

Challenges and Constraints for Government Agencies Supporting Firm Level Innovation: Some Reflections from South Africa



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1 Introduction

Support for technology-based start-ups, often termed new technology-based firms, (NTBs), initially seen solely as a concern for developed countries, is currently spreading very rapidly in developing countries. Even least developed countries, including a significant number of countries in Africa, are currently active in establishing new supports and institutions. NGOs, the private sector, donors and philanthropies and more recently governments have all entered this field giving rise to panoply of support measures and institutions. Institutions that directly support the development of firm level capacities to innovate by providing funding are now widely accepted as integral to the National System of Innovation (NSI).

The first part of this chapter explores the importance of technology-based firms within the NSI and the very significant contribution that these firms potentially make to the enhancing technological and innovative capacities and to the achievement of developmental goals more broadly. However, in seeking to support such firms, governments need to exercise considerable caution. This is the focus of the second part of this chapter.

There are very significant challenges in identifying and selecting the firms that require support in order to expand and develop. Moreover, there are issues as to the appropriate form of support. While NTBs rely on innovation and accordingly the expansion of their technological competencies to develop and grow, it does not necessarily follow that government support for such firms is necessarily best targeted at enhancing the capacities of these firms to innovate. Finally, there is the question of governmental capacities: does government have the capacities to select the firms that require support, to determine the form of support that is appropriate and to

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deliver that support effectively? These are all issues that need to be considered prior to establishing the appropriate institutional mechanism to deliver support to NTBs.

The third part of the chapter, and the chapter's main focus, is an examination of one possible institutional support for NTBs; namely support provided directly by a governmental agency. The chapter draws largely from the "lived experience" of one such institution—namely the Technology Innovation Agency (TIA) in South Africa. TIA is a government agency and TIA's role is to take forward the knowledge that is the outcome of research into application—particularly commercial application. To this end, TIA is engaged in funding and supporting new knowledge-based innovative firms. It is this engagement that is the focus of this part of the paper.

It needs to be stressed; this chapter is not an evaluation of TIA. Rather, this chapter draws on the experiences of TIA in order to highlight some of the real-world complexities and constraints that are likely to be faced by other developing country governments that attempt to develop technology-based firms through providing direct funding and support for innovation to such firms through the mechanism of a government agency.

2 NTBs, Economic Development and the National System of Innovation (NSI)

NTBs are young firms, typically less than ten years old, which have the potential for rapid rates of expansion. NTBs are innovative—they employ new production technologies and/or introduce new products to the market. These two characteristics are interdependent: the firm's potential for expansion grows directly from its capacity for innovation.

Start-ups have the potential to bring many benefits:

On average, new firm entrants have higher growth rates and they create far more jobs than do well-established firms. However, the higher growth in output and employment results from the rapid growth of a small minority of firms. The defining characteristic of these firms is that they have significant technological and innovative competencies (Ayyagari et al. 2011). As a result, employment opportunities created by these firms tend to be both skill intensive and high productivity. High productivity, in turn, has the potential for significantly higher earnings.

These firms disproportionately engage the young. Both the entrepreneurs and the employees tend to be both skilled and young. Start-ups facilitate early entry of young people into the economy. This has significant concomitant social benefits. These firms, by definition, and by contrast with the vast majority of new firms which are routine in product and in process, introduce something new. For countries that are seeking to diversify away from traditional activities—for developing countries these are usually primary based activities—the introduction of new knowledge-intensive products and services are particularly critical. Indeed, the need to diversify the economy away from a dependency on primary products has been a very important

factor in the increasing attention that developing countries are currently according policy to enhance NTBs. Saudi Arabia, seeking to reduce its dependency on oil, and South Africa, seeking to reduce its dependency on minerals, are just two current examples.

Firms that enter new markets, more particularly if the products entailed are new, but even if the products are well established, will require some level of innovation and the development of new competencies in order to meet the demands of the new market. First time movers in exporting are pioneers. Other domestic firms can learn from their experiences with exporting so significantly reducing the costs and enhancing the returns for other domestic firms to follow suit (Hausmann and Rodrik 2003). Exports have an important impact on growth. The composition of exports is also important. Countries with more diversified and more knowledge based exports enjoy faster rates of economic growth (Hausmann et al. 2007). The development of NTBs is critical to enhancing exports in general, but more particularly to enhancing the diversification of exports towards more high value knowledge products and services, thus enhancing development prospects.

The innovative content of many start-ups consists of bringing new technology and solutions to the specific problems and challenges that the country confronts. Start-ups are generally characterised by experimentation with new solutions to address the challenges that a country faces. These firms demonstrate routes to growth through innovation and enhancing technological competencies. They enhance a climate of enquiry and innovation more broadly and as such are a critical component of the ecology of the NSI. While NTBs do tend to agglomerate in large already well-developed urban areas, they can be the spur to growth in neglected regions or areas of the country—Medellin in Colombia, for example; or the reinvigoration of depressed areas—Detroit in the United States is an obvious example.

