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Innovation Policy Reforms, Emerging Role Models and Bridge Institutions: Evidence from North African Economies

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This article focuses on role models of modern innovation based development and public interventions to diffuse and scale up these role models. It discusses the so-called bridge institutions of innovation, which transform skills into knowledge valued by markets. It shows how these institutions (science and technology parks, international universities and skilled diaspora networks) promote innovation and create high productivity employment. Policy to promote innovation is, therefore, designed as a process with endogenous dynamics, where one-step follows the other and evolves in three time horizons: immediate (entry points), medium term (the critical mass effect) and long-term (major structural reforms). Case studies from North African countries indicate that entry points are numerous and more common than originally expected and that key issues are mostly linked to building critical mass in the medium term, and achieving structural reforms and cultural change in the long-term.

Keywords: role models, bridge institutions, search networks, self-discovery, critical mass, innovation policy

Introduction

The increasingly educated youth in North African countries (NACs) aspires to well-paid high value-added jobs, while the economies in the region have managed to create in their vast majority only low value-added jobs, often due to weak growth and innovation policies. This was, to a large extent partly at the roots of the so-called ‘Arab Spring’ (Andersson and Djeflat 2013). As documented by many contributions, NACs’ economies are beset by many problems and innovation performances are unsatisfactory (World Bank 2012). Yet, in spite of a difficult investment climate in almost every NAC, one finds striving and rapidly growing medium-sized firms – knowledge-based ‘gazelles’ with obvious short-term benefits and dynamic clusters highlighting the heterogeneity of spaces and sectors in the same economy. Technological progress is the source of long-term growth, and innovation in its various forms is at the root of this progress. Innovation can be an important engine to move economies up the production ladder and it is at the core of a long-term strategy for more and better jobs. Promoting innovation can also have broad benefits in terms of triggering an endogenous momentum for reform. The market for innovation is still relatively uncontested (Baumol et al. 1982) in NACs, with a few emerging examples of success stories. Hence, there are fewer existing entrenched interests that would benefit from limiting entry in the sector. By creating the right opportunity of scaling up, governments can effectively help build new constituencies that would gain from a broader reform of the investment climate, something that could benefit

investors at large. While an in-depth treatment of innovation is outside the scope of this work, this paper focuses on transforming skills and talents present or latent in NACs’ labour forces into knowledge valued by markets, high-value added exports and other outputs (intellectual property rights, knowledge-based goods and services for domestic consumption etc.). Success stories of this transformation exist within the region but they are seen as exceptions: the key question is how could they become role models for educated youth, universities and other stakeholders? What role could bridge institutions play including diasporas? Finally, how can diverse but fragile micro-level reforms be scaled up to the level of clusters and value chains and from change at the micro level transform into solid reforms at the national level? This paper attempts to answer these questions looking at the NACs’ experience. It adopts the heterogeneity approach as a tool for policy making which is rather scarce in the literature and constitutes one of the main contributions of this paper. Methodologically, it draws from two main studies conducted in the region by the authors: the first one is the fieldwork done in the INGOMED project¹ in 2003–2004, where a sample of ten leading enterprises was examined (Djeflat 2010). The second one is a more recent work done on Morocco where emerging electronics industries and several bridge institutions (technoparks, universities, export processing zones) were surveyed (Kuznetsov and Djeflat 2011).

The structure of the paper is as follows. Section two outlines the analytical framework at the center of which is the focus on *heterogeneity* and internal diversity of

the economies and the importance of micro-economic reforms. Section three examines empirical evidence from North African Countries and draws on experiences from some Emerging Countries namely China and India. It examines firstly various factors which played a significant role in the emergence of clusters namely in the agro-food industry in Morocco. Secondly, it analyses how framework programs can provide the right environment for micro-reforms to scale up using the Chinese case. Thirdly, it dwells on the emergence of *role models* (Kuznetsov 2008) of high-productivity employment by looking at two concrete examples in advanced technologies. Finally, a fourth section examines the various time horizons (immediate – role models; medium-term – bridge institutions and longer-term – enhancing the talent pool and undertaking major reforms) in an endogenous policy process of reforms in order to move swiftly from entry points to structural reforms.

Analytical Framework: Heterogeneity of national economies and micro-reforms to expand it

Recent work on innovation in business and economics literatures characterises it as a complex and interactive process involving multiple feedbacks between different services and functions as well as manifold interactions with customers and suppliers (Freeman 1987; Lundvall 1988; Rosenberg 1982; Kline and Rosenberg, 1986; Nonaka and Takeuchi, 1995). Clearly, there are two main angles to innovation: the first one relates to the engagement in R&D processes, as well as linkages between various key institutions in the interactive learning process in the STI (Science Technology and Innovation policy) style. The second one relates to endogenous dynamics at the firm level where interactions among all workers and firms and daily practice help increase innovation and have an impact on economic performance in the DUI (Learning by Doing, Using and Interacting) style (Lundvall 1992, Lundvall and Johnson 1994, Jensen, Johnson, Lorenz and Lundvall 2007). This paper defines innovation broadly as a novelty in a given context rather than high-tech or R&D.

Heterogeneity and cluster dynamics

Heterogeneity has for some years now kept the attention of several researchers who highlighted the positive effect on high-income economies (Florida 2002, Jacobs 1969). Tiemann and DiRienzo (2006) found that heterogeneity was good for high income, and creativity based economies. The heterogeneity of private and public sectors in NAC economies is crucially important, yet often overlooked. The spatial differentiation of economic activity, typically linked to industrial specialisation (Krugman 1991, Fujita, Krugman and Venables 2001), means that a focus on national indicators and institutions can obscure critical transformations occurring at a sub-national level. Likewise, the state is not a unified

whole but consists of multiple, differently organised units with varying political and economic resources, jurisdictions and interests. The hierarchical model of State, based on the principle of authority, has been beaten by the multiplication of players and layers of negotiation, internationally, nationally, and locally, in favour of the *governance model*, based on organisational structures of partnership and/or of open market that more and more characterise local societies (Perulli, 2000).

