ISSN 2045-5119

TMD Working Paper:
TMD-WP-61

NSI to IDS: From the National System of Innovation to an African National Innovation and Development System (IDS)

Mammo Muchie
Tshwane University of Technology

December 2013

NSI to IDS: From the National System of Innovation to an African National Innovation and Development System (IDS)

Mammo Muchie[1]

SARChI , NRF /DST Research Chair Holder,TUT, Pretoria, South Africa., DIR, Aalborg University & Senior Research Associate, SLPMTD, Oxford University,UK

Paper Submitted to

6th Annual Conference of the Academy of Innovation and Entrepreneurship

Innovation and Entrepreneurship for Inclusive and Sustainable Development, Oxford, United Kingdom, 29-30 August 2013

[1]Mammo Muchie, Holder of SARChI's DST/NRF Research Chair, Tshwane University of Technology, Pretoria, South Africa and Senior Research Associate, Oxford University, UK: Email: mammo@ihis.aau.dk; muchiem@tut.ac.za

Abstract

There are four approaches to economic growth and development. The first is historical development that is best articulated in the history of development studies; the second is the Listian political economy approach that inspired import substitution industrialization and the developmental state. List introduced the political context explicitly and forthrightly to the challenges of economic development. The third is the Schumpeterian innovation approach to economic development. The latter introduced innovation as emerging with the dynamics of creative destruction by introducing explicitly sociological constraints to the dynamic of economic development. The last is the uneasy treatment of economic development by neo-classical mainstream economics. Neo-classical economics did not appreciate the emergence of development economics as a separate field and later in the 80s some neo-classical economists denounced the field with books such as the poverty of development economics(Deepak Lal) prompting reactions such as the Dilemmas of Economic Development by John Toye and others.

What this demonstrates is that there are a number of ways development economics is going through. What this paper will do is not address all of them, but select one approach, and that is the innovation approach to development economics. We think it will be useful to explore how the system of innovation has evolved, used and applied in order to filter through the epistemic virtue from it that can be employed to shed light on how development economics can evolve into a development and innovation system. We propose to unify the development ecomomics with the economics of innovation by suggesting the new conceptual framework of innovation and development system.

1. Introduction

Before we propose the link between innovation and development, we first try to begin by identifying what has been explicitly recognized as central and peripheral within the systems of innovation concept; the inclusion or exclusion of the factors that are important in understanding the political economy of innovation systems; the themes, issues and range of actors and spaces that must be included in NSI types of appreciative theory or modeling. We reflect and review the variety of ways the system of innovation has been used by the economists who have used the NSI perspective in their search to develop alternative frameworks to understand the problems and challenges of economic system dynamics in general and economic development in particular. We will probe how the search for an alternative economic framework for economic development through the NSI perspective have been applied with a view to advance an argument for its judicious application as an intellectual conceptual tool to help understanding and explanation of the problems and challenges of development and underdevelopment.

If we proceed with the search and selection of an alternative framework that employs innovation systems perspectives on the problems of development and underdevelopment, there will be a need to advance theoretical knowledge further. This can be done by consciously developing linkages and combinations between economic and non-economic structure and actors, formal theories and appreciative theories, awareness and learning in connection between the tools used in each type of theorizing, deepening evolutionary economic dynamics to include new thematic areas such as national economic integration in relation to reducing dependency on donors in different types of developing and transition economies, finding productive linking internal and external, domestic and international, political and economic, and empirical and policy changes and approaches in different national economic settings.

Whilst there is enormous value in encouraging innovation in charting new lines of inquiry, there is also a need to have strong discipline in the way the creation of new and original ideas are being developed. A community of innovation studies can put itself at risk if casual and rather perfunctory renditions of the traditions of evolutionary economics (Nelson and Winter, 1982), the economics of technical change (Dosi et al, 1988), and theories of innovation systems (Lundvall, 1992), national innovation systems (Freeman, 1987, and Nelson, 2000), sectoral innovation systems (Goto and Odagiri, 1993 and Malerba, 2002), and other types of conceptions continue to proliferate unchallenged with critical scrutiny. To date, the range of areas, the themes, frameworks, domains, levels, types, features and primitives that innovation system covered can be captured by drawing a mental map (see Figure 1).

If indeed the range for theme and domain extension is needed, it has to flow with a close proximity to the core achievements and theoretical and empirical insights that the use of innovation system concept has produced. The conceptual constraint that is distinctively associated with a system of innovation should not be transgressed, violated or invalidated beyond a point that the use of the concept no longer makes any sense or useful contribution.

In addition at the time when many developing countries and some multilateral organizations like UNCTAD are beginning to use the system of innovation for policy learning in establishing their science and technology policy systems, it is vitally important to distinguish the appropriate and inappropriate use of this concept. For example, South Africa used the system of innovation framework in 1996 to generate its White Paper on Science, Technology and Innovation Policy. Today, the Department of Science and Technology of South Africa has produced a Ten –Year Plan on Innovation Towards a Knowledge Economy(2008-2018) based on the innovation system to confront the grand challenges of development that

the country is confronted for spreading the benefits of knowledge to all its citizens.(DST,2008, pp.1-30)

One of the reasons why we think such a debate is necessary also stems from our own attempt to carry out research on the developing world that we have been doing since 2002. We have had a strong interest in the linkages between innovation systems and industrial economic development narrowly, and more broadly structural social and economic development/transformation. As a consequence we have generated a number of models, based on the innovation conception as it has been used by the originators (Freeman, Nelson, Lundvall and others) to capture as realistically as possible the uneven and lopsided existence of the innovation landscapes in developing countries like India, China, South Africa and Brazil and even smaller countries in Africa (Muchie et al, 2003, Baskaran and Muchie, 2006). We have then tried to elaborate on the model variations that are pertinent to the kind of research question we tried to puzzle through such as, for example NIS's impact on FDI, and FDI in R & D (Baskaran and Muchie, 2007 and 2008).

Two challenges face the system of innovation approach. As a critique of neo-classical economics, it has successfully emerged and is being recognized as an alternative economic thought. What remains are two challenges: The first is the need for a more unified and integrated system of innovation conception that relates specific research issues with the broader systemic features that still remain largely to be studied, researched and developed. The second is the link amongst innovation, development and systems. There is a need to generate an alternative model by clearly showing how the system of innovation can be applied in contexts, cultures and histories where learning, innovation and innovation systems are generally considered weaker by broadening the micro-level user-producer interaction to include user-user, and producer- producer and other varied forms of interactions.

2. Formal theory and appreciative theory for developing an alternative economics framework

Nelson and Winter in their pioneering work define and distinguish formal and appreciative theory in economics as follows:

"A theory defines the economic variables and the relationships that are important to understand, gives a language for discussing these, and provides a mode of acceptable explanation."(Nelson & Winter 1982.p46)

Theory selects some phenomena as important or unimportant, peripheral or central, interesting or uninteresting, informed or ill-informed, sophisticated or unsophisticated by setting boundaries for inclusion and exclusion based on the relevance of the body of knowledge being sought to be generated.

When theory provides a' framework for appreciation,' it serves as a 'tool of inquiry'. The focus is on the 'endeavour in which the theoretical tools are applied."(ibid.) In formal theory, "the focus is on improving or extending or corroborating the tool itself..." (ibid.)

Formal theory is a source of ideas for appreciative theory and the vice versa. In general, drawing linkages or connection between these distinct forms of theorizing can enrich understanding of economic enquiry.