Finally, NTBs provide an important route to empower those who have hitherto been denied opportunities. Thus, government support programmes and policies can target previously disadvantaged groups. In South Africa, for example, government support for start-ups is graduated with greater levels of support being made available to black and female owned enterprises.

In all of the different dimensions outlined above, NTBs make a significant contribution to economic and social growth and development (OECD 2016; Wu and Atkinson 2017). The social benefits of new technology-based firms significantly exceed the private returns. It is this gap between social and private benefit that provides the overall justification for government to engage directly in providing resources to support the development of technology based and innovative start-ups.

The social benefits associated with the growth of NTBs are not characteristic of new small firms in general. The vast majority of new small firms are designed and intended to remain small. Indeed, many of these firms have no intention of significantly expanding output or employment. These firms do not introduce new products. They utilise standard technologies and well-worn business practices, entail no new economic activities and give rise to no new approaches to economic and social problems. The number and success of such firms is, in large part, a reflection of general economic conditions—expanding and growing with the overall economy.

Therefore, while government will have policies to encourage entrepreneurship and small firm development in general, there are strong grounds for proposing that government policies and supports should be firmly on NTBs. These firms require different modalities of support from small firms and new entrants in general. Since enhancing innovative and technological competencies are critical for these firms, state support can focus on enhancing these capacities.

3 Supporting NTBs: A Cautionary Note

Identifying and selecting such firms is very difficult. Moreover, targeting government support at enhancing their innovative and technological competencies may not be the optimal route to supporting these firms at this particular stage of their development. Finally, there is the issue as to how firms are to be identified and selected and supported i.e. what is the appropriate institutional form for such selection and support?

3.1 *Identifying and Selecting Firms for Support*¹

Heavily influenced by the example of California and Silicon Valley, assumptions are often made as to the characteristics of the firms that have significant prospects for strong and sustained growth. Such firms are assumed to be very recently established; small; in high technology fields; capable of growing continuously.

However, each of these assumptions turns out to be (largely) incorrect:

- High-growth firms do tend to be younger than the average firm, but most will have been in business for at least a couple of years before any growth spurt occurs.
- Many high growth firms are larger than the average firm at the beginning of a high-growth episode and are larger than the average firm after three years of growth.
- While high technology is the location for many high growth firms, such firms are located also in other sectors. Moreover, the sectoral locations of high growth firms differ as between countries.
- Rather than growing continuously, many firms are likely to exit the market soon after the growth spurt and very few firms are likely to repeat a growth spurt.²

¹This section draws on a recent World Bank publication, Grover et al. (2019), Chap. “[The Readiness of Innovation Systems for the Fourth Industrial Revolution \(4IR\) in Sub-Saharan Africa](#)”.

This study utilises longitudinal data sets of company performance from Brazil, Côte d’Ivoire, Ethiopia, Hungary, India, Indonesia, Mexico, South Africa, Thailand, Tunisia, and Turkey.

²Half the firms that experienced a high-growth event in the previous three years are likely to exit the market altogether in the following 3–6 years; less than 15% are likely to repeat a high-growth episode, Grover et al. (2019).

The heterogeneity of firms with high potential for growth regarding age, size, sectoral location and continuity of growth, makes it very difficult to identify the appropriate targets. The right firm must be selected and it has to be selected at the right time—as with music the right note has to be struck at the right time to produce the desired sound. Moreover, the firms selected should be those which have the potential to expand because they have the fundamentals in place to support high growth as opposed to those firms who have the potential to expand due to some other factor such as an exogenous shift in demand. What criteria are available to those making the selection so as to determine the firms' prospects for growth derive from the fundamentals?

None of the criteria available such as past record, business plans etc. has much predictive capacity. Indeed, it may well be that the better endowed firms are more likely to score higher in any of these assessment criteria, resulting in public funds being made available to them and so enhancing inequities (Grover et al. 2019: 118).

***3.2 Should Government Support for NTBs Be Targeted at Enhancing Their Technological and Innovation Capacities?*³**

Governmental measures designed to enhance the capacities of NTBs to innovate were initiated in the developed countries. In the developed countries governmental support for these firms is now universal and invariably directed at enhancing their capacities to innovate. Such policies and institutions are seen as an integral component of the NSI and contributing to development of knowledge-based economy.

However, in order to realise a return on its investments in innovation, firms require a series of complementary inputs. In this regard, the context, the broader environment, in which NTBs are embedded, differs markedly as between developing and developed countries. To take just a few examples:

- (a) Innovation may require new skills—but firms may face very considerable skill shortages.
- (b) Innovation may require reorganisation of the company's workforce—but firms may confront political or labour market impediments.
- (c) Innovation may require new investments in selling and supporting new products—but firms may confront barriers in raising the capital for risky ventures where returns are uncertain.
- (d) Innovation may require the importation of new machinery—but access to new capital equipment may be inhibited by trade or tariff barriers.