Clusters: At mezzo economic level, territory based concentration of entrepreneurial dynamism coupled with support of local institutions can give birth to particularly performing entities. They take the form of clusters, where cumulative learning can occur (Porter 1998, 2006, Longhi & Quere 1991) sometimes within a general climate of stagnation and de-learning in the rest of the economy. Several factors can be at play often simultaneously in a co-evolutionary perspective rather than individually (Figure 1). They often pertain to the institutional, organisational and political environments. Institutionally, *rules, regulations* and export market constraints increase awareness level, and put higher implementation clout through modernisation, certification, quality infrastructure, and ISO standard requirements. From an *organisational point of view*, joint and concerted efforts can materialise in specialised coordinating bodies, which rest both on formal relations to ease public-private partnership and/or through informal ties and social capital.

Gomez (2006), for example, identified the importance of coordination of three fresh fruit producing clusters in Brazil: the sectors associations played a key role² and innovative actions could be undertaken through mobilising members of local networks where informality plays a determinant role. Joint actions become sources of competitive advantages (Schmitz 1995, cited in Clarke and Ramirez 2010). These efforts when successfully undertaken, open the way to upgrading innovation efforts, climbing thus the ‘indigenisation ladder’, through concerted and planned innovative efforts often with the contribution of other key partners from business and knowledge spheres and other *intermediate institutions* (Femise 2004). Some of these intermediate institutions can also play the role of knowledge intermediaries (Clarke and Ramirez 2010): these include trade and professional bodies, consultants, individual entrepreneurs, research councils, NGOs and Trade Unions. Intermediate institutions could be extremely relevant in defining the direction of development policies, because of their embeddedness in the territory (Granovetter, 1985, 2005; Polanyi, 1995, 2001). They are able to endorse novelties and to generate pressure for drastic and discontinuous changes, since they can play a more flexible role than centralised institutions (Femise 2004). The literature of neo-regionalist movement has attributed more and more importance to regional institutions (Cappellin, 1998) to create and support regular and

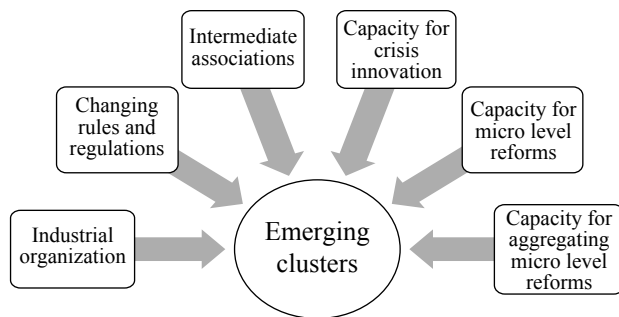


Figure 1:

continuative models of social interaction at regional level (Saxenian, 1994). From this perspective, economic and institutional change begins in certain locations and/or domains and advances through partial and incremental *micro-level reforms*. Organisations, not yet institutions, rise in order to aggregate people for solving very specific and urgent social problems (Femise 2004). Sometimes *crisis innovation* is required to provide early and quick responses (Mendes 2009). This is part of the enabling role highlighted by Howells (2006) and which made it possible for Peruvian Mango producers to innovate (Clarke and Ramirez 2010). These micro reforms often of an incremental nature do not aggregated automatically to become larger-scale transformations over time: there is no guarantee that they will continue through. The risks that they remain isolated ‘island of activism’ or what Judet (1981) called ‘cathedrals in the desert’ are high. Hence, two important questions can be raised: 1/ how to provide the right environment for micro-reforms to flourish and 2/ how to aggregate micro-economic reforms to trigger off major reforms. The answers are examined below namely looking at role models, bridge institutions and the appropriate path to structural reforms starting from selected entry points.

Role models, entry points and structural reforms

Role model is a concept attracting more and more interest of scholars. Fornahl (2003) for example found situations in which regions develop different common cognitive perceptions, influencing the diffusion of new positive examples (Role models). Role models can also act as a stimulus within the ‘triggering event’ stage (Lafuente and Vaillant 2008). However, not any success story can become a role model. They could simply be *dynamic exceptions*. They would become role models once established organisations – universities, chambers of commerce, the government and the media - realise the significance and potential of these dynamic exceptions and foster collaborative links with them. The co-evolutionary prospect prevails, extended to a wider span of key players (Nelson 1994, Van de Ven and Garud 1994, Puchet et al. 2010). Key success factors rest on

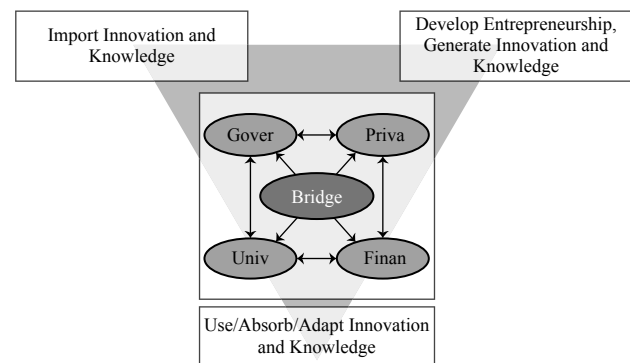


Figure 2:

succeeding that political economy of the whole process i.e.: mobilising of stakeholders for relevant reforms.

