Technovation 29 (2009) 645–656

BETWEEN VISION AND REALITY: PROMOTING INNOVATION IN KAZAKHSTAN THROUGH TECHNOPARKS[1]

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Abstract

The paper analyses the role of technoparks as instruments of innovation promotion in Kazakhstan using data from a firm survey and interviews. It explores three specific issues: first, the overall effectiveness of technoparks in promoting innovation development in Kazakhstan, second, the underlying innovation model in Kazakhstan technoparks, and third, whether technoparks can compensate for missing elements in the technology based infrastructure and environment. Our conclusions are that technopark firms are no more innovative than other firms. They are oriented largely towards the local market, and operate in traditional sectors; the frequency and intensity of their external links are more developed than are their internal links. The key motivations for relocating to a technopark seem to be lower rents and the possibility of accessing finance. Overall, Kazakh technoparks seem to be successful in terms of facilitating business incubation, but much less so in terms of innovation promotion and diversification of the economy. Focusing on technoparks as the main mechanism to diversify the economy seems to be an ineffective and uncertain policy option at this stage of the country's economic development. However, there seems to be significant scope for supporting business incubation. The conclusions of this study are of relevance to other emerging economies.

[1] The research that forms the basis for this paper was funded by the Asian Development Bank, project TA No. 4027-KAZ: Industrial Sector Review and Study. The views expressed in this paper do not reflect the views of the Asian Development Bank. The authors are responsible for all remaining errors.

1. INTRODUCTION

The belief that technoparks (TP) promote economic growth resulted in the spread of their different forms in developed countries, particularly during the 1970s and 1980s and their proliferation in the so called emerging economies during the 1990s. The original rationale for TPs was that physical proximity would create additional value for new technology based tenant-firms (NTBFs). It was believed that close daily interaction between tenant firms and providers of incubation and innovation services would add value to companies in terms of their faster establishment, the easing of initial teething problems, better infrastructure support, and better service provision including easier access to finance, and thus faster growth. In summary, it was believed that TPs would generate value added by enhancing, in these specific ways, the ability of its tenants to survive and grow in technology-intensive business areas.

However, the development of the TP movement has generated conflicting evidence regarding their effects and there is a huge gap between the policy makers' optimism regarding TPs and their actual performance. There is no consensus on the effectiveness of TPs, or the value added that they generate for technology based firms on their premises. In part, this is the result of the wide variety of types of TPs, which range from business parks, through to incubators and science parks and industrial parks. In part, it is due to methodological problems in evaluating the contribution of TPs to the local economy.

These complexities are compounded by the fact that TPs operate in different institutional contexts which influence their role and effectiveness but which have not been taken account of by the literature. Emerging economies are institutionally less developed compared to advanced countries in terms of capital markets, research and development (R&D) and the overall process of transformation of resources and knowledge inputs into marketable outputs (Peng, 2000). Emerging economies have undeveloped preconditions for technology based competition and TPs are seen as organisations that could compensate for missing markets, interactions and skills.

This paper aims to contribute to our understanding of this issue by exploring the role of TPs in Kazakhstan as a mechanism for innovation promotion. Specifically, we address three questions: first, what is the underlying innovation model of Kazakhstan TPs, second, what is the overall effectiveness of TPs in promoting the innovation development of Kazakhstan, and, third, can TPs compensate for missing elements in the technology based infrastructure and environment

Kazakhstan is an example of a fast growing transition economy that has been searching for ways to improve its competitiveness and diversify its economy, which is reliant on oil. The introduction of TPs has been seen as a way to promote innovation and ensure growth based on local knowledge and innovation. In this respect, Kazakh innovation policy has tried to emulate the successes of TPs in other countries. However, what is at issue is whether TPs can become the key mechanisms for promoting innovation and structural change.

We explore this issue using data from a questionnaire based survey and interviews in five Kazakh TPs and some off park firms. We found that TPs cannot compensate for missing preconditions for technology based growth but rather operate as business incubators partly facilitating the local entrepreneurial value chain and improving the cost competitiveness of their tenants. We explain the discrepancy between the vision and the reality of TPs as being due to differences between policy based on the idea of a linear innovation model and actual practice by which TPs improve the cost competitiveness of their tenants.

Section 2 reviews the literature on TPs. Section 3 analyses TPs in conceptual terms, as instruments to promote innovation and diversification in the Kazakhstan economy. Section 4 analyses Kazakh TPs based on a survey and interviews and Section 5 discusses policy options for innovation promotion, and summarises some key points.

2. TPS FROM AN INTERNATIONAL PERSPECTIVE: A REALIST'S OVERVIEW

A number of TP models co-exist within individual countries, some having evolved from original models over time. The differences between them stem from differences in how they describe themselves, and also in the real differences underlying the TP vision.

The literature is cluttered with terms such as science parks, business incubators, TPs and technopoles, organisational forms that are defined variously by different sources. Common to all organisational forms is that they are property related initiatives that aim to enhance knowledge clustering and networking among individual firms. Here we use the generic term 'TP', which is in common use in Kazakhstan and which reflects the overall policy aim that TPs should be agglomerations of NTBFs. However, what we find in practice is that TPs are largely dominated by low tech firms in traditional areas serving primarily local markets.

A common rationalisation for the TP movement is the belief that these institutions promote economic growth at regional and/or national levels. However, there seems to be a huge gap between the policy makers' optimism regarding TPs and their actual outcomes.[2] Below we briefly review the literature on this issue by focusing on the three issues addressed in this paper: the innovation models underlying the TP idea; the overall effectiveness of TPs to promote innovation development; and the role of TPs in different institutional environments.

2.1. The underlying innovation models of TPs

The Silicon Valley phenomenon is the origin of the TP ideal. The idea that underpins popular beliefs about TPs, and thus popular understanding about the growth of Silicon Valley, is the *linear innovation model* (Markusen et al., 1986). The implicit argument in favour of TPs is that universities/institutes as generators and repositories of scientific knowledge and expertise, could transfer, through articulated mechanisms, at least part of this stock to companies. However, in one of the few systematic analyses of this phenomenon Markusen et al. (1986, p.177) conclude that: 'one of the most cherished myths of high-tech policy – that a strong research university is the key to high tech growth – seems to be without empirical foundation'. For Markusen and colleagues public funding of applied R&D coupled with demand from US defence firms, is at the root of the Silicon Valley phenomenon. In contrast to popular perceptions, innovation studies have shown that firms need highly specific kinds of knowledge in order to solve their problems (see Dosi, 1988 for an overview). Except

[2] E.g., the conclusions from a benchmarking exercise on 79 US business incubators (US Department of Commerce, 2003) are that none of the assumed predictor variables appeared to be strongly related to primary performance outcomes (revenues, employment).

where academic departments have developed areas of applied expertise, university knowledge outputs may be either too general or too theoretical and fundamental, and thus too long-term to be easily usable. The knowledge applied by commercial enterprises tends to be firm-specific and cumulative. The cost of assimilating knowledge and technologies from outside a firm in order to incorporate them within the firm is very high, and the idea that academic research is a pool of free knowledge which can be tapped into at limited cost is not sustainable. Where industrial enterprises do have links with academic research, these generally involve long-term relationships and financial support for the research, and are not dependent on close proximity between the firms and the academic institutions (Quintas et al., 1992).