The above is merely an illustrative list of some of the factors that will influence the returns that NTBs are likely to make from their investments in innovation. These and other factors are complementary to innovation. Where these complementary

³This section of the paper draws on Cirera and Maloney (2017).

factors are absent, or constrained, the firm's returns to innovation will accordingly be similarly absent or constrained.

While such complementary factors may be present in the developed countries—abundance of the requisite skills, easy and low tariff access to imports, export market access and well-functioning capital markets—the same does not hold for the developing countries. As a general observation, the less developed the country, the more firms in that country are likely to lack access to the complementary factors required to ensure positive returns to innovation.

Where access to complementary factors is absent or limited, government support for innovation in NTBs will elicit limited additional firm level investments in innovation. Rather than providing support to firms to enhance their capacities to innovate, government should focus on enhancing these firms' access to the complementary factors that currently most constrain the returns that they obtain from investing in innovation.

Further factors that limit the ability of the firm to innovate, and therefore reduce the returns to innovation, are internal to the firm. A firm's capacity to innovate is not a given. A firm may begin by assimilating technologies that are readily available. Firms gradually develop the capacity to make minor adaptations. This may require hiring of technicians or engineers. As the firm engages in further incremental innovation, it requires more skills, some internal organisation and enhanced efficiencies. As the firm moves closer to the technological frontier, the firm's skill requirements, plant and equipment, work organisation and management practices all change. Formal R&D departments and deep collaborations with technology providers are likely to be required as a firm reaches closer to the technology frontier. Firms develop their internal capacities to innovate only over time and only with considerable internal effort and commitment of resources. Where these in-firm capabilities for innovation are lacking, government supply of finance or other supports for firm level innovation, will not find partners who have the requisite competencies to innovate and to yield sufficiently high returns from their investments in innovation.

A recent World Bank report drawing on the World Management Surveys has shown that

...developing country firms are... lagging in a wide range of capabilities that are critical to the Schumpeterian catch-up process: few managers in developing countries can take a long-term view, have sophisticated project evaluation skills, or have a human resource policy that would staff research and development (R&D) projects. (Cirera and Maloney 2017: 65)

A critical first step in determining the support that governments provide to NTBs is to assess (a) what are the factors that are external to the firm and (b) what are the factors that are internal to the management of the firm that are most constraining the firms from innovating. Identification of the binding external and internal constraints will determine what forms of state support are likely to be most effective. As countries develop, we would expect that the external factors constraining innovation would diminish and change and similarly, as firms develop the factors internal to the firm that are constraining innovation would also diminish and change.

However, identifying these constraining factors, both the factors in the external environment within which firms operate and the factors that are internal to the firm, is a non-trivial task. Obtaining information from firms is a complex and time consuming business. Business associations may represent some firms, usually the well-established, and not others. Firms have bounded vision and they often do not themselves understand the constraints that they face either in the external environment or internal to the firm (Rodrik 2004). Of most importance is that these firms are by definition “entering into new territory”—new markets, new products, new production processes and new organisational forms. Of concern are not merely the constraints that firms face currently but the constraints that they are likely to face in the future. Of their current constraints and even more of the future constraints that firms will face, the firms themselves have only a very limited knowledge.

Despite these difficulties in obtaining the necessary information, before establishing policies and institutions focused on enhancing the capacities of firms to innovate, it is critical for government, to determine whether this is indeed what the firms require most. There can be no automatic assumption, particularly in developing countries where, to reiterate, firms are likely to face a very large number of constraints that are external to as well as constraints that are internal to the firm, that support for innovation is what would be most effective to enhancing the growth of these firms. Indeed, it is only a very small number of firms in the developing context which will benefit from support targeted at enhancing their capacities for innovation.

Nevertheless, there are likely to be some firms that have the internal capacity to undertake complex innovation and to obtain the necessary complementary inputs to innovation. The issue to which we now turn is the institutional form that support for such firms takes in developing countries.

3.3 Government Agencies to Implement Innovation Support for NTBs

The difficulties of identifying and selecting firms for support combined with the widespread absence of complementary inputs, both external and internal to the firm, make the challenge for government agencies tasked with implementing innovation policies very challenging. These challenges are particularly daunting in a developing country setting. Moreover, in the developing country context, governmental capacities will be more limited.

Developed countries have developed a number of institutional forms or agencies to support NTBs. There has been considerable variation in the performance of these different agencies. Best practice institutional models include Singapore, Israel and Finland. But, government agencies in other developed countries have had much less

success. In brief, "...there is no single "successful" model for an innovation agency (Glennie and Bound 2016: 6)." Success is heavily context dependent.⁴

The establishment of governmental support for start-ups in the developing countries is of very recent vintage. In Latin America, for example, several countries have introduced supports for start-ups only within the last decade. Support is now widespread, including large and small countries, including Brazil, Argentina, Mexico, Colombia, Peru and Paraguay (OECD 2013, 2016).