Nelson and Winter have proposed boldly an innovation framework to economic theory as an alternative to neo-classical framework (Nelson & Winter, 1982: 128-130) building on earlier criticisms of mainstream

economic thinking mainly from the writings of Veblen, 1909), Schumpeter, 1911, 1942) on modern dynamic economic theory building.

Today it appears that the formal theory is mainly pursued by the evolutionary economists. Appreciative theories based on empirical studies and research for policy selection or application has been pursued by the national innovation system perspectives and others in institutional and business economics. It seems to us there has been a proliferation of the appreciative variant of theorizing as part of the generation of the alternative framework on the economics of innovation.

There appears to be a sort of unwritten division of labour between the formal and appreciative theory where the formal theory of economic dynamics is dominated by evolutionary economists, and appreciative theorizing is largely populated by those who are empirically and policy orientated. It is not clear how much significant interaction and learning takes place between the formal theory and appreciative theory with mutual gain to each other. Formal theory concentrates mainly on economic structure. Appreciative theories focus mainly on system of innovation actors in their role in the processes of the development of economics of innovation dynamics and systems.

Both share the language brought out by the alternative economic theory such as: the use of evolutionary biological metaphors as opposed to static metaphors of mechanics in physics, they focus on institutions and change through new combination of routines. Above all they introduce innovation as deviation from routine behaviour capable of upsetting equilibrium by a process of creating and destroying in the process of economic growth.

Issues that seem to preoccupy much of the economists hoping to create an alternative to the main-stream neo-classical economic framework

appear to be understanding economic growth; short term and long term economic firm level and/or national performance, micro and meso level competitiveness, firm and national level productivity, economic catching up, learning and knowledge creation and absorption in a given economic structure, and inter linkages between firm competitiveness and national competitiveness and productivity, symmetry and system building such as national, sectoral and other types of innovation systems. Since innovation is characterized by the process of creating and destroying, some economists including Veblen earlier on have not been open to the notion of innovation systems and symmetry. They focus more on asymmetry and system breaks than makes, associating innovation more or less with a dynamic that disrupts systems and symmetry rather than the opposite.

The skepticism on innovation systems is understandable given that the available coordinating mechanisms such as the market, the state, the firm and others tend to operate in a way that may not facilitate symmetry and systems. In the real world, nearly all the elements, market, state, space, nation, sector, region, global, firm, technology, innovation and system do not exist without some interference from some variety of interaction. There is more anti-system than system in the context where making and forging development is on the agenda. The epistemic preference of system is more to convert anti-systemic and non-systemic phenomena into systems.

Innovation is also disruptive. It is creative destruction, something new to the market, the firm, the user and producer always challenges what was old and what pre-exists already. Thus the challenge is to create the development economics of innovation systems from a context that they system and innovation are more likely to create disruptive construction.

Thus the use of the system perspective is important as a focusing device to conceptualize, identify and select from the range of emerging forms of possible interactions, variations that are either emergent and to be made yet or already made, efficient or inefficient, strong or weak, necessary or contingent for generating outcomes and impacts on national economic development, productivity, competitiveness and overall better long term

economic performance. In other words different innovation systems can be correlated with different outcomes and impacts on performance, productivity, competitiveness, capability, learning and competence or any combination of them. And how systems are constituted and the taxonomy and complexity of interactions, and the work to understand and explain them remains significant. To be sure, the real economic processes may deviate from what may be desirable, and from the way systems of innovation are forged. That does not invalidate the choice of how innovation systems emerge and are formed by the interaction of the structures, institutions, policies, knowledge and incentives in given environments and situations.

Regardless of whether system building or not occurs in real economic systems, the national system of innovation perspective has been popularized. It has constituted perhaps a significant development of appreciative theorizing. Its main inquiry is to understand the variations or differences in the innovation performance of nations that enters into explaining the long-term economic performance, national productivity measured in such macro-economic variables as GDP and national competitiveness. Much of the work has been focused on industrialized economies not developing economies. Even in the developed economics innovation system research, the degree to which micro-level firm innovative capability, performance and competiveness can be aggregated to contribute to national innovative productivity, performance and competition has been analytically contentious.

Appreciative theory in this innovation system genre has produced such terms as the knowledge-economy framework, the learning economy framework, and with the Globelics initiative, a further development has occurred. Globelics has combined together knowledge, innovation, learning and capability building and suggested research applicable to the problems of development and underdevelopment by translating innovation systems into :' knowledge, learning, innovation and capacity,

capability and competence building systems.' This opens up a possible line of inquiry where an alternative economic framework of combining " knowledge, learning, innovation and competence building' into an '**innovation and development systems'** can address the problems and challenges of transition from underdevelopment to development for the developing world, the BRICS and others.

If we proceed with the search and selection of an alternative framework that employs innovation systems perspectives on the problems of development and underdevelopment, there is a need to formulate a new conceptual framework of Innovation and Development Systems (IDS). This can be done by doing two main reviews: The first is to understand and develop how linkages and combinations between economic and non-economic structure take place. Further explorations will be needed on the following: interaction between different actors and stakeholders, how innovation and learning is embedded by economic activity generators such as firms, the link between, formal theories and appreciative theories, awareness and learning in connection between the tools used in each type of theorizing, deepening evolutionary economic dynamics to include new thematic areas such as national economic integration in relation to reducing dependency on donors in different types of developing and transition economies, finding productive linking internal and external, domestic and international, political and economic, and empirical and policy changes and approaches in different national economic settings.

Combining development economics with systems of innovation in research requires suggesting the combination of innovation with development. Instead of using systems of innovation at a meta-level and try to draw or adapt it to address the dilemmas of underdevelopment, a new conceptual framework and approach can be proposed. We suggest and propose to combine development economics and the system of innovation by formulating the development economics of innovation by formulating the National Innovation and Development System (NIDS) or the general non-region specific focusing device that we propose as the Innovation and

Development System (IDS). This conceptualization can link clearly development economics and systems of innovation by advancing research that combines the challenges that each side may not fully capture. It enriches both development economics and the economics of innovation that innovation system approach has promoted by strengthening the focusing device for exploring and examining the problems of development and underdevelopment with a new synthesis of IDS.

3. Varieties in the presentation of systems of innovation perspectives

Development economics evolved in the post-war world when many colonies were granted political independence and the issue of development confronted both the elites and the former colonial powers. It continued during the Cold War and still exists to this day. On the other hand the approach of systems of innovation is a generation old. It is very new. We will discuss mainly the system of innovation and only include that development economics in relation to systems of innovation by concentrating on how to link them rather than explicate development economics in itself here.