This conceptual critique of the science park movement has been accompanied by an empirical critique. For example, analysis of another widely cited success story – the Cambridge Science Park – argues that 'a science park was not necessary for the growth of high technology firms in the Cambridge area. Such growth occurred through the parts of Cambridge area where no park existed, nurtured by defence and other large state R&D links' (Quintas, 1986a). The assessment of science parks in the UK by Massey et al. (1992) showed that science parks are not major sources of technology development. Detailed case studies suggest that, if anything, most science park firms are diffusing and applying new technologies in the economy in a modest way, rather than being technologically 'leading edge' (Quintas, 1986a, b).

The successful cases suggest that the model that underpins the true TP is not the linear innovation model, but rather it is *an interactive innovation model*.[3] As innovation involves numerous feedback loops (Kline and Rosenberg, 1986) and the creation of synergies across a large number of partners (firms, universities, consultants, R&D organisations, intermediaries) parks should be seen as players within the technological entrepreneurial value chain (Phan et al., 2005). Within this perspective science parks across the world do not operate as sources of ready-made innovations, but rather as places of technology transfer and knowledge support for companies. However, as pointed out by Phillimore (1999), 'much evaluation of S&T Parks continues to implicitly use a linear framework by concentrating on the direct transfer of knowledge from universities to Park companies, and has a fairly limited conceptualisation of whether interaction is occurring or not'. Hansson et al. (2005) also argue that 'the old role of science parks, defined mainly by a linear conception of the relationship between science and innovation and a concept of science parks as providers of infrastructure in a broad sense …, may need to be replaced by an interactive, dynamic and network-oriented understanding that emphasises learning instead of a narrow understanding of scientific innovation and regional development'.

2.2. The overall effectiveness of TPs to promote innovation development

There is no agreement regarding the overall effectiveness of TPs. This is due to lack of systematic framework to understand the performance of TPs which is reflected in a variety of their mission statements. As pointed out by Bigliardi et al., (2006) a wide range of mission statements is the major cause of the difficulty in developing a rigorous approach to assessing their performance.

There are few academic studies of TPs which give them a positive evaluation. The parks milieu appears to have a positive impact on firm growth as measured in terms of *sales* and *jobs* despite the lack of a direct relationship between the science park

[3] E.g., Hsinchu Industrial Park depends very much on downstream R&D and manufacturing activities.

location and *profitability* (Lofsten and Lindelof, 2001, 2001b). Westhead and Storey (1995) found that the probability of a firm surviving was higher if the firm had links with a university. Philimore (1998) found that the companies located in a science park usually form networks, and he considers this interaction to be important (see also Sarfraz, 1996). Dettwiller et al. (2006) found superior performance among on-park firms, which they attributed to differences in the facilities management enjoyed by science park firms.

Any attempt to draw a definite picture of the effectiveness of TPs as a mechanism for innovation promotion encounters the problem of the huge variety of their forms and objectives. An assessment of French technopoles by Chorda (1996) points to several important departures from the original technopole model as well as two key under-achievements in the realisation of the technopole model – critical size and networking. An assessment of German innovation centres shows that, despite long-term support for these centres, their employment impact is small (Staudt et al., 1999). The first comprehensive analysis of EU business incubators (EU, 2002) showed that public support for them is critical. However, the analysis also concludes that business incubators are a very cost-effective instrument for the promotion of public policy objectives.

A common criterion for measuring the success of TPs is the extent to which they enhance linkages between firms within parks. and external organisations, such as universities. Empirical research suggests that the level of interaction between firms located in science parks and local universities is low, which is the core rationale for science and technology (S&T) parks (see Westhead and Storey, 1995; Vedovello, 1997). Science parks generally do not constitute a significant stimulus for technology transfer from universities to industry (Koenraad, 1991) and generate only a modest direct contribution to employment (Storey and Tether, 1998). In a nutshell, international experience and support for different types of TPs is of a few very successful cases, and a majority of cases with mixed success or no success in achieving their stated objectives. There is a huge gap between the enthusiasm of policy-makers for TPs and actual results. The success stories seem to arise out of several simultaneous and self reinforcing factors which are idiosyncratic and difficult to replicate.

2.3. The role of TPs in different institutional environments.

Largely inspired by successful cases of agglomerations of NTBFs, such as Silicon Valley and the Cambridge Science Park, many developing and semi-developed economies have established TPs in expectation that they will act as 'development catalysts' for technology based growth[4]. Unfortunately, there is no systematic comparative overview of the effectiveness of TPs in developing, semi-developed or so called emerging markets. Among the catch-up economies, Malaysia's Multimedia Super Corridor (MSC) is one such prominent initiative designed to transform the nation into a knowledge-based economy (Ramasamy et al., 2003). The most successful case is the Taiwanese Hsinchu Science-based Industrial Park (HSIP) (Xue, 1997). Its successful development led to the park becoming a 'development catalyst' and has resulted in the establishment of a high tech industrialized milieu in the wider surrounding area (Ku et al., 2005). Less successful cases can be attributed to the

[4] For a list of countries that have science parks see http://www.iasp.ws/publico/index.jsp?enl=1

absence of local interactions and the inability of park to operate as a 'development catalyst'. For example, the Singapore Science Park which was developed to provide and upgrade the infrastructure for multi-national corporations (MNCs) has achieved only modest success in plugging itself into the global networks of high technology clusters. There is little interaction between the firms within the park and firms outside of it (Koha et al., 2005). An assessment of three Greek science parks suggests that synergies between on-park companies are limited to commercial transactions and social interactions (Bakouros et al., 2002).

No evaluation of TPs in transition economies has yet been developed. In the majority of cases, TPs have emerged as a result of the transformation of former R&D institutes or as local government initiatives. Only occasionally are they the product of private initiatives by individuals or creative groups that have spun-off from large organisations. Practice shows that Polish technology parks are too weak to encourage the reindustrialisation of depressed areas, and their economic weight is insignificant (EU, 2003). The TP model was implemented in Russia during the 1990s to commercialise its vast S&T potential. However, the high expectations have not been realised, primarily because of weak demand from large firms for the products and services of NTBFs (Kihlgren, 2003). Evaluation of a US programme of support for business incubators in Ukraine is fairly positive although such investment by the local economic development community would not have been possible, and it is questionable whether the success can be sustained once foreign funding is removed (Shelton and Margenbhalter, 2002). An assessment of an incubator established by the Budapest University suggests that it has been relatively successful in operating as provider of incubation services for university professors (Palmai, 2004).