Support for start-ups in Africa has lagged momentarily but is increasing rapidly.⁵ Few African governments are currently actively engaged in directly funding start-ups. In most African countries, funding and support for start-ups is provided by a variety of non-governmental actors. In Kenya, Nigeria and Rwanda governments are playing a more direct role and have specifically 'targeted' the support of start-ups in the ICT sector (Bright 2016; Elebeke 2017; Mulligan 2015). Governments in Africa and elsewhere in the developing world are likely to significantly expand their support for start-ups in the near future.

What institutional form should support for NTBs take in a developing country context? Since they have only been recently established, and since the impact of supports may only be evident over a long term, systematic reviews of the performance of different institutional forms of support are lacking.

In South Africa, government direct support for technology-based start-ups has increased very significantly in the last decade. The institutional form that this support has taken is that of a government agency. What can be learnt from the South African experience?

4 The South African Technology Innovation Agency (TIA)

TIA was established by the Department of Science and Technology (DST) in terms of the TIA Act of 2008. South Africa has a well-developed NSI with multiple publicly funded research institutions and universities a dedicated ministry in government. It has a strong and well-established business sector, but with limited entry of new firms. While South Africa produces considerable research output, technology and commercial outputs, notably in respect of new technology based start-ups, has been

⁴There has been a tendency for policy makers to identify best-practice institutions based in countries such as Israel, Singapore and Finland and then attempt to emulate them. While the experiences of these countries are valuable, their contexts are radically different: in the broader environment within which the firms operate, in the capacities, that firms have to innovate and, most importantly, in governmental capacities.

⁵Supports programmes are increasingly available and have spread to most African countries (Disrupt Africa 2017). These include even a number of the poorer and smaller countries. 159 African tech start-ups are said to have raised funding in excess of US\$195 million in 2017. While this is still a small number, the rate of growth is impressive—a 51% increase on the previous year (Disrupt Africa 2017). The top three countries were South Africa, Nigeria and Kenya. Ghana and Egypt were also significant. In terms of sectors, finance received the most funding and e-commerce had the most significant growth (Disrupt Africa 2017).

far more limited. The South African NSI was accordingly regarded as characterised by a deep and widening “innovation chasm” between research and development and commercialisation. There were a number of disparate entities engaged in bridging this chasm and the view was that a single agency could perform this function more effectively. Seven entities that had previously engaged in supporting innovation were accordingly merged into a single agency—TIA.

To this end, TIA is not engaged in supporting research but rather in facilitating and encouraging the translation of research into technological and particularly commercial outputs. TIA defines its mission as facilitating the translation of South Africa’s knowledge resource into sustainable socio-economic opportunities. TIA’s main goal is to help create new knowledge-based economic activities and industries so as to grow and diversify the economy, TIA’s focus is thus on technology and commercial development. To this end, TIA is engaged with firms from proof of concept to the point where commercial partners and investors for the further development of the technology can be accessed. To achieve this, TIA established the following funds: the Seed Fund, the Technology Development Fund and the Commercialisation Support Fund. These funds provide financial support to applicants on a competitive basis. In addition to finance, TIA’s Innovation Skills Development (ISD) unit provides managerial, business and mentoring support in the areas of business and entrepreneur development.

TIA also supports and manages a number of technology stations and platforms whereby SMMEs get access to technical, engineering and testing services. But, the focus of the following discussion is the direct financial support that TIA provides to enhance the innovative activities of technology-based firms.

4.1 A First Question—Two Different Approaches to Funding

There are broadly two approaches that government agencies can adopt in order to support NTBs. The first approach is for government to initiate a fund which then injects monies directly into one or more recognised private Venture Capital (VC) funds. The rationale for this approach is that private VC funds are not sufficiently profitable, and the available investments are too risky to attract private investors. Direct government financial support for private VCs is usually quite limited and is structured so as to somewhat reduce the risk without taking away the upside gain of a successful investment. Management and decision making is generally left entirely in the hands of the VC management with government essentially playing the role of a passive investor.

The distinct advantage of private VC as a funder and manager is that incentives are well aligned. There is significant downside risk and upside gain for private funders who have every incentive to allocate their funds effectively and to add additional resources that they command—management, networking, market information—that can play a major role in determining that the investments ultimately succeed.

If structured correctly, this fund-of-funds approach, retains the considerable downside risk and particularly the upside gain to private VCs that are the recipients of state funding. As a result, much of the incentive alignment is in place. In societies, where there are other far safer traditional avenues for investment, it will be difficult for private VCs, in the absence of some form of direct funding support from government, to operate. On the other hand, if the deal flow is low—there are few bankable projects—providing subsidies to private VCs will be likely to lead to otherwise unworthy projects receiving funding.