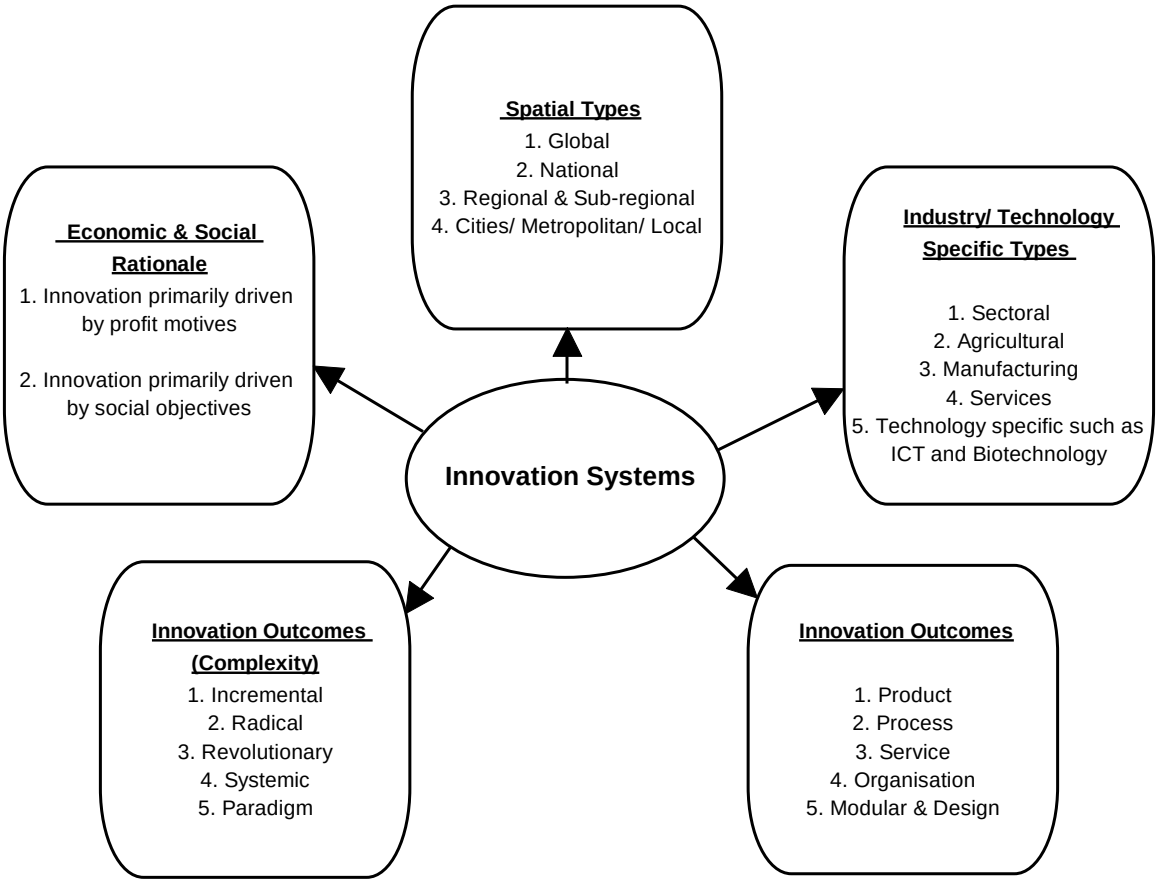
The national system of innovation, the most popularized version of the innovation system framework originated in the North. It evolved in search of how to organize science, technology, engineering and innovation systems effectively for both policy learning and managing economic development.

Since 1980s theories on innovation and their use have gradually expanded their focus and complexity. From the initial focus on the individual firm or entrepreneur they expanded to include the environment and industry in which firms operates. They started focusing on the national system of regulations, institutions, human capital and government policies and programmes (Niosi et al, 1993). Subsequently, the focus also included regional level or local level systems of innovations. In other words, initial perception that innovation is basically an individual act of learning by a

firm or entrepreneur has expanded to include the larger system (consisting of various institutions, policy framework, incentives etc.) in which this act occurs. It is now widely viewed and accepted that innovation is a process, which is not linear as it involves continuous interactivity between various actors and factors.

Figure 1 illustrates how the use of the concept of systems of innovation has grown and proliferated over the years. This can be traced in four major areas: (i) spatial; (ii) industry and technology specific; (iii) in terms of innovation types; (iv) in terms of level of technology/ innovation complexity; and (v) in terms of economic and social objectives. In the area of spatial we can identify global innovation systems, national innovation systems, regional and sub-regional innovation systems, and local and city innovation systems. In the area of industry and technology specific innovation systems we can see studies focused on specific industrial sectors such as manufacturing, telecommunications, automotive, agro-food and service and specific technology focused such as biotechnology, information and communication technology (ICT), and electronics. In terms of innovations types we can see the focus of studies on product innovation, process innovation, service innovation, organisational innovation and so on. Similarly, studies focused on levels of technological or innovation complexities such as incremental, revolutionary, radical, systemic and paradigm and so on. Finally, we can broadly see studies focusing on innovations driven by social objectives and economic motivations or objectives.

Figure 1: Innovation Systems - Theories/ Concepts/ Typologies/ Taxonomies



Integrating the Concept of the System of Innovation with Economic Development

The system of innovation is a concept utilized to describe the relationship between internal processes in firms and external processes in the wider environment in the context of knowledge creation, diffusion, and transfer. In the developed world's economic development the IS framework is based on empirical evidence on technologies, knowledge, innovation and learning.

In many developing economies we cannot expect the System of Innovation is forged. There is a need to re-frame IS to make it relevant to embrace the development economics interactions in a specific and empirically valid way amongst relevant stakeholders that bring knowledge, learning, innovation and competence building are critical drivers to promote developmental-transformational outcomes.

There is a need to identify how given development economics how the IS concept features can be re-worked. To begin with this is how IS has been conceptualized. There are many types of ***interactions*** that take place both within firms and outside firms. Among the various elements the concept of innovation system identifies is related to ***variation*** of the ***elements*** that constitute ***parts*** of a ***system***. A system of innovation is a concept to distinguish the most significant interactions from less significant ones in relation to actors, activities, and institutions in the process of knowledge creation, exchange, diffusion and transfer. Interactions that promote or hinder knowledge diffusion, exchange or transfer are even more relevant in the development economics of innovation system constructions.

As a *heuristic* concept 'system of innovation' helps to focus on knowledge and learning activities among various actors and institutions that provide competitive advantage in the long-term. The main characteristic of this concept is its flexibility in terms of its application to various geographic regions as well as various organizations. In other words, the type of activity could change (simple or complex, small or big).

The actors could change (small firm or large firm); institutions could vary (local or global, public or private). The space could vary (local or national, or regional or global). The sector/industry could vary. The concept of innovation relates knowledge creation, diffusion and transfer to the actors, activities, institutions, spaces and their interactions. The interactions in the process of acquisition, diffusion and transfer of knowledge can form different degrees and levels of systemic properties and functions around the creation of innovation as the core. The concept of innovation system captures the specific interaction of 'innovation-knowledge' as the independent variable and spatial, sectoral and institutional arrangements as the dependent variable in the context of the activities and actions to bring about transformation and development.

As a *critique*, the concept of 'system of innovation' can be used to challenge ideas about wealth accumulation based exclusively on static comparative advantage without products, markets, organizations, processes, innovation and learning imparting development features to a given national economy. Many developing countries depend on one or two main commodities for export, and they are advised to specialize in these commodities to earn the foreign exchange that may be ploughed back into the economy. Development is conceptualized as a consequence of the incremental growth that this export-orientated strategy based on the comparative advantage of agricultural and mineral produces might yield. The system of innovation perspective questions the significance of the development features, development dynamics and development effects of such an export-promoting specialization development strategy. It points direction and policy to the significance of the co-evolution of technologies, learning and institutions and incentives by bringing about systemic and significant interactions of the social, economic and political domains in order to imbed development features and development effects by diversifying the product and process base of a national economy.

As a *metaphor* 'system of innovation' orientates actors to integrate knowledge, innovation and learning to solve problems based on their own resources with self-reliance rather than resorting to dependency. Innovation system suggests that ideas, the domestic actors, institutions and

incentives must interact in order to create new opportunities in production, distribution, markets and circulation. This can inculcate a mental attitude of 'can do it yourself', rather than waiting for external impulses to create dynamic activities in the economy.

