6%), with the environment-related R&/or D reaching 6.8%.

We are beginning to assess the rate of conversion of the available funds, at least for the portion of the funding provided by the South African government, for socio-economic impact. The focus of the Ten-Year Innovation Plan was the transition from a resource to a knowledge-based economy and identified a number of enablers included those to address the "*innovation chasm*" between research results and socioeconomic outcomes. An instrument to address financing and fragmentation of funding instruments was acknowledged as well as an Intellectual Property Management Office to enhance protection of intellectual property rights and to develop national capacity to manage technology licensing and commercialisation. Significant progress has been made including the establishment of the Technology Innovation Agency (TIA)[3], tasked with, amongst other functions, funding technology development and commercialisation as well as the provision of seed capital. Furthermore, August 2010 saw the enactment of the Intellectual Property Rights from Publicly Financed Research and Development Act (IPR Act), which established the National Intellectual Property Management Office, as the office responsible for implementation of the IPR Act, through a combination of compliance monitoring, advisory functions and financial support. The IPR Act legislatively mandates all institutions (the twenty-six (26) higher education institutions (HEI) and eleven (11) schedule 1 (to the IPR Act) institutions including the Council for Scientific and Industrial Research, the National Health Laboratory Service, the Nuclear Energy Corporation of South Africa, MINTEK, as well as the Medical Research Council) to have an Office of Technology Transfer (OTT), which must ensure the effective management of the intellectual property (IP) within their institutions. IP management includes the stages of disclosure, IP protection, technology development and fund raising, marketing, IP transactions (including licensing or assignment of IP as well as the set-up of a start-up company which is ultimately spun-out of the institution), and product development, with regular assessments taking place at each stage and with a number of fluid and dynamic feedback loops through-out the process. This is often the methodology applied for transfer of technology from a HEI/ schedule 1 institution to the private sector.

Qualitative and quantitative data available on the status of OTTs at institutions and the progress made over the last seven (7) years in the various stages set out above for the transfer of technology is showing some early positive trends of what is regarded as a nascent system in South Africa. Although capacity at the institutions is still, in general, relatively "green" in terms of years of experience in this "game" with four (4)

[3] Following the merger between the Innovation Fund, Tshumisano Trust, Cape Biotech Trust, PlantBio Trust, LIFElab, BioPAD Trust, and the Advanced Manufacturing Technology Strategy (AMTS).

years being the average reported, disclosures received by the OTTs from researchers of potentially new IP creations, the number of new patent applications (typically provisional patent applications), the number of technologies managed by the OTT (with one hundred (100) being added each year over a consecutive four (4) year period) as well as the number of patent families, trade mark families, and registered design families have increased more rapidly than the increase in research expenditure, which indicates acceleration of these activities relative to research expenditure. At best, these aspects are regarded as outputs of publicly financed R&D, with IP transactions and revenue accruing to an institution as outcomes and indications of commercialisation. IP transactions concluded have increased significantly over the period with institutions receiving, on average, R32.9 million per year in IP transaction revenue. The majority of IP transactions yield less than R100 000 per year. This figure is in line with international norms with most big institutions', including Michigan University of Technology and Stanford University, large licensing income coming from a couple of "big hits". Also worth noting is the fact that start-up companies formed per year have more than trebled between 2009 and 2014 with the total number of full time personnel employed in these companies, originating from HEIs, between 2010 and 2014 having grown by 29%, from 238 to 308. An example of the type of socio-economic impacts we are now able to track follows the vignette where research was conducted at the Cape Peninsular University of Technology for the development of a supplement rich in the correct levels of omega-3 fatty acids needed, for amongst others, brain functioning. Spinnler Benadè and Maretha Opperman developed and patented a health supplement called Omega Caro-E. Health Canada recently approved the product licence authorising the sale of Omega Caro-E in Canada, with revenue having accrued to CPUT. CPUT has subsequently formulated Omega Caro-E Kidz, which is an emulsion for pre-school children who are not able to swallow capsules, as well as NUTRI Caro-E which is a nutritional supplement premix that can be added in various applications, such as fortified biscuits, porridge and peanut butter. This is a clear indication of research which can have economic and social benefits.

Our stock-taking on the impact of the intellectual property and technology transfer office activities is showing positive growth trends! It may be too early to tell but contagious optimism envisions us approaching the beginning of a logarithmic curve – I dare you to contain our excitement in this regard!