The second approach is for government to own and manage its own fund which then directly funds NTBs. There are two major concerns with this approach. Firstly, incentives are misaligned. Those who dispense public funds are only indirectly rewarded for good performance, or (less often), punished for poor performance. As a result, projects supported by government owned funds are likely to be less well screened and less well supported in terms of other factors such as management, networking and market knowledge than is the case with private VC.⁶ The second concern is that where private and public funds coexist, the latter might crowd out the former, leading to less rather than more funding support for start-ups.

On the other hand, direct government funding allows for the pursuit of social objectives, such as reducing inequality. It also allows for funding allocation to be in alignment with other aspects of government policy, notably industrial policies that favour particular sectors, activities or localities. Privately funded and managed VCs are not able to effectively take account of such government objectives.

The South African context is one of pronounced inequality, particularly persistent racial inequality. South Africa also has an active industrial policy which favours particular sectors/regions/activities. The decision to allocate funding directly reflected government concerns to overcome racial inequalities and to steer the economy in certain directions. As a result, TIA has a wide range of objectives—well beyond the objectives that could be accommodated by a partnership with a privately funded and managed VC.

Of particular salience are racial inequalities. One of the key performance indicators (KPs) by which TIA is assessed is the number of PDIs (previously disadvantaged individuals) receiving support and the percentage share of successful PDI applicants. Severe skills shortages, few black graduates and strong incentives in terms of government policies to promote black economic empowerment combine to provide many employment opportunities for skilled black graduates in already well-established firms. As a result, there are very few black owned start-ups. Most start-ups are white owned, resulting in a pronounced racial division at the level of entrepreneurship. However, giving preference to black owned start-ups in a situation where there are

⁶There is some evidence that government-owned funds are less effective in providing capital to start-up than are government-supported venture capital funds—the funds-of-funds approach. “There are significant differences between government ownership and government support of venture capital firms, broadly suggesting that support outperforms ownership” (Brander et al. 2010: 13). Interestingly, a modest amount of government support for a private fund may result in such a fund performing better than a private VC. Significant support has the opposite effect (Brander et al. 2010: 12).

very few, does not address the problem. Rather this is likely to lead to the funding of firms that have fewer prospects of success and so result in a misallocation of resources.

4.2 Ensuring Simplicity and Speed of Application

In order for support to innovative firms to be effective, such support must be rendered rapidly. For a firm introducing novelty, time is of the essence. Innovations frequently fail not for any inherent deficiency but simply because they take too long to be implemented and to come to market. It is not sufficient for the right supports to be in place. The right supports must be provided timeously if they are to be rendered effective.

A related problem is the time, but also the effort and the expense that an applicant is required to spend in order to access the support. Management time and firm resources spent on accessing the support materially detract from the value of that support. Where ensuring access is difficult, firms may resort to hiring outside professionals to prepare and present their applications. The transactions costs and the time involved in working with intermediaries are likely to be very significant.

Grant funding schemes, such as that operated by TIA, follow a common basic structure. The granting agency prepares and publicises a request for firms to apply for funding support. This request or call for applications outlines the qualification criteria i.e. which firms qualify, but also which projects; what categories of activities; levels of funding; and the terms of funding such as duration and pay-back provisions.

One of the key performance indicators to assess the efficacy of governmental agencies in their support for innovating firms is accordingly the turnaround time; this is the time of receipt of application to the notification of success and the first receipt of monies. As agencies develop and establish their procedures, turnaround times should reduce. However, streamlining procedures is a complicated and difficult task and requires time. In the case of TIA, turnaround times were as high as 6–8 months. Over time, this was significantly reduced. The 2016–17 annual report states that the turnaround time at 3 months and 2 days (TIA, Annual report 2016–17: 35).

Of course, in principle, the request for funding should be clear and the application procedures should be as light and as simple as possible, so reducing the turnaround time. But, this is by no means common in the practices of government agencies. “Too often...application procedures require excessive documentation or cumbersome application forms, which imply significant costs for applicants and act as a deterrent to apply for government support. Thus, in some countries consultants have specialized in filling applications, which can result in these programs being captured by those same firms that have developed a good understanding of the application processes or that have hired these consultants. Avoiding this capture and reaching out to the main policy beneficiaries require light application processes, with clear and transparent requirements that are evaluated by externally qualified evaluators with previously designed appeal mechanisms” (Cirera and Maloney 2017: 125–126).

However, light and simple processes, while generally desirable, have the disadvantage of encouraging all and sundry to apply. Since “free” or “cheap” monies are on offer, firms that may not be suitable may well take the chance and make an application. Where applications are very easy and light, this can result in agency spending considerable time and resources processing non-suitable applications.

Of more import is that as a government agency, TIA is dispensing public monies. Expenditures of public monies necessarily require controls and reporting procedures. In South Africa, the Public Finance Management Act (PFMA) 1991 requires that TIA itself and the granting of financial support to firms are subject to stringent processes of governance, accounting, reporting and auditing requirements. This has certainly served to ensure accountability and limit corruption, but it has also decreased the agility and rapidity with which TIA can support applicants that are assessed as worthy of support. Accordingly, there is something of a trade-off as between speed required for efficiency and procedures of reporting and accountability that are designed to limit arbitrariness, capture and possibly corrupt practices.