A key attribute of the innovation system concept is the focus it provides in framing problems and the value it signifies to the domain of reality that mainstream economics neglects or underemphasizes. The innovation system concept makes central, institutions, histories, territories, technologies, organizations and nations that are often neglected and treated as a residual in mainstream neo-classical economics. The concept has evolved by putting innovation and learning at the heart of the economics of development. Economic development is generally understood as the improvement of economic, social and technological conditions in general and not development economics that focuses on these conditions in the context of transforming the conditions of underdevelopment. The issues of relevance in systems of innovation do not often lend themselves to a reduction in order to fit single disciplinary boundaries. The innovation system is interdisciplinary.

Friedrich List (1856) and his concept 'national production system' may be seen as the historical origin of the national system of innovation (Freeman 1995). Perhaps he is the first to use the system of national economy of production. The innovation system concept has evolved over the years since List's time and its application has been evolving to different sets of problems and areas. Some analysts who work with systems of innovation draw affinities to it with the French Regulation School, and theories of evolutionary and institutional economics in the tradition of Schumpeter (1934) and Veblen (1919).

Innovation system has varied definitions. Of the influential definition, we mention the following: Innovation system has been defined as" the network of institutions in the public and private sectors whose activities and interactions initiate, import, and diffuse technologies" (Freeman, 1987:1). There has been an accent and emphasis on organizations that support R & D and promote the creation and diffusion of knowledge as the main sources of innovation (Nelson and Rosenberg, 1993: 5). Some stress:

"All important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations" (Edquist, 1997:14).

According to Bengt-ÅkeLundvall, the modern version of the concept appeared first in an unpublished contribution to OECD by Freeman (1982) and some years later Lundvall (1985) used the concept in formulating the importance for innovation of the concept of producer-user interaction and feedback for learning. Freeman used the innovation system concept in 1987 when he analyzed Japanese economic performance (Freeman, 1987). Subsequently, Lundvall (1992) and Richard Nelson (1993) edited two books on the system of innovation that has become standard references on the subject.

Whatever variations exist, Edquist claims that all agree on the following:

a) innovation is the key element and is linked to learning; b)Innovation system is holistic and interdisciplinary by attempting to comprehend the selected object of study as a whole that include not just only economic, but also institutional, organizational, social, and political factors also; c)Innovation system is path –dependent requiring the challenge that developing innovation is a long-term process; d) Innovation system is also interdependent and non-linear and finally e) in the innovation system organizations and institutions are critical.(Edquist, 1997)

W hat has not been done is extend these innovation systems by focusing on the developing economics where institutions and organization, innovation and learning and all the other features of the innovation system have to be re-examined and reconstituted. In order to address these challenges that development economic has been trying to address for a half-century, we propose that what is needed is not merely Innovation System (IS) conceptual framework, but a more relevant and immediate focusing framework of IDS (Innovation and Development System.)

We started to develop research that has led us to promote the IDS framework by exploring how the innovation and learning approach

captured by Innovation System can be applicable for economies in the developing world in general including Africa in particular (Muchie *et al*, 2003).

Significance of Innovation System for Development

As stated in the above section, innovation system has its origins from Friedrich List's concept of the system of national economy of production as opposed to the cosmopolitan theory of economics by Adam Smith. List regarded the productive power of the mind – what he referred to as *mental capital*- paramount relative to the productive power of matter and nature, and what he described as the mere accumulation of *wealth* per se. For List accumulation of wealth unrelated to mental capital is purchased with severe deficiency of developmental *features, effects and dynamics* in a country's given national economy. Development is driven by the intellectual achievements, discoveries, inventions, transformations and progress that a nation has accumulated in its history.

Institutionally the deployment of government policy to bring about an effective education, training, science and engineering system; linking these systems of training to accelerate the national productive forces and protecting them from the cosmopolitan notions of free trade constituted List's categories or elements of a national system of innovation. The key for List was to bring about productive interaction of the mental capital with the capital of nature and matter to create manufactures on the foundation of an ever-spiraling scientific and technological advancement to augment wealth. This would not be the case for example for a country that relies on comparative advantage and exports the minerals and agricultural commodities it is endowed with to accumulate wealth. List would not recognize the developmental features and dynamics in such economic activity unless it contributes to the build up of mental capital.

Joseph Schumpeter in his theory of economic development in 1934 put the importance of innovation for economic development suggesting that innovation is critical for economic policy. Almost every thinker of economics dealt with economics development: from the classical

economists such as Adam Smith's Wealth of Nations (1776), David Ricardo's Comparative Advantage (1817) to JM Keynes, The Means of Prosperity, 1933 and others. But this theory of economic development is general. It is not development economics.

Economic development is often goes through an uneven path. The development economics of innovation even goes with disruptive-constructive logic ebb and flow logic. The interesting question is how the development economics of innovation can address the lopsided connection between mental capital , social capital and development as wealth creation. Many developing economies export what they already have a comparative advantage in and/or rely on donor assistance to build their economies. Many developing economies even those with middle to high income exhibit innovation systems that are often bifurcated, lopsided and dualistic with features that reflect contradictory disruption and construction.

Howsoever one defines a system of innovation, the relevant issue remains to be the significance of explaining how the co-evolution of technologies, institutions (as sets of habits, routines, established practices, rules of the game and so on), and organizations that relate to the structure of production systems, takes place. Such co-evolutions are often at variance with the kind of development economic thinking of the late 1950s and 1960s. The latter mainstream thinking de-contextualized technology by seeing it merely as embodied in machinery/equipment and embodied in training and skill. Mainstream thought saw technology for development to be transferable from those that keep it under control detained by using intellectual property regimes to those that are technology or knowledge poor. This approach violates List's key factor - building the capital of the mind, in order to build in development features and dynamics and sustain also development effects of a given national economy. Catching up was conceptualized as borrowing and learning from the transfer of technologies, and not as organizing a system of national productive economy spearheaded by the capital of the mind. Mainstream thought saw catching up as possible and desirable with latecomers being able to *imitate, or use;*

not *create or innovate/produce* the products and processes from the developed economies.