Entry points and structural reforms: Often, reforms hurt established interests and therefore are difficult to conduct. Innovation can foster innovation: emerging pockets of dynamism in the private sector can help through collaboration and partnership create emerging pockets of dynamism elsewhere (Kuznetsov and Sabel, 2011, Saxenian, 2006, Sabel, 2012), in the university sector, in Government and among Diasporas. New dynamic private sector with high-paying jobs, new problem solving and creative public sector and new dynamic university segments could emerge together – as two sides of the same collaborative process. Governments can follow different strategies to promote innovation. One model is to embark in a wide scope reform where all of the regulatory elements that are necessary to make the business climate conducive to investment in innovation are reviewed and, if needed, overhauled. An alternative approach is to focus a bottom-up *entry points*, by sustaining existing examples of successful innovators in spite of difficult investment climate, scaling them up to ensure coordination and concerted action, and only in the medium term tackling the major policy reforms is the proposed strategy (Figure 2) (Sabel, 1995, Saxenian, 2006, Kuznetsov and Sabel, 2011). The second approach seems more suited to economies such as NACs with highly entrenched interests as a result of the ‘rentier culture’ (Bizri 2013) that are likely to block systemic reform efforts as well as economies with limited capacity to effectively implement and sustain top-down change.

Bridge institutions

Behind any successful example of high innovating cluster, there exists a dynamic set of actors that can be qualified as *bridge institutions*. These are vital to leverage global knowledge and transform it into domestic applications that can foster improvement in productivity and competitiveness, and eventually into export volumes and job creation. In practice, bridge institutions include

both international networks linking domestic firms and universities with their foreign peers (Table 1) and organisations that link academia and universities with markets and commercial opportunities (Table 2). In more details, bridge institutions can take a variety of forms and shapes acting both internationally and at domestic level. Internationally, a host of institutions and schemes can play the bridging function: they range from FDI investing into high technology segments in the host country up to international joint research projects and joint patenting. Domestically, institution such Science parks and incubators and venture capital networks play an important role.

Diaspora can play an important role as a bridge institution and become a catalytic force to reduce costs and be important agents of transformation. While leveraging, the Diaspora offers important opportunities; it also presents challenges. Many engagements are about entrepreneurship and risk taking in expectation of higher than usual returns. As such, it can and should not be mandated, administered or directed by the State. However, it can be nourished and supported. The literature refers to this as the paradox of *guided serendipity*³ – creating a framework where unplanned occurrences can take place on a regular basis. As originally coined, serendipity meant an ability to apply sagacity to chance observation and thereby find something other than what one was looking for (Taton 1957, Campbell 2005, Stoskopf 2005). Domestic institutions appear to determine the success of Diaspora projects, particu-

larly of complex and long-term projects. To articulate projects with high development impact, Diaspora members need to search for people and institutions with whom to engage. This is the paradox of the *Archimedean lever* (Kuznetsov 2008): Diaspora members help to identify dynamic domestic institutions and individuals (the Archimedes' levers) to unblock binding constraints on development. A way to overcome these paradoxes is to leverage a competitive mechanism to fund innovative pilot activities that introduce linkages between Diaspora and home country agencies (in the form of building on established links, broadening the range of existing activities or introducing new activities to an established partnership, or be a first time relationship between new partners). A contest of this type focuses on pragmatic search for solutions to sector specific needs of domestic agents and on Diaspora search networks⁴ (Kuznetsov 2008) as institutions that help to find such solutions. Diaspora members can serve at once as *antennas* to detect better performing and more dynamic segments of domestic institutions and *institutional vehicles* (as members of so-called search networks) to expand, institutionalise and scale up these better performing segments. For Diasporas to contribute, investment climate and governance in home country must improve. Nevertheless, as noted by many, including Albert Hirschman more than half a century ago (Hirschman, 1958), if developing countries had such conditions, they would have not needed external change agents to begin with. Therefore,

Table 1: Institutions facilitating linkages between domestic and foreign knowledge producers

Foreign knowledge	Bridging institution	Domestic knowledge
Global technology	Trade, FDI (MNCs in particular) Foreign technology licensing Export processing zones	Domestic producers
Foreign knowledge and information more generally	Publications and databases Internet, diaspora flows, diaspora networks	Domestic knowledge and information
Foreign universities	International students International programs Faculty exchanges Collaborative research	Domestic universities
Foreign research institutes	Collaboration in writing papers International joint research International joint patenting	Domestic research institutes including public, academic and private

Table 2: Institutions linking knowledge agents and markets at domestic level

Domestic Knowledge Agents	Bridging institutions	Domestic markets agents
Universities	Technology transfer offices for licensing and business development.	Firms
Public or private R&D institutes	Science parks and incubators Business mentors, New firm start-ups Angel and venture financing Venture capital networks	

the proposed contest starts from a different premise: how institutional environment of the home country can improve, gradually and incrementally, through participation of Diaspora members. Science and technology ministries of Mexico and Russia have implemented such a contest. This is in line with a growing literature on the positive effects of diasporas (Mountford 1997, Stark and Wang 2002, Vidal 1998).

Indigenising innovation-based growth: from entry points to structural reforms

By taking stock and then diffusing the experience of first movers (firms that do new things), they can become role models for others to follow. It would then be key to designing a small portfolio of private-public initiatives that would support first movers. One example is design and establishment of an autonomous private sector-driven organisation with a mission to incubate innovating firms in promising areas of the economy, following the example of *Foundation Chile* (Kuznetov and Sabel 2011).

Fundacion Chile is a successful bridge organisation triggering productive innovation in a difficult but heterogeneous environment. The Fundación was created as a non-profit corporation by the Chilean government in 1976 with a USD50 million payment by the conglomerate ITT as part of an agreement indemnifying the company for expropriation of its national telephone subsidiary (Kuznetsov 2008). Fundacion Chile became the key player in Chile in renewable resources, creating, for instance, a successful salmon cluster (currently under duress because of a government failure to develop vaccines to prevent fish diseases).