4.3 Safeguarding Against Corruption and Capture

In essence agencies providing financial support for innovating firms are distributing public monies to private clients. As with all activities entailing the provision of public monies, the provision of financial support for these firms runs the very considerable risk of corruption and capture. In this instance, the problem is compounded in that once monies are handed over, it is very difficult to undertake surveillance such that the agency is able to ensure that the monies allocated have indeed been utilised as applied for and as granted.

One way in which this can be—at least partially—mitigated, is by utilising matching grants. Accordingly, matching grants are very widely used globally. It is estimated, utilising public expenditure reviews, that matching grants make up 80% of support across 140 innovation instruments in Latin America (Cirera and Maloney 2017: 123). Under the system of matching grants, the granting agency requires that the applicant match (the percentage provided by the firm is variable) any grant advanced by the agency. These can range from one-off funding allocations to more complex and long-term private public partnerships. However, the once-off matching grant is most often utilised. To provide further security to the use of public funds by private beneficiaries, grants are often made in tranches, requiring that certain goals are achieved, including expenditures by the recipient firm of their own resources, before further tranches are granted.

Internal to the agency, a strong internal and external audit function answerable to the Board and not to the management are critical to ensure that resources are allocated effectively and in accordance with well-established procedures. An independent Board with declaratory safeguards to ensure that no employees of the agency derive any personal benefit from any of the agency’s operations is a further essential constraint on state capture and corruption.

These are all safeguards—and there are others—that can and should be utilised to curtail state capture and corruption. However, none of these safeguards provides any form of guarantee. The potential will always exist whereby an agency and its employees distribute monies that are not theirs; a classic principal agent problem. The problem is likely to be particularly significant in the early stages of an agency's operation. Before systems are in place, internal and external auditors and the board well established and conversant with the operations of the agency, the agency is more prone to these sorts of problems.

TIA has all these safeguards in place. However, a large part of the senior management that were initially appointed when the organisation commenced were found to be responsible for corrupt practices and were dismissed. It took some considerable steering on the part of the Board to turn the organisation around, to acquire new management and to put in place more effective systems to safeguard against corruption and capture.

4.4 Reducing Costs

Government agencies are costly to run and administer. By far the most significant costs relate to wages and remuneration. A very high proportion of the requisite employees of a government agency are skilled—many highly skilled. Wages and remuneration are commensurately high. Particularly in a situation of a shortage of skills, as is the case in South Africa, in order to attract and to retain such skilled workers, a government agency will be required to pay a significant premium. Moreover, the shortage of skills is likely to ensure that labour turnover rates are high raising costs still further. In the three years 2014/5–2016/7, wage costs represented two-thirds of TIAs total cost. Wage costs were twice as much as all the other administrative costs combined (TIA, Annual Reports 2014/15–2016/17).

One key measure of an agency's operational efficiency is the cost of administering the agency as a share of the overall budget. In brief: what share of the agency's budget is spent internally and what share of the agency's budget is finally allocated to the recipients of support, the firms themselves? This is often termed the efficiency ratio. Particularly in times where the agency receives less overall funding, in order to safeguard the core activity of the agency, indeed the *raison d'être* of the agency, the agency will need to improve its efficiency ratio.

This is what occurred in the case of TIA. The agency received a sudden reduction in its budget allocation in 2016. As a result, in a process overseen by the Board, TIA was forced to improve its efficiency ratio. "To enhance operational efficiency and ensure maximum budget allocation to projects, the Board set specific targets to regulate the ratio of administration costs as a percentage of the total budget. This is demonstrated by the efficiency ratio. The significantly improved ratio of 22% for FY2016/17 indicated that, for every rand received from the fiscus, R0.78 is utilised for investment and project funding, and R0.22 utilised for administrative and salary costs. Maintaining and improving on this ratio will remain a challenge as organisational

growth and development initiatives must always be balanced against the efficiency ratio. Our target efficiency ratio remains 30/70 (TIA 2016–17: 21).

At one stage, TIA's efficiency ratio stood at 38%. In the three year period 2014/15–2016/17, the efficiency ratio averaged 26% (TIA, Annual Reports). By contrast, the percentage spent on operational overheads by Tekes of Finland, widely acknowledged as a best practice agency globally, was reported to be of the order of 5% (data supplied by McKinsey).

With only a little over 60% of the budget being allocated to the firms that the agency was established to support, the very *raison d'être* of the agency was in question. But as the above quotation makes clear, enhancing the efficiency ratio has to be balanced against the agency having sufficient resources to perform its functions effectively. As noted above, the major component of administrative costs is labour—notably highly skilled and therefore high cost labour is essential to the effective functioning of the organisation.