The success stories of Hsinchu Science-based Industrial Park and others, suggests that a highly idiosyncratic set of factors lies behind the strong self-renewal capabilities of these cases. As pointed out by Phan et al. (2005) successful parks are able to create greater value for the firms located in them if they possess specific rather than general non-specific resources that are not available elsewhere. In countries behind the technology frontier there are missing institutional preconditions for technology based competition. So, the key issue is whether TPs are able to compensate for missing factors in the broader environment of the country. It seems that the presence of skilled human resources, basic research, information infrastructure and risk capital are not the major weakness; it is the non-existence of related and supporting industries that matters. These are usually lacking in countries behind the technology frontier as they are usually the products of technological and economic development. For example, this difference is crucial in explaining success of Hsinchu Park compared to the less successful Taiwanese Zhangjiang Park (Lai and Shyu, 2005)

3. TPS AS MECHANISMS TO PROMOTE INNOVATION AND DIVERSIFICATION IN THE KAZAKHSTAN ECONOMY: A CONCEPTUAL ASSESSMENT

Kazakhstan's economy is dominated by oil and gas, mining and metals, which account directly for 30% of gross domestic product (GDP), nearly 80% of industrial output, and more than 80% of exports (World Bank, 2005). The country has a weak manufacturing base and faces huge challenges to diversify its economy. From 1991 to 1995 real GDP fell by 39% and exports collapsed. However, during 1999-2005thanks

mainly to oil prices, the economy recovered and grew on average by 9.1% (Alam, 2008). The country is blessed with significant oil reserves which, according to World Bank (2005) forecasts, should ensure that the Kazakhstan government receives annual budget flows of up to $7 billion two decades on. This should ensure high growth rates, but not necessarily development, and not technology and knowledge based growth. The oil windfall raises questions about how to increase the competitiveness of the non-oil sectors and diversify the economy (Tsalik and Ebel, 2003). The recently created State Holding Company, Samruk, and the Sustainable Development Fund, Kazyna, were set up respectively to manage the largest public companies and boost the creation of new enterprises. A policy ambition to diversify Kazakhstan's economy through innovation promoted via TPs is a part of this long-term policy agenda. In this section we briefly analyse the role of TPs as a mechanism for innovation promotion and diversification of the Kazakh economy.

The key difference between Kazakhstan's national system of innovation and the systems in developed countries is that the R&D capabilities of the former are still mainly located in public organisations rather than enterprises. Table 1 shows the institutional structure of Kazakhstan compared to the EU and North America in this regard.

Table 1: Institutional structure of R&D systems in Kazakhstan, North America and the EU

	Kazakhstan, 2002	North America, 1995	European Union, 1995
Proportion of GERD performed by the Business Enterprise Sector	18.6	**59.3**	**52.5**
- in house business R&D *(zavodskaya nauka)*	4.4	-	-
- construction and design bureaus *(KTB)*	14.2	-	-
Proportion of GERD performed by the Higher Education Sector	22.2	15.6	20.8
Proportion of GERD performed by the Government sector	**57.2**	10.2	16.2
* GERD = gross expenditure on R&D			

Source: OECD, 2000, and Statistical Office of Kazakhstan

The share of business R&D, which is three times lower in Kazakhstan compared to the developed countries, shows that Kazakhstan is lagging significantly. The 18.6% share of the business enterprise sector in Kazakhstan in 2000 equates to the Korean situation in the early 1970s, which suggests a lag of around 30 years. During the 1990s, there was no sign of a shift towards R&D being undertaken within firms. In that sense, Kazakhstan has not yet started a transition towards an enterprise-based technology development system.

The underdevelopment of a firm-centred innovation system in Kazakhstan is a big disadvantage for the development of TPs, as one of the keys to their growth – demand from domestic large firms – is missing.

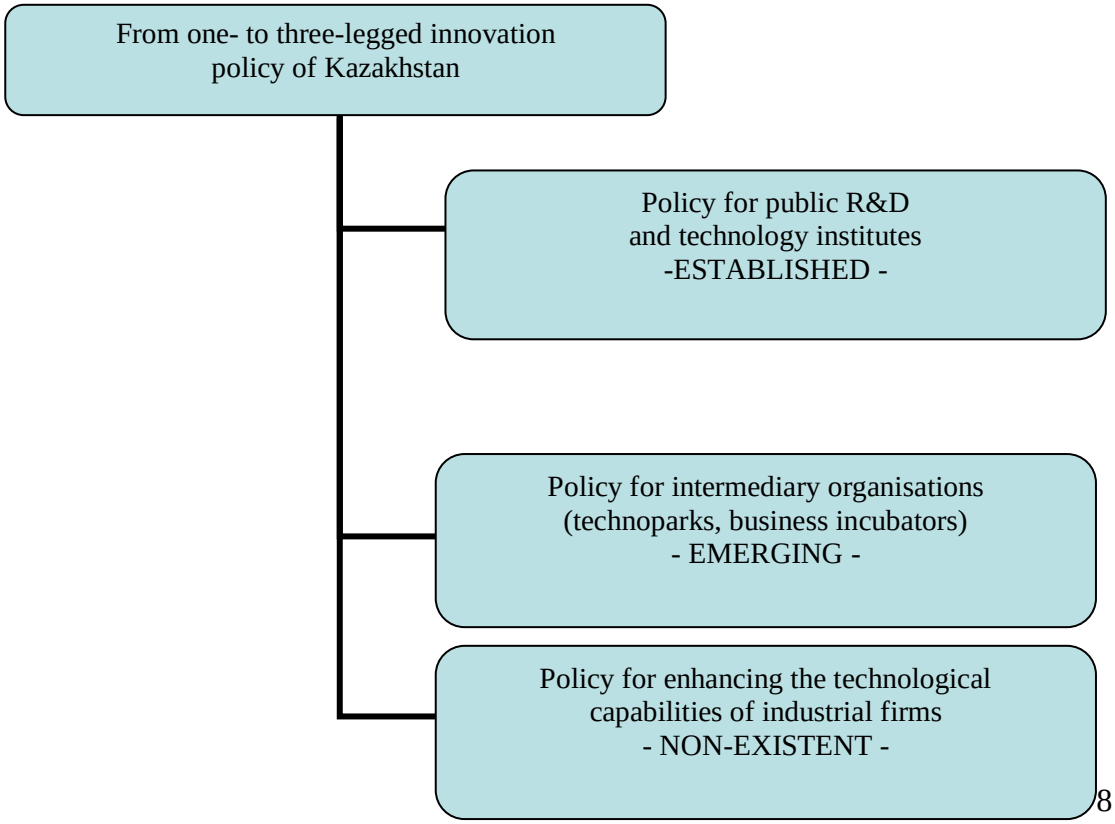
Kazakhstan has introduced some first institutional changes towards a structure of

firm-centred innovation capabilities, from the situation when most S&T capabilities were located in public institutes. Policy has attempted to overcome the inherited gulf between R&D and industrial enterprises by bringing them together in National Science Centres, responsible for the implementation of goal-oriented S&T programmes. It is hoped that in this way a direct link will be established between S&T organisations and industrial enterprises. The focus on TPs represents a continuation of this goal by enhancing *linkages* between R&D and enterprises.