Competitive funding schemes have been proven effective to articulate innovation consortia. In the medium term, such contests for collaborative innovation efforts should become a main source of funding for national R&D. They should emphasise international participation as a condition and rely on international peer reviewing. The main objective of such funding schemes is to give an opportunity for dynamic and entrepreneurial individuals and organisations to develop their own projects in collaboration with each other and with international players.

Critical mass: In the long term, the focus should be on a critical mass of changes in the national innovation system. Critical mass is an elusive concept and is difficult to measure. What is the minimum level required of a mix of human, financial and institutional ingredients, appears to be one of the key issues. Critical mass can be defined as a sufficient numbers of adopters in an innovation in a social system so that the rate of adoption becomes self-sustaining and create further growth (Rogers 2003). It is also perceived as the discrete point at which the presence of sufficient number brings about qualitative improvement in conditions and accelerates the dynamics of change (Kenna and Berche, 2010). In practical terms, it means two things: first, the existence of a portfolio of

dynamic export-oriented and innovation-based segments in the real sector, and second, a wide diffusion of innovation directed to the lower-income segments of the population. Recognition that lower-income consumers are a major market opportunity has produced a series of examples of ‘piggy frogging’, namely searching and piggybacking on foreign technologies and then leapfrogging by recombining knowledge from diverse domains resulting in new lower-cost, high-performance technical and organisational solutions for low-income and higher-income consumers. More generally, the *global search* for homegrown responses to a country’s challenges could be a guiding principle for the innovation agenda for a country. A significant improvement of investment and innovation climate may be needed to sustain the innovation agenda in a more effective manner. Aligning increases in R&D expenditures with substantive improvements of the investment climate should be a long-run rather than an immediate objective. The issue is articulation and *self-discovery* (Hausmann and Rodrik 2002) of competitive advantages.

Empirical evidence from North African countries (NACs) and emerging economies

Emerging clusters: the case of the agro-food of Agadir

The examples which follow show that in spite of the often-unconducive investment climate, there exist examples of initiatives that can be sustained and scaled up. Of all emerging clusters in the North African region, the case of Agadir agro-industrial cluster in Morocco is most successful in a highly competitive sector in the Mediterranean space. The city of Agadir ranked fourth in 2000 in terms of income after Casablanca, the economic capital of the country. The importance of agro-food is vital for Morocco, as it contributes for up to 33% to GDP. Performances in terms of agro-food and fisheries have been outstanding: in the last twenty years, 237 industrial companies, which represent about 6% of total domestic production and 20 180 jobs have been created.⁵

Agro-food is the dominant activity in the Willaya of Agadir⁶ and the province of Taroudante, due to a rich and prosperous agricultural sector.⁷ Industrial units are mostly small and constitute 43% of the number of enterprises. Agro-food constitutes 80% of industrial employment, two thirds of added value, 65% of local industrial production, 81% of investments of the region and 92% of exports. (Jaidi 2005). Employment in the agro-food sector has been growing at a rate of 20% over the last few years. In agriculture, it is surpassing all the other willayates⁸ in terms of acreage and production and is expected to remain a leader in Morocco in the next ten years. Production is the highest compared to the other regions of the country: it is expected to grow by a rate of 47% by the year 2020. Regarding the fishing industry, export performances have been remarkable: 70% of local production

is exported, nearly 50% of this to the European market. Knowing the high quality standards and strict regulation the European Union (EU) imposes, this constitutes a rare success story of its kind in the region. The fishing industry is also one of the most important employment creators, reaching 13 800 permanent jobs.⁹ Globally, the canned food sector represents 4 billion MAD¹⁰ of income (80% through exports), 25 000 direct jobs and 100 000 indirect employment.¹¹ Examining the cluster of Agadir, which can be considered as a successful trajectory of cumulative learning and innovation, several of the factors mentioned in the theoretical framework can be observed:

- *The changing rules and regulations* on the international market: these rules, which made it very stringent to export agro-food products, have led the Moroccan enterprises to undertake a real process of upgrading, modernisation of their equipment. It also led to the upgrading of their techniques of surveillance, standardisation of production processes and to the establishment of auto-control processes and the development of quality insurance programs. This modernisation dynamics was extended to fish processing units but also to the fishing fleet with generalisation of cool storage on board to preserve the quality of the captures. Regarding distribution channels, efforts were made to upgrade the halls and their certification, on top of the construction of wholesale markets in conformity with hygiene and salubrity of fishing products. This was completed by the surveillance of the cold chain storage throughout. Innovation through quality improvement and infrastructure seems to have produced the desired effect (Peuckert and Gonçalves 2011). This has led gradually to the idea of creating the Morocco Label (of quality) internationally recognised and accepted such as the ‘pilchard’ sardines for example. To benefit from the Label, Moroccan standard - NM 08.7.001, the produces must comply with rigorous criteria and very strict quality requirements in terms of production processes used, of packaging and of labeling. In 2005, forty products benefited from the Morocco label and 300 were in the waiting list.
- *Industrial organisation*: export groups formed themselves in ‘Boards’ (cooperatives) whose mission was to take care of questions related to logistics, insurance, and transport to foreign markets as well as the sharing of available quotas allowed by the EU. These Boards encouraged informal and social relations to be strengthened, which proved to be an important vehicle of confidence and spontaneous cooperation, showing the importance of ‘social capital’ in such a context. Two cooperative Boards were formed: the Fresh Fruit (FF) and Maroc Fresh Board (MFB). These two structures contributed to reinforce the network and create a greater closeness amongst the members. They also helped to strengthen bargaining power both internally and with foreign partners and coordinate the activities to set up dialog regarding management and production according to a set calendar. Quality control was made by an autonomous body in charge of coordination and control, the EACCE (*Etablissement Autonome pour la Coordination et le Contrôle des Exportations*). The criteria for awarding the Morocco Label of quality mentioned above were set through a dialog between the stakeholders managed by a committee made of various key players and external experts in agro-food. The coordination is devoted to the *Service de Normalisation Industrielle Marocaine* under the authority of the Ministry of Commerce and industry¹².
- *Intermediate associations*: Local authorities, chambers of commerce, and associations played a non-negligible role in supporting these programs and projects, in a spirit of public – private partnership. Professional associations are more and more aware of the need to mobilise their members for innovative projects and get them more sensitive to the need to take part to fairs and exhibitions and the modernising of their management tools and practices. However, they still suffer some problems: these relate to the difficulties met by the different associations and professionals in putting up joint innovation projects. This stresses the need to put the emphasis on changing both individual and collective mentalities and the restructuring of institutions, which favor these changes. Other difficulties stem from governance problems of networks stressing thus the need to favor all that facilitate coordination and promotes cooperation between private, public and other types of intermediate institutions in order to stimulate and give the necessary support to research and innovation of enterprises. The numerous limits of existing structures relate much less to human and material resources and more to organising and mobilising capacities.
- *Building capacity to undertake crisis-driven innovative actions*. Several stages can be identified: in 1995, the first action consisted of the initiative taken to coordinate a network to fight tomato disease through chemical treatments while preserving the fauna and flora. In 1999, it took the form of mobilising members to fight the tomato leaf curl virus known as ‘TYLCV’¹³ and elaborate a guide. Subsequent actions involved promoting innovative projects within enterprises to modernise their management. To promote the innovation ‘spirit’, the association of producers established contacts with other key counterparts such as : national and international research institutes, suppliers of new technologies, private schools and the regional office for agricultural products valorisation. These four key elements raise the issue of governance of the innovation process and its importance.
- *Capacity in promoting micro level reforms to facilitate the birth of the existing clusters*. This appears as one of the necessary condition for intermediate institutions to play a more dynamic and more efficient role