4.5 Acquiring the Necessary Skills and Competencies

One of the key reasons for government to establish an agency structure to support start-ups rather than for support to start-ups being merely an additional function added on to an existent government department is that such an agency is not bound by the human resource procedures and policies that characterise government employment. Generally, agencies will be endowed with considerable freedom to establish procedures and policies so as to be able to attract and retain skilled workers.

Indeed, almost certainly, the most difficult challenge facing a government agency seeking to support start-ups is acquiring and retaining the requisite skills to perform this function effectively. While the severity varies, almost every developing county has a shortage of skills. Moreover, the skills that are almost certainly the most difficult to source, are precisely those that an agency will most require—in particular, scientific, engineering, technical and managerial skills. The wider the agency spreads its supports, the wider the array of technical and other skills that the agency will require.

The situation in this regard in TIA is summarised in the Annual Report.

It is worth noting that the requisite skills to fulfil the TIA mandate are quite scarce. These include Workout and Restructuring Portfolio Managers, Intellectual Property Legal Advisors, Portfolio Managers with commercialisation background and Investment and Internal Auditors with Quality Assurance experience. TIA struggles to attract and retain talent with such skills....This poses an operational risk to the organisation. (TIA, Annual Report 2016–17)

Moreover, personnel who have both sets of skills, technical and managerial, are optimal. However, in a situation where development has been constrained and few people have experience of management in the business sector, such skill sets are unlikely to be forthcoming.

In this context, in-house training within the agency plays an important role.

The nature of TIA business requires highly technical skills from engineering and science backgrounds combined with commercial and skills. This is to ensure a comprehensive approach to sourcing, assessment and management of investments. Due to the vast economic sectors where the Agency operates, it is imperative that the required skills are sourced and utilised to achieve the TIA objectives. In sourcing the skills, it became apparent that in some cases, the technical skills are not always coupled with the relevant leadership skills necessary to manage the projects and the people. Several efforts are made to develop these skills which include training on performance management, industrial relations and project management to name a few (TIA, Annual Report 2016–17: 72)

A number of specialist skills cannot be supplied in-house and must therefore be sourced from the private sector. As one example—Intellectual property (IP) law capacity is of the most critical resources, and one of the most costly. TIA has frequently to resort to the private sector to acquire such expertise. In South Africa, IP law is relatively well-developed, and the requisite skills are available locally. In other developing countries, governmental agencies may well have to resort to acquiring such expertise from outside of the country with, of course, implications for both the budget and for the turnaround time for applicants.

As outlined earlier, the major barrier to effective innovation at the firm will often rest less in the limited resources for innovation that are available to the firms, and more in the lack of firm level competencies particularly management capabilities that severely constrain the returns to innovation. Financial grants to firms to support innovation will only be effective if the firms have the managerial capacities to design and implement good innovation projects and to develop the firm but lack the necessary finance. But, as outlined earlier, start-ups frequently lack these internal management skills. Moreover, every company goes through a life cycle with each stage requiring a different set of management skills. The person who starts the business is seldom the person who can grow it, and that person is seldom the one who can lead a much larger company. Private VCs provide financial and managerial skills attuned to the different stages of a firm's development. These financial and business skills make an important contribution to the company's eventual success (Zider 1998).

However, skill shortages, combined with budget constraints, are likely to result in governmental agencies focusing almost exclusively on the tasks of allocating financial support to applicants. An agency, in a situation where management skills are in short supply, is unlikely to be in the position to offer significant non-financial support to applicants. This is the case in TIA where managerial and non-financial support provided to successful applicants is very limited. Successful applicants are required to report on progress, but other than reviewing progress of applicants and informal engagement, TIA is not able to offer significant management or other non-financial support.

4.6 Ensuring Secure Long-Term Funding

Financial support to firms for innovation is very rarely a once-off grant. Invariably, grants are multi-year, with payments made in tranches once milestones are met. At any point in time therefore, the granting agency has long-term funding commitments that it must, of necessity, meet. If funding is reduced, the agency will have to ensure that its existent commitments are met and accordingly severely curtail any new lending.

Curtailing new lending is however also very difficult. Support programs have been announced and applicants have been invited to submit. It is both difficult and inequitable to reduce access to funding for firms whose applications are in process. If good firms go without funding, the credibility of the agency suffers. It is clear that in order to enable smooth and efficient operations, and to ensure the legitimacy of the agency in the eyes of those whom it supports, the agency will ideally require a high level of certainty as to the availability of future funding.

Of course, this may be difficult for government, particularly when economic times are difficult and have not been planned for. In the case of TIA, despite a three year budget horizon in terms of the government's Medium Term Expenditure Framework (MTEF), when the economy stagnated and governmental revenues declined, budgetary allocations fell—sometimes precipitously. In 2013/14, TIA's parliamentary grant declined from R481 million to R338.4 million—and only rose slowly thereafter so that three years later the parliamentary grant was still some 20% lower than it had been earlier (TIA, Annual Reports). The organisation was also forced to make major savings in its operations in order to meet its funding commitments and to stabilise its project funding disbursements. It is clear that governments contemplating establishing an agency to provide financial support for the innovation activities of firms will need to be able to ensure that such funding is secure and dependable.