However, Kazakh innovation policy is still predominantly preoccupied with the capabilities and resources of scientific, technological and training institutions, which undertake technological activities *on behalf* of industrial firms. Policy measures designed to strengthen the technological activities of *firms* are virtually non-existent. There are still no effective resource allocations or other mechanisms designed to increase firms' abilities to implement *their own* technological learning; strengthen *their own* design, engineering and other technology development capabilities, or undertake *their own* innovative activities (see Pro-INNO, 2008).

Kazakhstan's innovation policy features a predominantly 'mono-structural' framework, centred largely on public institutions as the vehicles for implementing industrial technology development policies. Funding of innovation projects undertaken to solve the innovation problems of enterprises started only in 2001. The government has not yet developed a comprehensive threefold structure of policy which, alongside its focus on the role of public institutions and, recently, TPs, would give similar emphasis to the role of firms as the creators of technology and the generators of underlying skills and capabilities. In conceptual terms we should see a shift from a one- to a three-legged innovation policy (see Figure 1).

Figure 1. From a one-legged to three-legged innovation policy

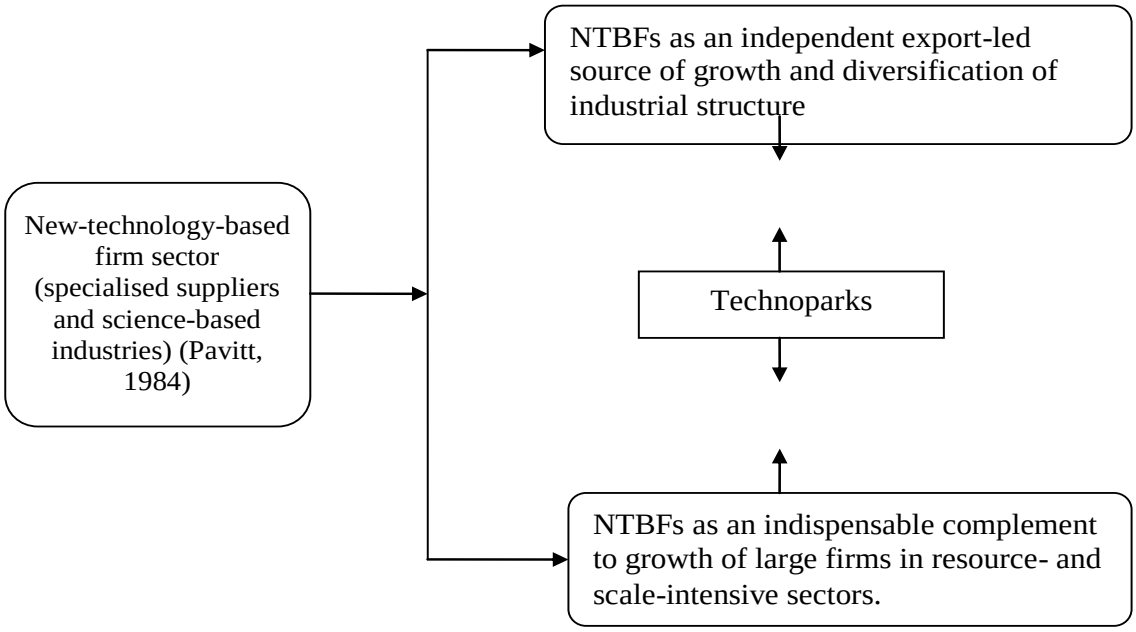


3.1. TPs and diversification of the Kazakhstan economy

In Kazakhstan, TPs are expected to become the sources of diversification for the economic structure, which is overly dependent on oil and mineral -based sectors.

Figure 2 shows that NTBFs could operate as an independent export-led source of growth and diversification for the industrial structure (similar to the Indian software industry), or as a complement to large firm growth in the resource- and scale-intensive sectors. This is basically the idea behind the recent creation of an IT Park as a special economic zone, now entering its second stage (see Pro-INNO, 2008).

Figure 2: How NTBFs impact on growth and restructuring



Barriers to the growth of NTBFs as independent export-led sources of growth and diversification are quite substantial. To appreciate the scale of these barriers, we can take the example of Russia, where a large S&T system has yet to generate any perceptible streams of knowledge-based revenues at macro-level.[5] Intellectual property rights, standards and technical certifications, systems of guarantees and marketing barriers are some of the more important factors behind the inability of Kazakhstan to exploit its S&T potential internationally, as a source of growth (see Dyker, 2005). Several Kazakh research institutes have developed products with technology content, such as accelerators and pharmaceutical products, but their further growth in terms of exporting, has been constrained by marketing and technical barriers.

There is an expectation that TPs could create an environment that is different from the rest of the economy, which would be the source of growth and which would spread to

[5] The Russian software industry may be an emerging exception.

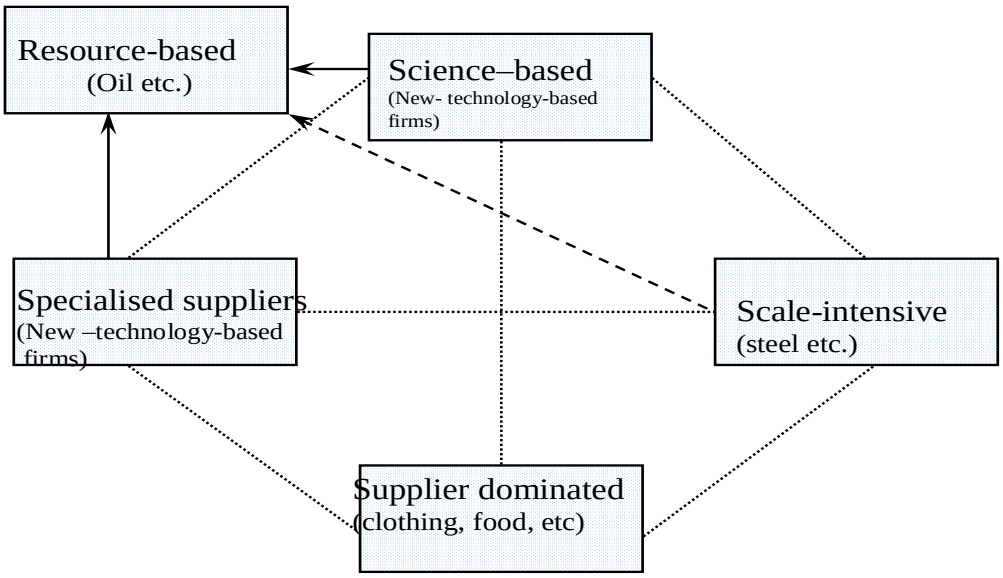
the rest of the economy. Unfortunately, it seems that a range of factors (funding, linkages, knowledge, entrepreneurship, market access, etc.) would have to be in place for such a process to take place.