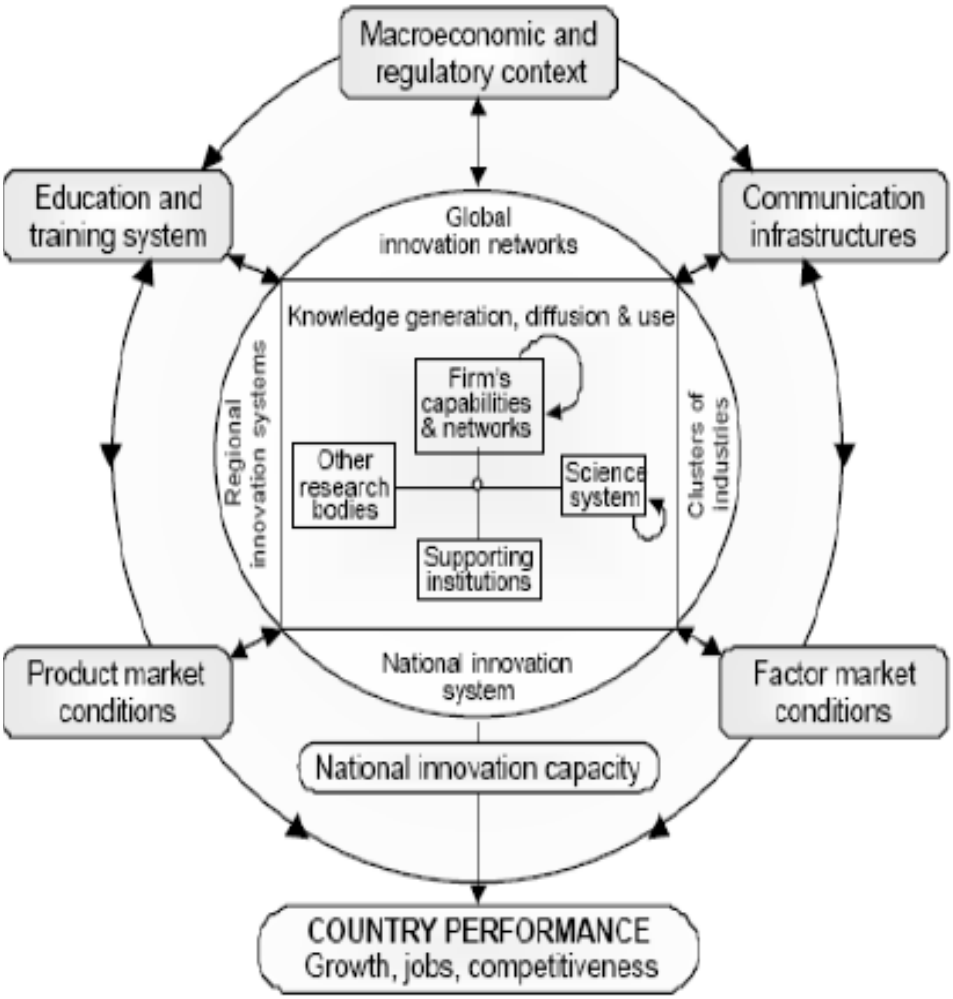
The innovation system framework suggests that theoretically development is not only a process of *production*, but also it is a process of *innovation*. In addition developing economies are not mere *users* of technology, but also their development should be conceptualized on the domain of active generators or *producers* of technology. Developing economies are not therefore passive recipients of technology from the industrialized economies. The assumption that development can be engineered or steered by technologies that can be transferred from those who control knowledge through intellectual property is a seriously inadequate proposition. There is also the problem that technology transfer cannot be assumed to take place easily. Often the proprietors of technology control knowledge, they do no readily spread it. This provides an additional reason for organizing a national system of innovation. Thus there is no alternative that those who wish to use technology must be prepared also to learn to produce it. A necessary condition for development from an innovation system perspective is that those who wish to embark on a sustainable developmental trajectory cannot afford to shy away from trying to develop by being producers of technology, and not stay merely as diffusers, users, absorbers and implementers of technologies produced elsewhere.

The development economics of innovation system makes development a pillar where specific national economies become or specialize as both producers and absorbers, creators and diffusers, though at present they may still be at the stage where they are more diffusers and absorbers than creators and producers of technology at present time. Of course both producers and users of technology undertake different types of innovation. The broad classification of economies as those who are the technology producers as the *innovators*, those that are absorbers of created technologies elsewhere as the *diffusers,* and those that may be *excluded* from being either innovators or diffusers create how a new development economics of innovation system may capture the dynamics and variation of the development process.

The system of innovation perspective emphasizes the identification in any given economic setting the interactions of the significant social-economic variables, and the dynamic co-evolution of institutions and technologies that result in imparting key development features and dynamics to a given national economy.

Comparing and contrasting OECD (1999) Model and Our Unified IS Model

Figure 2: Actors and Linkages in the Innovation System



Source: OECD (1999), *Managing National Innovation Systems*.

Figure 3: Unified Conceptualisation of Innovation Systems

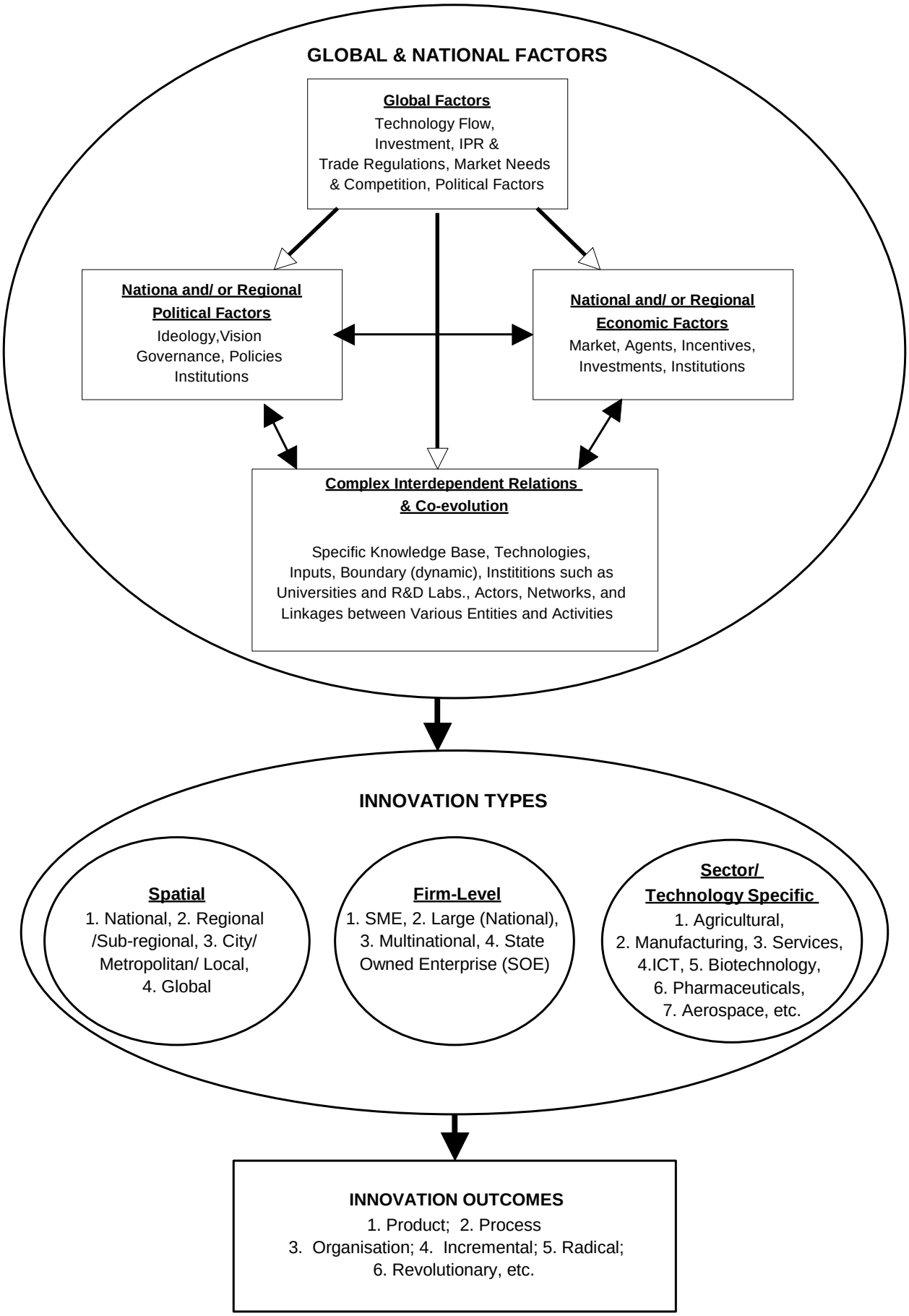


Figure 2 illustrates the OECD (1999) model which attempted to capture together various actors and linkages in the Innovation System (IS), mainly drawing from the experiences of the developed economies. It was successful in bringing together various actors and linkages which were hitherto discussed often in isolation of each other, which helped to provide an overall IS framework. However, it suffered from number of deficits of which the major ones are the failure to address the global factors except the global networks and the political vision or drive at national, and sometimes at regional/local levels. The globalization factors have not been captured comprehensively in the model, as it was the product of 1990s when the forces of globalization were still not fully understood. We have addressed these deficits in our proposed Unified conception of IS. This is illustrated in Figure 3.