4.7 Monitoring and Evaluation

Governments everywhere are experimenting with new policies and new institutional arrangements to support start-ups. Particularly because policies and institutions are so new and indeed experimental, it is important to monitor and evaluate policies designed to support firm level innovation and the institutions that implement these policies. Performance will need to be evaluated and policies and institutions held accountable to clearly stipulated *ex ante* performance indicators. Policies and institutions can then be moderated or altered dependent on performance.

Innovative firms are situated in very fast changing markets and environments—most often global markets which are subject to strong competition and threats of new entrants. To be effective, governmental support and governmental institutions will need to be agile, making adaptations rapidly as the requirements for innovation

change. The need for this agility, lends an added weight to the requirement for ongoing monitoring and evaluation.

TIA employs a number of Key Performance Indicators (KPI). In respect of TIA's support for firm level innovation, the most obvious set of KPIs relate to the effective commercialisation of projects that TIA has supported. Thus, TIA annual reports provide the number of firms that, since its inception, have managed to penetrate the market. However, this measure begs a number of questions. Most obviously, how should "penetrate" be assessed—in terms of output or employment, for example? More significantly, over what time period is it valid to make this assessment—some projects may realise only very short term gains, but others gains occur only over a long period. Finally, can such success be attributed to TIA funding? In the absence of TIA, might successful firms have found support elsewhere? In other terms, is TIA crowding out private support for innovative companies?

A further KPI is designed to address this last question in TIA—namely the outside funding that TIA projects and applicants were able to secure. This KPI relates firstly to the outside funding that TIA itself is able to attract into its own programmes viz. the amount of funding attracted into the TIA portfolio. And secondly to the outside funding secured on the part of those firms receiving TIA funding viz the number of knowledge innovation products produced by TIA supported projects receiving third party funding.

Without entering a considerable discussion on the merits and limitations of these KPIs, it is clear that, as with the KPIs in relation to commercialisation, the KPIs relating to the crowding out or crowding in of private funding support for innovation, are far from definitive. This is not uniquely a TIA problem. KPIs to assess performance are difficult to design and are, in any event, open to interpretation. To this end, regular KPIs should be supplemented by periodic external in-depth institutional reviews.

Before an agency to support funding of firm level innovation is established, it will be critical for government to establish clear performance indicators for that agency, particularly in respect of commercialisation and the crowding in/crowding out of private funding support for innovation. However, this is very rarely done. "A final important weakness in these countries is the lack of appropriate M&E frameworks and impact evaluations. Many innovation programs lack a well-defined, logical framework that could inform M&E efforts. In addition, impact evaluation in innovation programs is in a very early stage, with only a handful of evaluations available for the whole Latin American region" (Cirera and Maloney 2017: 122).

5 Conclusion

Governments are currently experimenting with various policies and institutional forms to support firm level innovation. At this stage, no definite conclusions can be drawn. There is no innovation policy that is universally successful. Nor is there any single successful model for an innovation agency (Glennie and Bound 2016).

Context is all important. Context, including critically, governmental capacities must be carefully considered in weighing up what policies and particularly what intuitional design is appropriate.

As the earlier section of this chapter has stressed, before even deciding on providing direct support for firm level innovation, government needs to have clearly identified that this support addresses the most binding constraints on the further development of the firm. If this is indeed the case, the next step is for government to examine what institutional form would best deliver that support. A government agency is one such possibility but, of course, there are other institutional forms.

This chapter does not seek to evaluate TIA but, drawing from the experience of South Africa and TIA, outlines some of the major challenges and constraints that a government agency located in a developing country is likely to experience. A major recent World Bank review of innovation, singles out the difficulties that governments face in establishing institutions to support innovation, particularly in developing countries which are far from the technology frontier and where government capabilities are likely to be very limited, as one of the most pressing and yet one of the most unacknowledged gaps in our understanding of innovation and policy.

Academic and policy discussions about innovation policy often omit the question of who actually implements it. The role public servants, ministries, and agencies play in ensuring or undermining the effectiveness of policy instruments is rarely considered. This is a critical part of the resolution of the innovation paradox: as the complexity and scope of the interventions necessary to resolve the failures that impede exploiting the gains from technological catch-up increase with distance from the frontier, the capabilities of governments to design and implement the interventions tend to diminish. Overall, the issue of capabilities in innovation policy making and how to improve them is probably one of the most pressing, yet unacknowledged agendas in innovation policy in developing countries (Cirera and Maloney 2017: 138)

This chapter attempts a very modest contribution to this agenda; drawing on the experience of South Africa to examine some of the difficulties and complexities that government agencies are likely to experience in funding the development of technology based start-ups.

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