in the structuring, the management and the promotion of networking and the local production systems (LPS). The political choice of strengthening local and provincial authorities is implemented through the modification of the local election system and the creation of autonomous technical capacity of local counsels to draw their own development plans and a real financial autonomy. This is also done through the experimenting and generalising very rapidly of mechanisms that help reorient the tasks of external public services at the provincial level towards a more efficient technical and financial support to local and provincial authorities.

- Finally, *the capacity to aggregate micro-level reforms to become larger scale transformation* that proved the most difficult stage. A small example from India can help illustrate how a micro-level reform can diffuse (Saxenian and Sabel 2008). In the early 1990s, Indian products were generally suspect because they were considered of low quality. Quality problems in software were an important obstacle to collaboration between local suppliers and customers in world markets. Anticipating this problem, an Indian engineer from the Software Engineering Institute (SEI) at Carnegie-Mellon University traveled to Bangalore to speak to software firms about the Institute's recently introduced capability maturity model (CMM) for software engineering process improvement. The core of the CMM is a process of periodic peer review of development 'pieces' to ensure, by ongoing clarification of specifications, that the rate of error detection is higher than the rate of 'error injection.' Many firms immediately picked up the idea and sponsored conferences and consultations on the topic. By the end of the decade, virtually all large Indian software companies had adopted the CMM. Today India is widely recognised for its high-quality software development processes; it has more SEI-CMM Level V (the top level) certified companies than any other country in the world (Saxenian and Sabel, 2008). The development of a globally competitive software services and technology industry in Bangalore involved a multiplicity of similar micro-level reforms, both within the cluster and externally.

The changes illustrated by examples from India and Morocco occur incrementally, but there is no guarantee that they will continue. When they do, they have the potential to alter the institutional fabric of the economy. Micro-reforms may not continue and may not necessarily be scaled up, especially those that policy makers do not notice. Yet such entry points are ubiquitous, particularly in countries with a difficult institutional environment. The 'born global' start-ups in Morocco that we will discuss later are examples of such micro-reform. Born global firms create a search network that adapts global best practice to a local and often hostile environment and involve government along the way. Other micro-reforms

are government initiated with strong infrastructure support: these are science parks and incubators. NACs have many science parks and technology incubators, all providing a microenvironment for start-up firms. The number of such establishments suggests an intention to promote and scale up nascent micro-reforms. Such parks and incubators have very heterogeneous performance and quality, and they may remain enclaves in an otherwise unfriendly institutional environment.

Providing an environment for micro-reforms to flourish: the framework programmes

The development of China illustrates how framework programmes can lead to deep institutional reform. By 1980, China had developed a massive but largely incoherent R&D system. The reform programme initiated in 1985 consisted of two framework programmes to encourage micro-level reforms and experimentation. On the one hand, 'technology markets' were established to align R&D institutes with industry needs. On the other, operational subsidies from the government were gradually reduced. Various forms of autonomy were introduced in R&D institutes (in terms of personnel, research projects, and acceptance and use of contractual fees). The technology markets, which were central to the initial programmes, have largely failed. Both buyers and sellers had difficulty engaging in market transactions. Buyers were not able to absorb the transferred technology and sellers of technology could not earn enough to secure their R&D institutes because the market was too small. In response, reform policy began in 1987 to promote the merger of R&D institutes into existing enterprises or enterprise groups. This was again largely a failure. Huge gaps between the merging parties, owing to differences in work culture and administrative affiliations, were hard to overcome. Yet the policy space opened by budget constraints arising from the drastically reduced subsidies to R&D institutes (the second prong of the 1985 reform) facilitated a variety of spin-offs. First, individual scientists and engineers created spin-offs from their parent R&D institutes. These were later followed by organisational spin-offs. In 1988, the Torch Programme¹⁴ was launched to encourage spin-off enterprises, called NTEs (new technology enterprises), from existing R&D institutes and universities. NTEs became an institutional vehicle to bring together the most dynamic segments of the R&D establishment: R&D institutes, universities, S&T staff, and local governments. Local governments invested in New and High-Tech Industry Zones as support institutions for NTEs. Scientists and engineers, often with the support of their parent institutions, developed commercial applications of their inventions and expertise.