Our unified conception of IS makes the following contributions to the IS theory and literature:

1. Conceptual framing -- our emphasis on the role of political factors such as political vision and direction at national level which can play a major or transformative role. These can be seen from both developed countries such as Japan (in the 1960s and 1970s), Korea (1970s and 1980s), India, China, Malaysia, Singapore, Brazil and so on.
2. Global Factors are identified and brought into the CORE of Innovation System, which were hitherto considered only partially and totally ignored.
3. Co-evolution dynamics are identified more clearly
4. The link between development and innovation is captured by unifying and creating a new focusing device that connects innovation, economics, system and development.

Figure 4: Unified Innovation System Conceptual Framework for New Transformative Development Dynamics in Developing Economies

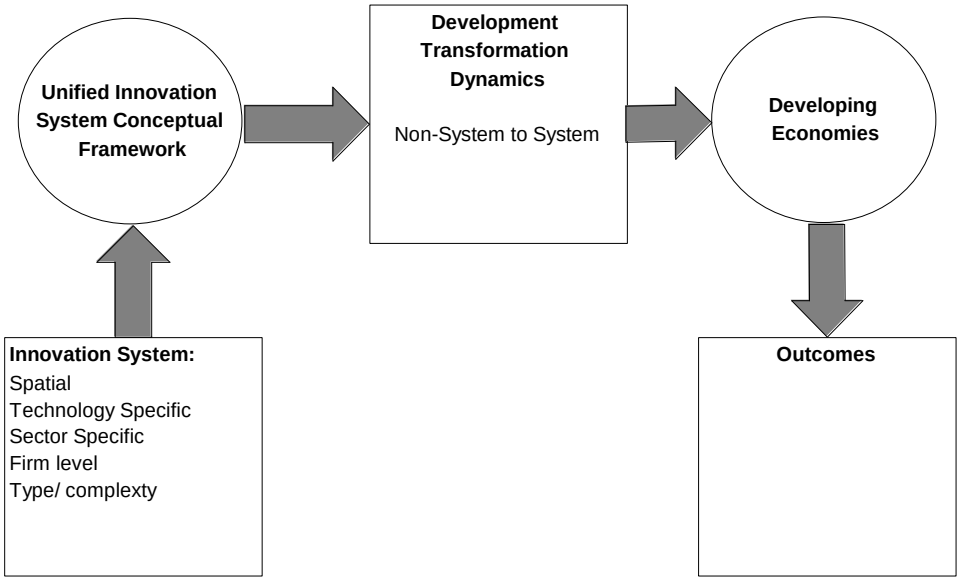


Figure 5: Locating Development Economics in the Unified System of Innovation

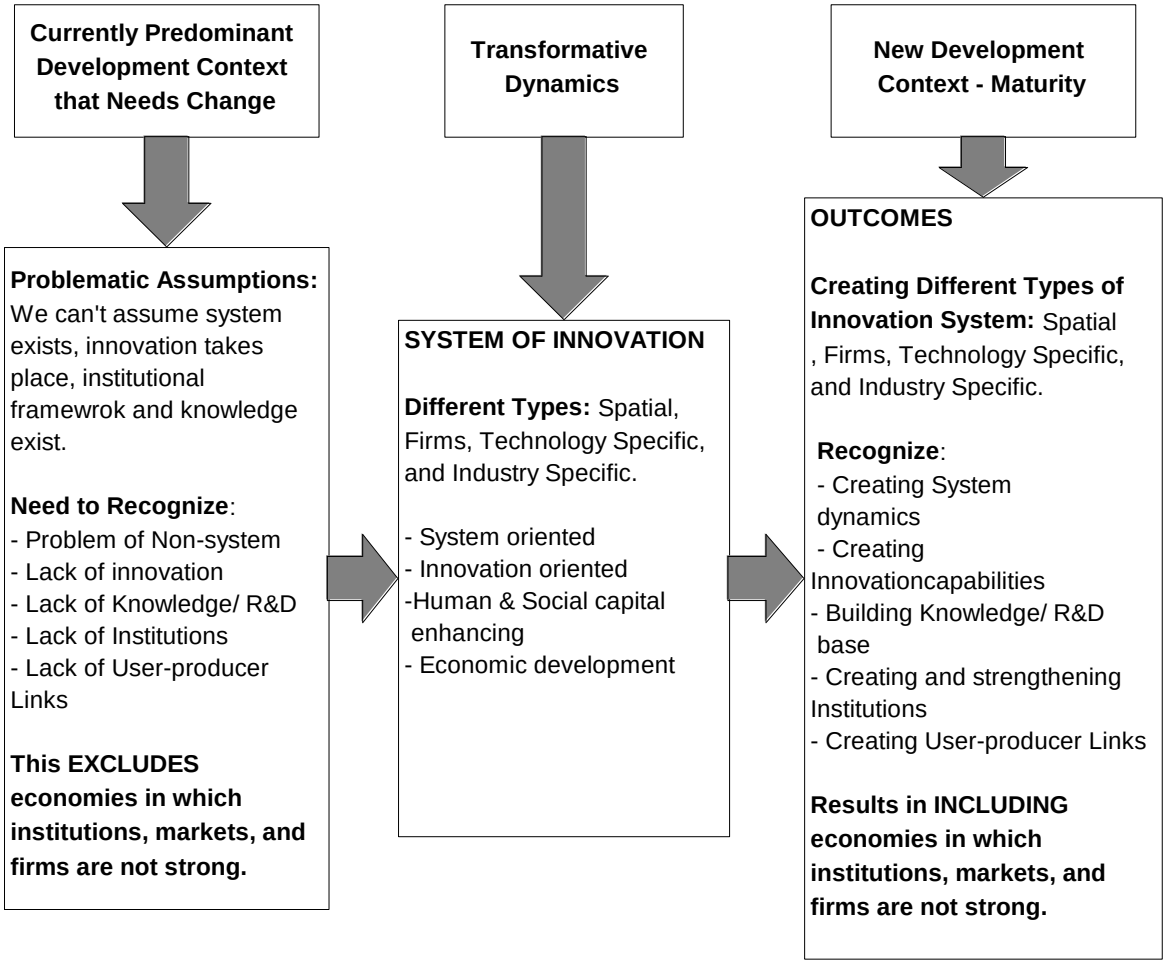
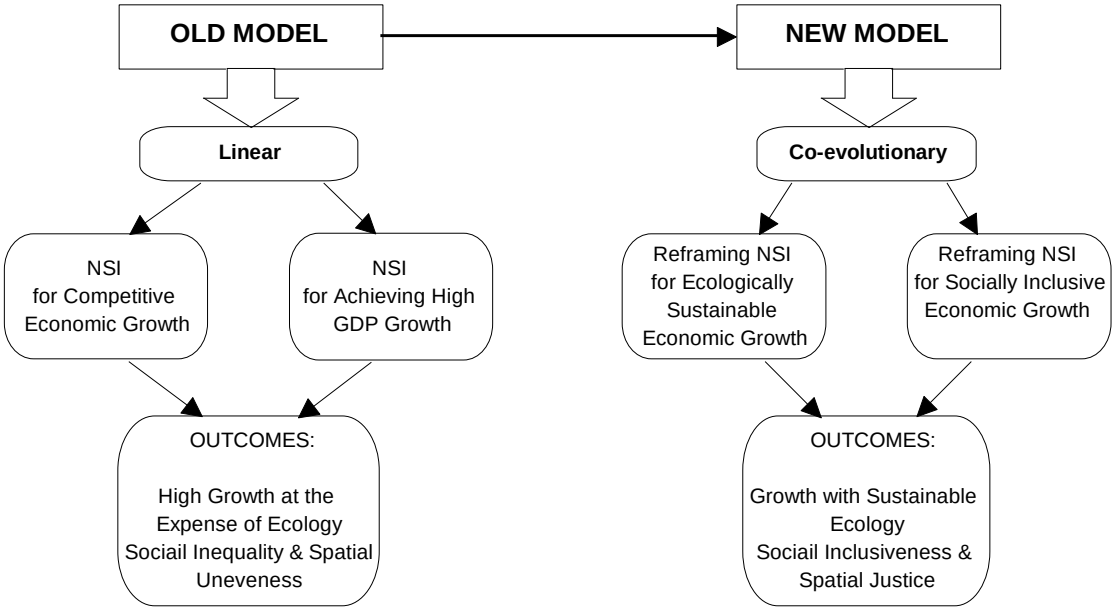