An alternative route is development of the NTBF sector as an indispensable *complement* to the growth of large firms in resource- and scale-intensive sectors (see Figures 2 and 3). The advantage of this route is that NTBFs do not face such high entry barriers, as demand is mainly domestic.
Domestic NTBFs could operate as:

- specialised suppliers for other industries, offering testing equipment, niche products, instruments ('hard' companies);
- consultants or 'knowledge brokers', facilitating adoption of new technologies ('soft' companies); and
- education/training organisations, offering methodologies and instrumentation services ('soft' companies).

In this scenario, the growth of NTBFs is dependent on the growth and restructuring of all four sectors (scale-intensive, supplier-dominated, science-based, specialised suppliers) (Pavitt, 1984). Figure 3 illustrates why the generation of new sources of growth through NTBFs, and TPs as mechanisms of support for NTBFs, faces such difficulties. There are limits to the potential for recovery and growth of NTBFs in the absence of demand from other sectors. In CIS countries, in particular, the capital goods sector, which partly overlaps the scale-intensive sector, has not yet fully recovered, and, indeed, is the least competitive sector. This leaves the resource-based sector as the only source of effective demand for NTBFs.

Figure 3: Sectors of potential demand for NTBF services and products[6]



[6] This classification is based on Pavitt's (1984) taxonomy which has been somewhat modified here to take nto account of the role of the natural resources sector, which is important for Kazakhstan.

In summary, a lack of demand from other sectors for the services of NTBFs and an externalised R&D sector poorly connected to local industrial firms, coupled with endemic lack of demand for local R&D, pose constraints on TPs operating as mechanisms of restructuring and innovation. So, the question is whether TPs can compensate for these missing conditions.

4. ANALYSIS OF CURRENTLY OPERATING TPS IN KAZAKHSTAN BASED ON QUESTIONNAIRE RESPONSES

4.1. Methodology

The fieldwork that forms the basis for this paper was undertaken between September and October, 2003; the data collection was conducted in 2004. Based on 21 interviews with entrepreneurs, and administrators and two questionnaires designed for TP managers and tenant firms we made an assessment of the state of TPs in Kazakhstan. Questionnaires to park managers consisted of 18 questions which asked for factual information on the TP and its companies, information about objectives, sources of funding, criteria and the process of selection of tenant companies, type of services offered to companies, assessment of links between tenants and an assessment of the value added of the park. The questionnaire for tenant firms consisted of 16 questions which asked for basic information on the company, its history, the innovativeness of its products/services, motives for location in TP, major barriers, use of TP services, questions about rent and assessment of value added to business from being located in the TP. We conducted interviews with half of the entrepreneurs in two parks in Almaty. We also interviewed 25 interviews with innovation policy administrators, business associations and a few enterprises outside the TP. A list of interviews and the questionnaires are included in the report prepared for the Asian Development Bank which forms the basis for this paper, and are available from the authors on request.

There are currently seven technoparks operating in Kazakhstan. These have emerged through the initiatives of entrepreneurs from public administration, primarily at the local level. Our sample consists of data from five of these technoparks and the questionnaire responses from 129 firms (see Table 2). We also collected data from **33** off-park firms, which serve as a reference group for some indicators. These firms are well performing firms from towns in which TPs are located and were chosen by local experts based on their broad similarities to TP firms in terms of size and sector affiliations.

A relatively large number of firms responded to the questionnaires but the number of questionnaires with responses to all the questions was significantly lower, and varies. Hence, beneath each table we indicate the number of valid responses.

4.2. Results

4.2.1. Major features of TP firms

All the TPs were established by local authorities (*akimats*) with the exception of Kostanai Park, which is a joint venture of 18 local entrepreneurs. Sources of funding vary; four parks are funded by a combination of local government funds and rents, the fifth is funded entirely by rents. Utilisation of the available sites varies from 53% to 100% and the share of commercially active tenants ranges from 30% to 100%. All

parks offer a range of services to companies that vary in terms of sophistication. Technoparks include technology and non-technology based firms and in this respect are not clearly differentiated.

Table 2: Identity card of Kazakh technoparks

	Almaty Business Incubator (ABI)	**Almaty TP (ATP)**	**Karaganda (KGP)**	**Petropavlovsk (PPV)**	**Kostanai (KST)**
Year of establishment	1999	2003	1999	2000	2000
Founders	Akimat Almaty	Akimat Almaty	Akimat of Karaganda region	Akimat of North Kazakhstan	Private Entreprises and Individual Entrepreneurs (18)
Legal status	State commercial enterprise	State commercial enterprise	Communal state enterprise	State commercial enterprise	Business Association
Sources of finance	Rents and regional budget	Rents, services of technopark	Regional budget	Local government, rent	Own funds (100%)
Tenants at establishment	8	27	4	16	1
Tenants as of 2004	30	27	16	46	26
Rate of survival	100	85%	n.a.	100%	n.a.
Utilisation of estate (%)	100%	53%	n.a.	54%	70%
% of commercially active tenants	100%	30%	n.a	n.a.	50%
Joint services	Computer related services, conference hall, restaurant	Restaurant, conference hall	n.a.	Office services, business plan and consulting services	Mortgage and tendering assistance
Estimated turnover of tenant firms	n.a.	n.a.	$88K (2002)	n.a.	$66K (2003)
Estimated value added of TP (scale 1-5)	2.5	2	3.5	3	2

Source: Questionnaire to TP managers

Kazakh TPs are relatively young and small endeavours, housing between 16 and 46 enterprises not all of which are commercially active (Table 2). They each employ some 200 to over 300 people (Table 4). Based on available data **for two TPs** we estimate that the average rate of turnover per enterprise is around $5000.

Table 3: Age and working experience of entrepreneurs inside/outside TPs (TP)

	Age of entrepreneur		Years of working experience in area of venture	
	inside TP	outside TP	inside TP	outside TP
average	43	46	13	15
median	43	48	10	12
max	56	63	35	40
min	28	33	2	1

Source: Questionnaire, based on replies of 41 TP firms and 21 outside TP firms

Entrepreneurs inside and outside TPs are post-socialist, i.e. their years of working experience in the area of venture (13 and 15 respectively) coincide with the start of transition. There is no significant difference in the age and working experience in the area of venture between entrepreneurs inside TPs and the sample of other firms (Table 3).