A strategy of simultaneously freeing up a policy space for new dynamic elements to emerge (from this perspective, the draconian reduction of subsidies was

the key, as it created a motivation to search and experiment) and explicit measures to encourage diverse pilots and organisational spin-offs worked well. It was almost ideally suited to leverage the tremendous heterogeneity of the Chinese economy and innovation system. Freeing up the policy space by gradually reducing subsidies to existing players motivated dynamic segments of the system to search for new solutions and approaches. Explicit measures to promote spin-offs created and institutionalised *search networks*, i.e. networks of diverse individuals and organisations looking for new solutions. In the case of NTEs, search networks brought together federal government officials (who monitored the results of the experiment), industry, R&D institutes and local governments (who contributed critical resources such as high-tech industry zones but also reaped the rewards of high growth). The result was ‘double transformation’ (Kuznetsov 2008) high growth due to *self-discovery* (Hausmann and Rodrik 2002) and diffusion to new segments of the economy, and reform of the established institutional structures. A double transformation generates a diversity of gradual step-by-step reforms that can lead to extraordinary changes (Kuznetsov 2008).

China and India are inspiring examples, but are these big heterogeneous economies relevant for NACs? Two points in response. First, the logic of piloting and experimentation exemplified by China and (to a certain extent India) works in many difficult but heterogeneous institutional environments. Second, a governance regime triggering and scaling up piloting and experimentation is more widespread than one would think. The central authority to plant experiments and scale them up is very different in China, where the Communist Party is still central for such experimentation, and Morocco, for example, where the King and his advisors play a key role. Yet the contrast between these two countries underlines key similarities in the governance of policy experiments. In both countries, though to a different degree and through different means, policy makers appear to organise experimentation and learning by assembling and monitoring a portfolio of developmental projects and programmes, an array of initiatives to promote specific aspects of innovation. Such a portfolio-based approach (Kuznetsov 2008) eliminates the need to identify ‘silver bullets’, the perfect combination of policies to stimulate innovation. It enables policy-makers to engage in a process of natural experimentation, introducing and observing variation in the policy context, economic outcomes and the connection between them. More specifically, the following set of tasks undertaken by policy-makers emerges: 1) they assemble a portfolio, identifying an array of promising projects and programmes. Thus, in the case of Morocco, a portfolio of ‘incubation space’ such as techno-poles has emerged. 2) They implement those projects, arranging financing for them and scaling the projects up once they show promise. Here the CDG

(Caisse de Dépôt et de Gestion) played a key role in leveraging funding in Morocco. 3) They monitor the projects, revising or eliminating poorly performing initiatives, and finally 4) they learn from success and failures: so for instance, information on the performance of one programme can inform the design of the other similar programme. Thus, the Rabat technopolis drew on lessons learnt by the Casablanca technopark, including through the transfer of management from Casablanca to Rabat.¹⁵

Emerging role models of innovation in NACs

The lack of a stable and enforced policy environment limits competitiveness in the private sector and reduces incentives to invest in innovation. Previous contributions have characterised developing countries as low R&D performers and laggards on other aspects of great relevance for the creation and exploitation of knowledge (Fagerberg et al., 1999; Fagerberg and Godinho, 2004). Data on R&D spending as a percentage of GDP, and on the overall level of innovation against GDP per capita both confirms that NACs innovate very little given their level of development. The knowledge economy score on innovation (Table 3), which proxies the degree of production and utilisation of knowledge, suggest the existence of three categories of NACs.¹⁶ High performers (Algeria and Tunisia), medium performers (Egypt and Morocco) and low performers (Mauritania, Libya and Sudan). However, even in those high performers, most R&D activities are publically financed.

Role models

Examples of role models throughout the emerging economies are numerous: many see the Indian ICT sector (8% of GDP and 1% of employment) as a new model of development that is based on the export of information-enabled services rather than labour-intensive manufacturing like the Chinese model. The success of the ICT sector has put India on the global map as a country with high-level skills, contributing to a rapid increase in direct foreign investments. Such an emerging model is of high relevance for NACs’ employment creation. The creation of high-wage employment can be an incremental process driven by examples emulated by others. The key issue is how to emulate and diffuse these role models (Kuznetsove 2008). The potential of innovation clusters is illustrated by two Moroccan firms: a so-called emerging *developing world* multinational (HPS) and a *born-global* firm (NEMOTEK). Both firms are unusually dynamic exceptions, so-called gazelles (rapidly growing medium-sized firms), which are becoming important role models for educated technical professionals in Morocco.

The first one, *High-tech Payment Systems (HPS)* was founded in 1995 by a group of Moroccan consultants and experts in Monetics (electronic banking). More than 90% of its products are exported to 60 different countries in Europe (26%), in the Middle East (36%) and the rest in

Asia, in America and in Africa to well over 100 clients, with revenues over 30 million US dollars in 2010. The domestic market represents less than 10% of the total. It has now branches in Paris and Dubai. HPS has become now a global company with three regional offices and two joint ventures in Bahrain (GPS) and in Mauritius (ICPS). The Power CARD software currently operates 100 electronic financial transactions sites and manages a total of 300 financial institutions in these countries. Its human capital is the vital key of its success: its number of employees grew rapidly from 179 in 2009 to 350 in 2011, most of them under the age of 35. They are recruited mostly from the *Ecoles d'Ingénieurs* in Morocco and certain other universities. Unlike a generally held view, these university graduates have satisfactory performances once they receive specific training related to the field of Monetics, which is nowhere taught in the country. Finally, returning Moroccans from the diaspora proved to be central to its successful innovative strategy. The company has collaborators from 60 different countries. The R&D budget reached 10% of sales, which compares favourably with its competitors, and R&D personnel represents 35% of total number of employees, all of them Moroccans.