Figure 6: Rethinking Innovation System Approach for Ecologically / Socially Sustainable Development and Growth



7. Some Concluding Remarks

Both evolutionary economics theory and systems of innovation perspectives have been used to frame alternative conceptual frameworks to neo-classical economic theory. We think that there is an even more relevant role to them in providing alternative frameworks to the problems and challenges of development and underdevelopment. We advance in this exploratory paper how a system of innovation that combines knowledge, learning, research, innovation, and capability building can provide an alternative framework to the study of development and underdevelopment. We propose a new focusing device that we formulate as the System of Innovation and Development in order to incorporate knowledge, learning and competence building in the process of development

But the IS Concept "originated from the countries of the North as an exposte concept. This fact means in the developing world, the concept was built on the evidence of empirical data while in the developing world only few countries fit the road description of the NSI."(Manzini,2012, p.10). To correct this discrepancy we have added IDS to make IS more relevant and strong in addressing the challenges that development economics has been grappling with over half a century.

For the system of innovation and development conceptual framework to add new contributions, its use and application needs to be understood with clarity where the relevant non-economic and economic structures, institutions and actors and their co-evolutions from the spectrum of developed to developing economies can be well specified, and the components those that need to be included are included, and those that do not need to be included are excluded.

What we did is extend the focusing device from mere systems of innovation to systems of innovation and development by reviewing the variety of ways of how the system of innovation has evolved in the first place in the developed economy context and extended to include the problems and challenges of development and underdevelopment.

There is always the risk of misuse and abuse of a framework when it is extended to new terrain and endeavors. In order to avoid such a mishap the review and exploration of how the system of innovation has evolved and been used has been undertaken and what remains to anchor in research and profound knowledge production is the application of what we propose here as the Innovation and Development Systems by taking as distinct categories and in unified way the various categories as focusing devices such as firms, spaces, technologies and innovations.

The innovation and development system has its own core and peripheral components that enter at different levels bringing up as challenges distinguishing the variables that need inclusion from those that do not.

An ontological appreciation of the challenges of development necessitates that the conceptual focusing device on systems of innovation is extended to an innovation and development system to open research on issues and problems that development economics on its own or system of innovation on its own could not fully explain and advance. The innovation and development system provides an ontological anchor directly to address the development challenge of many economies with low income by unifying knowledge, learning and capability building in such a way contributions to address the problems of development and underdevelopment will be continuously enriched. We propose that it is not IS (innovation system), but IDS (Innovation, Development System) that provides a useful analytical framework for policy learning and research by addressing directly the challenges of development and underdevelopment in many low income and pre- transition and transition economies in the developing world.

7. References

Acs Z.J. (2002), *Innovation and the Growth of Cities* (Cheltenham, UK: Edward Elgar).

Acs Z. J. and Varga A. (2002), "Introduction to the special issue on regional innovation systems," *International Regional Science Review*, vol. 25, no. 1, pp. 3-7.

Baskaran A. and Muchie M. (ed.) (2006), *Bridging the Digital Divide: Innovation Systems for ICT in Brazil, China, India, Thailand and Southern Africa* (London: Adonis-Abbey).

Baskaran A and Muchie M. (2007), "The Impact of the National Innovation Systems on the Flow and Benefits of Foreign Direct Investment to National Economies," DIIPER Working paper Series, Aalborg University, Denmark.

Baskaran A and Muchie M. (2008), "Foreign Direct Investment and Internationalization of R&D: The Case of BRICS Economies," *The 5th ASIALICS International Conference:" From Manufacturing to Services: Changing Role of Innovation Systems"* April 2-4, Bangalore, India.

Cooke P. (1992), "Regional Innovation Systems - Competitive Regulation in the New Europe," *Geoforum*, vol. 23, no. 3, pp. 365-382.

Cooke P. and Morgan K. (1998), *The Associational Economy: Firms, Regions, and Innovation* (Oxford.: Oxford University Press).

Cumbers A. and McKinnon D. (2004), "Introduction: clusters in urban and regional development," *Urban Studies*, vol. 41, no. 5/6, pp. 959-969.

Delapierre M. and Mytelka L. K. (1998), "Blurring boundaries: New inter-firm relationships and the emergence of networked knowledge-based oligopolies," in Massimo Colombo (ed.), *The Changing Boundaries of the Firm, Explaining Evolving Inter firm Relations* (London: Routledge).

Doloreux D. and Parto S. (2005), "Regional innovation systems: current discourse and unsolved issues," *Technology in Society*, vol. 27, pp. 133-153.

Dosi G. (1988), "Sources, procedures and microeconomic effects of innovation," *Journal of Economic Literature*, vol. 26, pp.1120-1171.

Edquist C. (1997), *Systems of innovation* (London: Frances Pinter).

Edquist C. (2001), "Systems of innovation for development". Background paper for Chapter 1: "Competitiveness, Innovation and Learning: Analytical Framework" for the UNIDO World Industrial Development Report (WIDR).

Feinson S. (no date), "Knowlege Flows, Innovation, and Learning in Developing Countries: National Innovation Systems Overview and Country Cases," See: <http://www.cspo.org/products/rocky/Rock-Vol1-1.PDF>

Flores M. (2004), "Proximity and Learning in Metropolitan Innovation System: Towards the formation of High Tech clusters in Monterrey and Milan," Globalics Academy, Lisbon. See: < http://www.globelicsacademy.net/pdf/MyrnaPineda_presentation.pdf>

Freeman C. (1987), *Technology Policy and Economic Performance: Lessons from Japan* (London: Pinter).

Freeman C. (1995) "The 'National System of Innovation' in Historical Perspective," *Cambridge Journal of Economics*, vol. 19, no.1.

Freeman C. (2002), "Continental, national and sub-national innovation systems- complementarity and economic growth," *Research Policy*, vol. 31, pp. 191-211.