Table 4: Employment and age of firms in four Kazakh TPs and outside TPs

	ABI	**ATP**	**KGP**	**PPV**	**- in TPs**	**- outside TPs**
Employment	254	335	337	191	1117	1781
- Median	7	8	7	3	9	32
- Average	11	13	11	4	12	61
- Max	34	50	43	12	50	250
Age - average	7	3	2	n.a	5	14
Age - median	6	3	2	n.a	4	9

Source: Questionnaire to firms
Legend: see Table 2

Firms inside parks are on average much smaller and younger than firms outside parks. The average employment in firms inside TPs is 12 and outside it is 61 (Table 4). Also, firms outside TPs are much older with average of 14 vs. 5 years. This contrasts sharply with the very similar number of years of experience in business (13 vs. 15 years) and similar average ages (43 vs. 46 years) of entrepreneurs in firms inside and outside TPs.

Table 5: Firms inside/outside TPs by type of activity

	Firms inside TPs						**Firms outside TPs**	
	ABI	**ATP**	**KGP**	**PPV**	**Total**	**Shares**		**Shares**
Manufacturing	9	5	12	45	71	55%	30	91%
Services	3	7	3	45	58	45%	3	9%
Total	12	12	15	90	129	100%	33	100%

Source: Questionnaire to firms. Based on 129 replies.
Legend: see Table 2

Almost half (45%) of firms in TPs are service oriented while our sample of firms outside TPs mainly includes manufacturing or product oriented firms (Table 5). This partly explains the relatively big differences in the average sizes of the two groups of enterprises (Table 4). This manufacturing–service structure reflects the situation in TPs in the US and Europe, where a large proportion of tenant-firms are service providers. This structure undermines the original idea of TPs as places where the key activity is commercialisation of new technologies and their transformation into new products. A specific feature of Kazakh parks is that they are also inhabited by low-tech firms active in traditional areas (Table 6). In terms of activities, and excluding pharmaceuticals/medical services and IT services, traditional products and services dominate.

Table 6: Activities of tenant-firms in four TPs

Furniture production and repairs	21	Transport services	4
Pharmaceuticals and medical services	11	Printing and copying services	4
Souvenirs and musical instruments	8	Advertising services	3
Sewing services/clothing	7	Training services	2
Technical and electric services	7	Legal services	2
IT services	6	Other products	6
Metal parts	5	Other services	6
Trading services	4	Not classified	10
Catering services	4	**Total**	110

Source: Questionnaire to TP firms.

TP firms are largely oriented towards the local market. On average, 90% of their sales are destined for the local market and only 9% for the national market (Table 7). This pattern is fairly similar for the three TPs for which we have data.

Table 7: Destination of sales of firms in TPs across markets (in percentages)

	Local	**National**	**Foreign**	%
Average	90	9	1	100
ABI	67	29	4	100
ATP	100	0	0	100
KGP	98	2	0	100

Source: Questionnaire to TP firms. Based on 36 replies
Legend: see Table 2

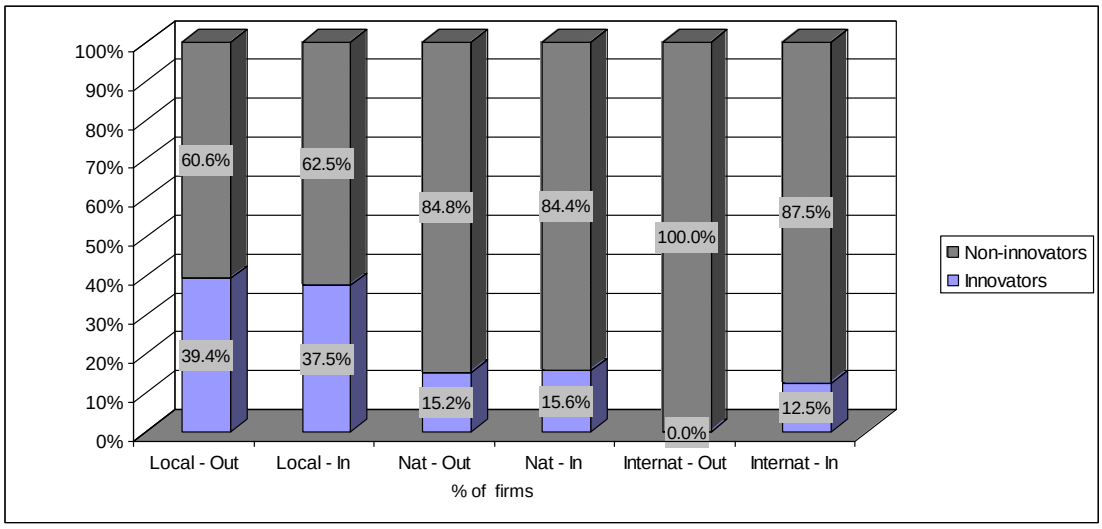
4.2.2. Innovation, motives, barriers, linkages and contributions of TPs

We collected data on product novelty from firms inside and outside TPs in different markets (local, national and international). Figure 4 shows that 39.4% of TP firms are local innovators, and 15.2% are national innovators. Interestingly, among the small number of firms oriented towards the foreign market 12.5% are international innovators. However, apart from a few producers of Kazakh national souvenirs and

musical instruments, which are innovators in the world market, there were no technology innovators.

A comparison of innovativeness between firms inside and outside TPs (ignoring the above mentioned marginal number of unique souvenir and musical instrument producers which can be considered as world innovators), shows that they are strikingly similar (Figure 4). For example, the share of firms selling innovative products in local markets is 37.5% and 39.4%, and on national markets 15.6% and 15.2% respectively. Thus, TP firms are no more frequent innovators than firms outside TPs.

Figure 4: Share of firms' innovators inside and outside TPs in local, national and international markets (as percentages)



Source: Questionnaire to firms. Based on replies from 32 in park firms and 33 off-park firms
Legend: (Non)innovators denotes percentage of firms inside (in) and outside (out) of TPs selling (non)innovative products in local, national and international markets

Firms are quite realistic about why they choose to relocate to a TP. Lower rent and better image ranked highest (4.1. and 4.0 respectively on 1-5 Likert scale). Although firms do not expect that location in a TP will significantly improve their access to finance (average importance is 2.9) they have expectation in terms of appropriate business services. The frequency of these factors varies across firms as seen by the number of firms that responded positively to individual factors. Rent is relevant for only 50% of firms (Table 8), but for these 50% it is a very important factor. The difference between the importance ascribed to an individual factor and the share of firms for which it is relevant suggests that the firms surveyed are in very different situations. For some, cash flow and thus rent are the most important aspects while for others it is image and through this possible access to external finance that matters.

For firms outside TPs, rent does not rank as an important cost. Only 7 out of the 24 firms (36%) outside TPs that we surveyed indicated rent as important. This may reflect the larger size and greater maturity of off-TP firms, and possibly a higher degree of business success, which to an extent adds force to the argument for hosting firms in TPs to reduce start-up costs. However, lower rents are probably not a sufficient justification for investment in TPs, as this problem could be solved simply

by subsidising firms' rents, no matter where they are located.