The second one, *NEMOTEK*, is a fledgling *born-global company*, established in 2008 by CDG, (Caisse de Dépôt et de Gestion), via an outlay of 50 million US dollars of investment, and is located at the new Technopolis Park near Rabat. Its current capital reaches 120 million US dollars and it employs 350. Nemotek has a worldwide customer portfolio and can be considered as one of the leading manufacturers of wafer-level cameras and a world leader in micro-camera manufacturing based on ‘*wafer level*’ technologies (it is the first company to buy MVP license from Tessera¹⁷ and the first to industrialise it in the world). Significantly, it benefits from relatively high IP protection compared to the Far East where the risk is relatively high. R&D is conducted in partnership with the MASCIR (Moroccan Association for Science, Innovation and Research) a public foundation specialising in nano materials, microelectronics and biotechnology. Nemotek relies significantly on the Moroccan diaspora: it has been able to attract back numerous highly qualified members of this diaspora, turning brain drain into brain gain. It draws on other foreign competencies by employing 50 engineers from all over the world.

These examples can become role models of collaboration (Kuznetsov 2008) with the significant technical and managerial talent of NAC professionals in the Western world and in local R&D labs and universities. The paradox, however, is that the examples we pinpointed failed to become role models. ‘Odd exceptions’ would be a more accurate characterisation. With the exception of a few professionals, universities, chambers of commerce, the government and the media do not realise the significance and potential of these

dynamic exceptions and foster collaborative links with them and the co-evolutionary prospect did not take place. Obviously, we merely scratched the surface in uncovering and documenting the exceptions: there are many more available and further investigations are needed.

Scaling up and diffusing emerging role models: The role of bridge institutions

The examples provided earlier show that NACs do exhibit exceptional segments of high innovation. Bridge institutions appear to have played a major role. They include cyber parks, international universities and skilled Diasporas.

Cyber parks: Cyber-parks (technology parks focused on IT companies) constitute the most popular type of entry point in the world of bridge institutions as a result of the ICT revolution. There are about twenty technoparks in NACs, some being at the early stages of emergence of their creation while others are more mature (Djefflat 2011). ICT is the most frequent focus of these zones. Five parks are specialising in other areas than ICT, including biotechnology, engineering and agro-food. The country with the highest number is Tunisia (8), followed by Morocco (6), and Algeria (4) (Djefflat, 2011). The oldest cyber park in NACs is the publicly owned El Gazala in Tunisia, while the oldest park with dominant private ownership is the Casa Technopark. This park, which will be examined in details below, is the result of genuine public-private cooperation: its bridge function is multidimensional involving universities, telecom companies, engineering schools and IT start-ups. Successful start-ups emerged such as Lead Tech Design (LTD), combining both innovative activities and export performances. Non-cyber specialised technopoles are a more recent phenomenon. Examples of such parks are the agro-pole of Bizerte in Tunisia, the Berytech technology park, initiated by a private university of St Joseph in Lebanon and others.¹⁸

Universities: Universities can become active agents with impact on local economic development and capacity to generate R&D for domestic needs. The International University of Rabat (IUR) is one of the first private universities in the country. Started in 2006 in the framework of a new law, the IUR is an internationally oriented, R&D-driven university housed in the Technopolis of Rabat, an industrial area that aspires to host high-tech industries. The university began providing in 2012 its first undergraduate and graduate courses in English and French, at high (\$10 000) but internationally competitive fees. The targets are mostly first-class students from the African continent, who would normally study in Europe. UIR is under contract with the Government of Morocco, a public-private partnership that allows it to use academic personnel from the public sector and acquire recognition on the part of the Ministry of Higher Education of its degrees and diplomas. It counts leading local financial institutions and companies among its

board and financiers. However, the crucial element of its success is the institution's autonomous status. It allows it to bypass the civil service code and to design its own terms for recruiting and managing talent, most of them diaspora members: 40% of positions are reserved for faculty members working in partner universities, which allows students to spend semesters in Europe or in the United States. The university is able to pay internationally competitive salaries for a few magnet department heads, (roughly double of that given in public universities), who in turn are able to attract talented younger researchers. Staff are expected to connect with clients in the local private sector, and are rewarded on results (such as patents, research grants, and contracts with the private sector). The R&D strategy is tailored to generating 'inexpensive innovations' for the domestic and African economies. Sectors include infrastructure development for transportation, tourism, affordable housing, and renewable energy using local sources. It also includes local niches of advanced technology such as railway, naval, automobile and aerospace engineering. Recent successes include an R&D contract with a local micro-camera export company, the creation of a start-up producing patented solar and wind-fueled devices, and technical assistance to the government-owned foreign currency exchange office.

Skilled Diaspora networks. A central question is how highly skilled members of the diaspora (Kuznetsov 2008) can be more systematically leveraged in NACs to improve higher education and enterprise upgrading. The diaspora is an important phenomenon in Africa. According to UNDESA (United Nations Department of Economic and Social Affairs), there are about 22 million African migrants, including those within the continent. Forty-seven per cent of them live outside the continent in Europe (29%), in Asia (13%), in North America (5%), and Oceania (1.1%). We have seen that both in Nemotek and HPS, returning Moroccans from the diaspora proved to be central to a successful innovative strategy. Nemotek relies significantly on the Moroccan diaspora: it has been able to attract back numerous highly qualified members of this diaspora, turning brain drain into brain gain. The IUR seen earlier has been relying extensively on diaspora networks. The CCME (Conseil de la Communauté Marocaine à l'Etranger) proved to be highly useful in this respect.