Gebauer A., Nam G. W., and Parsche R (2003), "Regional Technology Policy and Factors Shaping Local Innovation Networks in Small German Cities", ERSA 2003-innovationetwork.doc, see: <http://www.ersa.org/ersaconfs/ersa03/cdrom/papers/166.pdf>

Gereffi G (1999), "International trade and industrial upgrading in the apparel commodity chain," *Journal of International Economics,* vol. 48, pp. 37-70

Goto and Odagiri (1993).

Hatakenaka S., Westnes P., Gjelsvik M., Lester R. K. (2006),"The Regional Dynamics of Innovation: A comparative case study of oil and gas industry development inStavanger and Aberdeen," Paper presented at *the SPRU 40th Anniversary Conference on The Future of Science, Technology and Innovation Policy: Linking Research and Practice,* University of Sussex, Brighton, United Kingdom, September 11-13.

Hobday M. (2005), "Firm-level Innovation Models: Perspectives on Research in Developed and Developing Countries," *Technology Analysis & Strategic Management*, Vol. http://www.informaworld.com/smpp/title~content=t713447357~db=all~tab=issueslist~branches=17 - v1717, No. 2 , June, pp.121-146.

Janz N., Loof H and Peters B. (2003), "Firm Level Innovation and Productivity–Is there a Common Story Across Countries?," Discussion Paper No. 03-26. See <ftp://ftp.zew.de/pub/zew-docs/dp/dp0326.pdf>

Juma C., Fang K., Honca D., Huete-Perez J., Konde V., and Lee S. (2001), "Global governance of technology: meeting the needs of developing countries," *International Journal of Technology Management*, vol. 22, no. 7/8.

Kolehmainen J. (2002), "Territorial Agglomeration as a Local Innovation Environment: The case of a digital media agglomeration in Tampere, Finaland," MIT-IPC-LIS-03-002. See: <http://web.mit.edu/lis/papers/LIS03-002.pdf>

Lim J. D. (2006), "Regional Innovation System and Regional Development: Survey and Korea Case," Working Paper Series, Vol. 2006-05, Pusan National University. See: <http://www.icsead.or.jp/7publication/workingpp/wp2006/2006-05.pdf>

Liu X. and White S. (2001), "Comparing innovation systems: a framework and application to China's transnational context," *Research Policy*, vol. 30.

Lundvall B. A. (ed.) (1992), *National Innovation Systems: Towards a theory of innovation and interactive learning* (London: Pinter).

Lundvall BA. (1997), "National Systems and National Styles of Innovation," paper presented at *the Fourth International ASEAT Conference: "Differences in 'styles' of technological innovation,* Manchester, UK, September.

Lundvall B. A. (2002), "Towards a learning society," in Conceicao P., Heitor M., and LundvallBA., (eds.), *Innovation, Competence Building And Social Cohesion In Europe: Towards a Learning Society*, (Cheltenham, UK: Edward Elgar).

Malerba, F. (2002), "New challenges for sectoral systems of innovation in Europe," *DRUID Summer Conference 2002: Industrial Dynamics of the New and Old Economy -who is embracing whom?*, Copenhagen, Denmark, June 6-8.

Metcalfe S. (1995), "The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives", in P. Stoneman (ed.), *Handbook of the Economics of Innovation and Technological Change* (Oxford/ Cambridge, MA: Blackwell Publishers).

Mowery D. and Nelson R. (1999), *The sources of industrial leadership* (Cambridge: Cambridge University Press).

Muchie M. and Others (2003),*Putting Africa First: The Making of African Innovation Systems* (Aalborg, Denmark: Aalborg University Press).

Muscio A. (2006), "From regional innovation systems to local innovation systems: Evidence from Italian industrial districts," *European Planning Studies*, vol. 14, no. 6, July, pp. 773-789.

Manzini, M (2012); The National System of innovation Concept: An Ontological Review and Critique, S Afri J Sci , Vol.108, no.9/10, PP.50-56

Mytelka L. K. (2000), "Local systems of innovation in a globalized world economy," *Industry and Innovation*, June. See:

http://findarticles.com/p/articles/mi_qa3913/is_200006/ai_n8906844/print?tag=artBody;col1

Mytelka L. (2001), "Promoting scientific and technological knowledge for sustainable development," *Paper for the Third UN Conference on Least Developed Countries,* Round Table: "Education for All and Sustainable Development in LDCs," May.

Nelson & Winter (1982), An Evolutionary Theory of Economic Change, The Belknap Press of Harvard University, Cambridge, USA

Nelson R. R, (1993) *National Innovation Systems*: *a comparative study* (Oxford: Oxford University Press)

Nelson R. R. (2000), "National Innovation Systems," In Z. Acs (ed.), *Regional Innovation, Knowledge and Global Change* (London and New York: Pinter).

Nelson R. Winter S. (1982), *An evolutionary theory of economic change* (Cambridge, MA: The Belknapp Press of Harvard University Press).

Niosi J., Saviotti P., Bellon B., and Crow M. (1993), "National systems of innovation: In search of a workable concept," *Technology in Society*, vol. 15.

Niosi, J. (2002). "National systems of innovations are "x-efficient" (and x-effective): Why some are slow learners," *Research Policy*, vol. 31.

OECD (1999), *Managing National Systems of Innovation* (Paris: OECD).

OECD (1997), *National Innovation* Systems (Paris: OECD). See < http://www.oecd.org/dataoecd/35/56/2101733.pdf>

OECD (2005), *Governance of Innovation Systems: Synthesis Report*, Vol. 1.(Paris: OECD). See: <http://www.consejodeinnovacion.cl/cnic/servicios/documentos/web/download.php?id=49>

OECD (2007), *Regional dimension of innovation* (Paris: OECD).

Pavitt K., (1984), "Sectoral patterns of technical change: towards a taxonomy and a theory," *Research Policy*, vol. 13, pp.343-373.

Pogue, T. (2007) Mobility of Human Resources and Systems of Innovation: A Review of Literature, HSRC, Knowledge Systems Research Unit,

Porter M.A. (1990), *Competitiveness of Nations* (Cambridge: CambridgeUniversity Press).

Porter M. (1998), "Clusters and the new economics of competition," *Harvard Business Review*, vol. 76, no. 6, pp.77-90

Saxenian A. L. (1994), *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, MA: Harvard University Press).

Schmitz H. (ed) (2004), *Local Enterprises in the Global Economy* (Cheltenham, UK: Edward Elgar).

Schumpeter, J.A. (1934), The theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle, London: Oxford University Press

Schumpeter,J.A (1942) Capitalism, Socialism and Democracy, London, Allen and Unwin.

Srinivas S. and Viljamaa K. (2001), "Bioturku: "Newly" Innovative?: The rise of bio-pharmaceuticals and the biotech concentration in South west Finland, MIT-IPC-LIS-03-001. See: http://web.mit.edu/lis/papers/LIS03-001.pdf

Todtling F. and Trippl M. (2005), "One size fits all? Towards a differentiated regional innovation policy approach," *Research Policy*, vol. 34, no. 8, pp. 1203-1219.

Varga A. (1998), *University Research and Regional Innovation* (Boston: Kluwer Academic Publishers).

Veblen, T, (1919) The Place of Science in Modern Civilisation and Other Essays, New York, Augustus M.Kelley

Virasa T. (2002), "An Implication to the Role of RTOs in Strengthening Innovation Policy in Developing Countries: An Analysis of Firm's Innovation," College of Management, Mahidol University, Bangkok, Thailand. See: < http://www.apecforesight.org/leaders_forum/docs/dr_thanaphol.doc>