Table 8: Importance and frequency of motives for relocation to TP (Likert scale 1-5)

	Rent	Finance	Location	Infrastructure	Services	Image
Average	4.1	3.0	3.7	3.8	3.9	4.0
ABI	4.3	3.0	3.1	3.9	4.1	4.1
ATP	3.9	2.5	4.2	3.6	3.8	4.4
KGP	-	3.3	4.0	4.0	3.9	3.8
No of firms	19	26	21	21	30	26
Share of respondents	50.0%	68.4%	55.3%	55.3%	78.9%	68.4%

Source: Questionnaire to TPs firms. Based on 34 replies.
Legend: see Table 2

Access to finance and access to technology were indicated as being the key barriers to growth by 87% and 79% of firms respectively (Table 9). Access to foreign markets and infrastructure were not seen as important. As TP firms are predominantly local market oriented this latter result is not surprising. The small share of firms reporting infrastructure services as a major barrier (38%) suggests that the services that are available to them in TPs are not essential to their growth.

Table 9: Importance and frequency of barriers to growth of firms in TPs (Likert scale 1- 5)

	Finance	Technology	Infrastructure	Access to foreign market
Average	3.8	3.3	3.1	2.9
ABI	4.6	3.3	3.2	3.1
ATP	3.1	2.7	3.0	2.6
KGP	3.5	3.6		
No of firms	34	31	15	14
Share of respondents	87%	79%	38%	36%

Source: Questionnaire to TPs firms. Based on 34 replies.
Legend: see Table 2

For firms outside TPs finance and access to foreign markets are the most important factors affecting growth (Table 10). This is to be expected given that these are larger firms, the majority of which are in manufacturing.

Table 10: Importance of barriers to growth of firms in and outside TPs (Likert scale 1- 5)

	Finance	Technology	Infrastructure	Access to foreign market
- in TP	3.8	3.3	3.1	2.9
- out of TP	4.8	3.0	1.0	4.4
No firms out of TP	14	5	1	5

Source: Questionnaire to firms. Based on replies of 39 and 25 firms inside and outside TPs respectively.

TPs generate added value, to the extent that they enhance the ability of their tenants to survive and grow in business. Responses from TP firms point to a favourable perception of the value added from location in a TP (average rating 3.5) (see Table 11). The perception of value added from TPs for firms outside TPs is very similar (3.6). However, the perception of TP directors is somewhat lower ranging between 2 and 3 (see Table 1). This may point to there being a much greater potential for creating value added for firms than is actually realised.

Table 11: Assessment of value added by entrepreneurs inside and outside of TPs (Likert scale 1- 5)

	In TP	Out of TP
No firms	24	23
average	3.5	3.6

Source: Questionnaire to firms

Data on use of services from firms in two TPs show very different rates of use. Almost all of the 16 Karaganda TP firms have used the services available, while only 20% of Almaty TP firms have done so (Table 12). This may be related to the availability of these services in the town of Almaty, which is the largest town in Kazakhstan and the major commercial centre, hence there is availability of many services outside the TP.

Table 12: Number of firms' using the services of TPs

	Consultation	Business Plan	Office Services	Finance	Other
ABI (30 firms)	6	3	6	1	1
KGP (16 firms)	15	15	15	11	0

Source: Questionnaire to firms
Legend: see Table 2

Linkages among firms within TPs are part of the value added offered to tenants. Table 13 ranks the frequency and perception of intensity of linkages with firms inside the TP, and with firms outside the TP. In our sample, 46 firms claimed to have links with firms outside the TP, 31 with firms inside the TP and 23 with higher education institutions. The presence of several pharmaceuticals firms increases the importance of links with higher educational institutions and research institutes. The greatest intensity of linkages is with firms outside the TP. Links are very strong in terms of both joint development and production, most often in the form of materials purchase The frequency and intensity of linkages among firms outside the TP with other firms, are stronger than the links among TP firms. In addition, the intensity of linkages of firms outside TPs with higher education institutions is surprisingly strong when compared to TP firms (Table 13).

Table 13: Links with firms inside and outside TPs: frequency and intensity (Likert scale 1-5)

	Firms inside TP (n=25)	Firms outside TP (n=25)

		No of firms	Average intensity	No of firms	Average intensity
Other TP firms	Joint Production	16	3.5		
	Joint Development	12	3.0		
	Other	3	1.7		
	Total	31	-		
Higher Education	Joint Production	9	2.7		
	Joint Development	10	2.5	5	4.6
	Other	4	1.3	8	4.3
	Total	23	-	13	-
External Firms	Joint Production	19	4.5	23	5.0
	Joint Development	23	4.1	4	
	Other (purchase)	4	2.5	11	5.0
	Total	46	-	38	-

Source: Questionnaire to firms

A higher ranking for linkages with Kazakhstan firms outside rather than inside a TP is compatible with the results in the international literature, which has shown that the linkages among firms within science parks and incubators are weak (see Section 2).

In summary, the data, although based on a limited sample, confirm our intuition based on interviews with tenant-firms and TP managers. TPs have roughly equal numbers of firms involved in production or service provision. They operate mainly in traditional activities and, except for a few pharmaceutical SMEs, do not match the image of TPs as places for the commercialisation of new technologies. Firms within TPs are not more innovative than firms outside TPs. TP firms have stronger links with firms outside TPs than inside. Firms outside TPs have stronger links with higher education institutions than firms inside TPs. TP firms are younger than firms outside TPs. Many are hampered by cash flow problems and see lower rents as an important benefit. Those firms that are better of in terms of cash flow see the key benefit as possibly indirectly facilitating their access to external finance. The scope of TP services offered and used differs widely across TPs. Overall, Kazakh TPs operate as business incubators for locally oriented firms in traditional sectors, rather than centres of innovation promotion and diversification of the economy.

In conclusion, we summarise the results of our survey within the framework for assessing technology incubators developed by Chan and Lau (2005). We use their criteria, slightly adapted to the Kazakhstan context and categorise them in two major groups: cost reduction and capabilities enhancing contributions. We include geographical proximity or favourable location of TP as cost factor rather than as a factor that might stimulate new capabilities (Table 14).

Table 14: A summary of assessment of contribution of Kazakhstan TPs to their firms

Criteria	**Proxy from survey of TP firms**	**Contribution of TPs to firms**
Cost reduction contribution (average 3.9)		
Pooling and sharing	Infrastructure (table 8)	**3.8**

resources (exhibitions, marketing events, sharing facilities, administrative support)		
Costing (rental subsidies)	Rent (Table 8)	**4.1**
Consulting / counselling services (provision of legal, accounting and business advices at low or not cost)	Services (table 8)	**3.9**
Geographical proximity (easier access to market and partners)	Location (table 8)	**3.7**
Capabilities enhancing contribution (average 3.2)		
Clustering (development of a pool of skilled labour; externalities from supporting network i.e. complementary)	Average of links in joint production and development with higher education institutions (table 13)	**2.6**
Networking (industry access to clients / suppliers, partnership opportunities with other technology firms, knowledge sharing;	Average of links in joint production and development with other TP firms (table 13)	**3.2**
Public Image (image of TP)	Image (table 8)	**4.0**
Funding (access to venture capital and other funding sources)	Finance (table 8)	**3.0**

Source: Based on criteria developed by Chan and Lau (2005)

Table 14 indicates that the contribution of Kazakhstan TPs to their firms is relatively more important in terms of cost reductions than in terms of contribution to enhancing the capabilities of tenant firms. TPs do not add significant value added to firms in terms of improving their capabilities but make them more cost competitive when compared to firms outside TP. However, this is also partly a reflection of a low technological level and traditional orientation of tenant firms rather than only the failure of TPs to compensate for missing services and innovation links.