Innovation-based growth as endogenous process: from entry points to structural reforms

As mentioned in the first section, to make it feasible for innovation-based growth to become an endogenous process, innovation agents need to become part of the political economy of the country and this requires structural reforms. This ultimate stage comes after a critical mass of innovation agents can consolidate the gains obtained once a portfolio of bridge institutions is built after entry points (Kuznetsov 2008) have been

identified and supported by Government through various mechanisms and funding. This later constitutes the immediate agenda. In the case of Morocco, a short-term agenda could comprise the following steps: first, taking stock and performing an independent evaluation of the existing R&D efforts made by sectorial ministries and agencies to arrive at a shared understanding of the level and composition of R&D expenditures in the country. Second, taking stock and developing a portfolio of promising cases of innovation in the country as innovation initially develops from tinkering and problem solving in everyday practice within the real sector. Such cases are sometimes unknown to the government and to the general public. A portfolio of dynamic export-oriented and innovation-based segments in the real sector in Morocco exists and could be fishery, organic produce and others; this is the first step. A significant improvement of Morocco's broad investment and innovation climate will be needed to sustain the innovation agenda in an effective manner. Aligning increases in R&D expenditures with substantive improvements of the investment climate should be a long-run rather than an immediate objective. The issue is articulation and self-discovery of competitive advantages (Kuznetsov 2008).

Concluding remarks

Development economics conventionally focuses on endowments: economies with an appropriate endowment (good institutions, good investment climate, cultural dispositions, property and trade laws, as well as institutions for assuring the rule of law) grow. Those lacking such endowments do not. But the surprising frequency of spontaneous growth episodes in 'poorly' endowed economies; the sharp disparities in regional developments within national economies subject to the same general rules; and the periodic successes of economies that change their institutional *endowments* by growing (China) rather than growing by first fixing endowments, all strongly suggest fundamental flaws in this all-or-nothing endowment view. This paper adopted an alternative perspective of gradual step-by-step transformation (Kuznetsov 2008) in which innovation and good investment climate emerge simultaneously as two sides of the same collaborative process, more in a co-evolutionary perspective. To summarise, the proposed pragmatic innovation agenda for NACs economies implies focusing on bottom-up entry points (the immediate policy agenda – building the foundation), and then scaling them up to ensure coordination and concerted action (the medium-term policy agenda – gaining credibility), and on that basis, moving onto or sustaining major changes (the longer-run policy agenda). The art and craft of policy-making lies in the sequencing of the various horizons of a policy agenda to achieve a virtuous circle of innovation and growth. Concrete, manageable bottom-up approaches serve as demonstration projects to advance the more

ambitious policy agenda. Bridge institutions of innovation and research universities illustrated the proposed framework. There are many promising bridge institutions of innovation in NACs and some emerging good universities. The paper proposed policy instruments to help transform these dynamic exceptions from the general rule into role models and eventually build innovation clusters around those role models. Further research is needed to highlight the bottlenecks and issues in the path to innovation friendly structural reforms.

Notes

- 1 INGOMED stands for 'Intermediate institutions for the growth of "governance" processes in the Mediterranean partner countries' ISSM-CNR/Maghtech, January 2003–June 2004, ISSM-CNR.
- 2 Cited by Ian Clarke and Matias Ramirez (2010).
- 3 It is said that the English author Horace Walpole (1717–1797) coined the term 'serendipity' in a letter to a friend written in 1754. He thus used the term to describe unexpected but valuable discoveries. <http://www.nec.com/en/global/rd/innovative/cnt/01.html> [Accessed 14 February 2014].
- 4 Search networks are defined as a network to identify successive constraints and then people or institutions that can help mitigate these constraints.
- 5 INGOMED.
- 6 Canned and frozen food, flour, oil and so on.
- 7 In terms of agriculture, the share of the region in total exports reached 55% of citrus, 95% of tomatoes and 70% of fruits and vegetables. In terms of value, exports reached 3.2 billion DH (8% of the value of total exports); Employment rates reached more than 70%.
- 8 Name given to the regional territorial unit such as prefectures or counties.
- 9 http://www.unhabitat.org/downloads/docs/2871_97849_profilagadir.pdf
- 10 MAD means Dirham, the Moroccan currency. 1 US dollar = 7.95 MAD.
- 11 Maghpress 27 July 2008 <http://www.maghpress.com/fr/aujourd'hui/63065>
- 12 <http://www.leconomiste.com/article/quatre-entreprises-candidates-au-label-maroc>
- 13 Tomato yellow leaf curl virus (TYLCV) has been discovered for the first time in the Netherlands. The virus has been incredibly harmful in the European Community and specifically regulated on tomato plants intended for planting. Currently, there are a very low number of infected plants. http://humansandviruses.blogspot.fr/2007_11_01_archive.html [Accessed 21 June 2012]
- 14 Launched in August 1988, Torch Program is China's most important programme of high-tech industries. As a guiding programme of China, it includes organising and carrying out projects of developing high-tech products with high technological standards and good economic benefits in domestic and foreign markets; establishing some high-tech industrial development zones around China; exploring management systems and operation mechanisms suitable for hi-tech industrial development.
- 15 The General Director of the Casa Technoparc, considered also the builder of the technoparc, was appointed as the project manager and manager of the new Rabat Technopolis Park.
- 16 See Knowledge Assessment Methodology (KAM), 2011 available at www.worldbank.org/kam on how innovation

score is built [Accessed 20 February 2014].

- 17 Tesserà is a leading provider of miniaturisation technologies for the electronics industry. Tesserà enables new levels of miniaturisation and performance by applying its unique expertise in the electrical, thermal and mechanical properties of materials and interconnect. Tesserà's technologies are widely adopted in high-growth markets, including consumer, computing, communications, medical and defense electronics. More than 15 billion semi-conducteurs worldwide incorporate Tesserà's technology
- 18 http://www.berytech.org/component/option,com_wrapper/Itemid,392/lang,en/ accessed 28 June 2011

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