4. CONCLUSIONS AND POLICY ISSUES

This paper explored the role of TPs in Kazakhstan as a mechanism for innovation promotion. We focused on three questions. First, what is the underlying innovation model of Kazakhstan TPs, second, what is the overall effectiveness of TPs in promoting the innovation development of Kazakhstan, and third, whether TPs could compensate for missing elements in the technology based infrastructure and environment

Our analysis shows that the linear innovation model which forms the basis of innovation policy of Kazakhstan is in dissonance with the reality of TPs whose firms

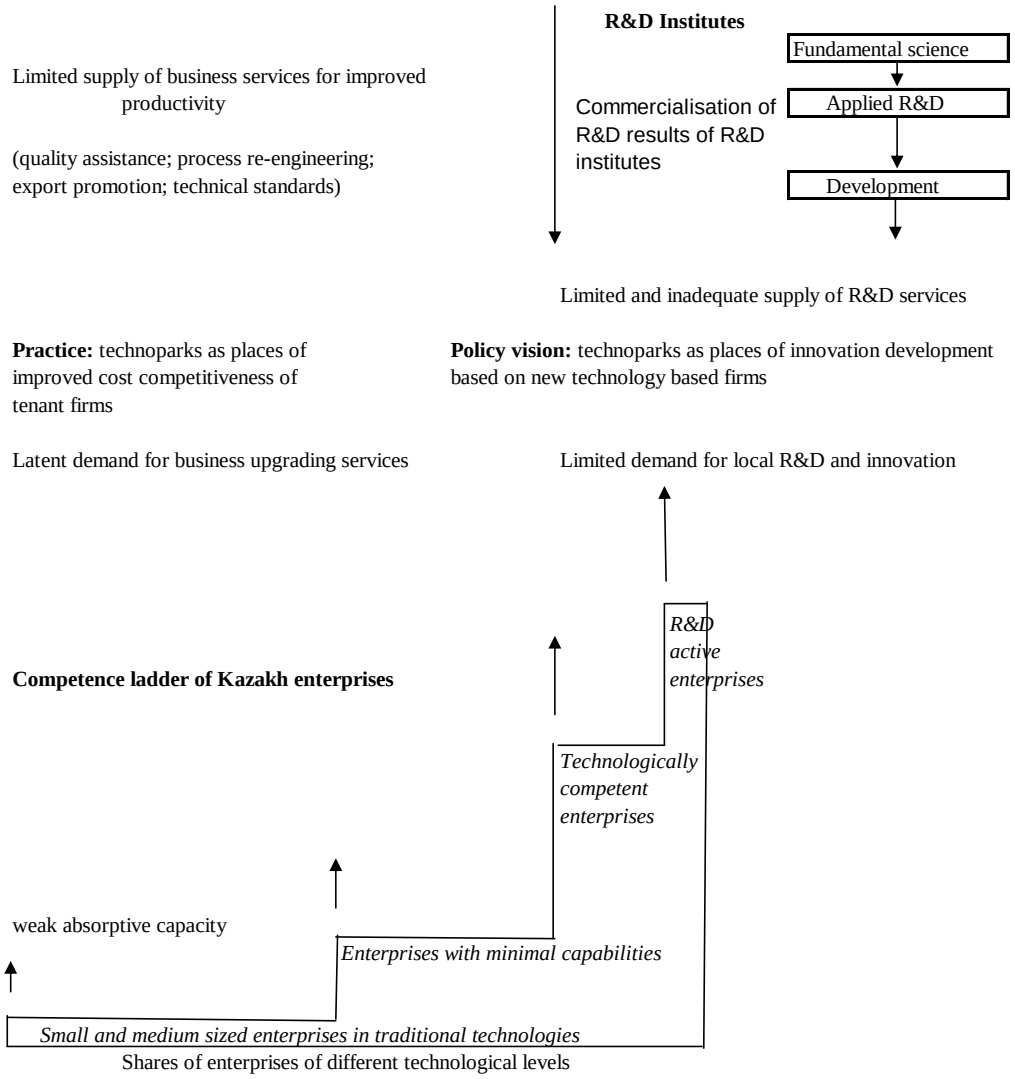
operate as business incubators in traditional industries serving local markets. TP firms are no more innovative than other firms. They are oriented largely towards the local market, and operate in traditional sectors; the frequency and intensity of their external links are more developed than are their internal links. The key motivations for relocating to a TP seem to be lower rents and the possibility of accessing finance. Overall, Kazakh TPs seem to be successful in terms of facilitating business incubation, but much les so in terms of innovation promotion and diversification of the economy. TPs as currently organised, funded and operated are not able to compensate for missing preconditions and factors of technology based competition. Hence, they are operating as business incubators by improving the cost competitiveness of their tenant firms.

Kazakhstan has embarked on the transition from a public R&D driven to a firm based innovation system. This transition can be neither understood nor successfully implemented within the logic of the linear innovation model, which is the basis for current Kazakhstan innovation policy. The strong emphasis on TPs is understandable within the logic of the linear model. We consider this policy foundation to be a serious weakness, as it does not reflect the needs of the actual innovation process.

Figure 7 depicts the nature of the problem by highlighting the implementation gap between the capabilities of Kazakhstan enterprises and the nature of the 'supply' from R&D institutes. The majority of Kazakhstan's enterprises are either small and medium sized firms in traditional technologies, many of which are located in Kazakhstan's TPs, or enterprises with minimal capabilities. Only a very small number of enterprises are technologically competent, and only a few enterprises are conducting R&D. The number of people in enterprises that are engaged exclusively in R&D is only 378, or 2.5% of the total number of R&D workers in Kazakhstan (Kembaev et al. 2001, Table 14, p. 30). In addition, R&D institutes are rarely able to provide R&D results in a form that would be useful to industry firms, especially given the latter's limited absorptive capabilities. There is a belief that TPs should be able to bridge the gap between the limited absorptive capability of enterprises and the research outputs of the R&D sector.

Figure 5: The linear innovation model logic that underpins the innovation policy of Kazakhstan: between policy vision and practice[7]

[7] The competence ladder is based on Arnold et al. (2000).



In practice, the size and nature of the implementation gap between the policy vision and practice remains a huge problem within this policy framework (Figure 7). The *Catalogue of Innovation Developments Recommended for Introduction*, published by the Ministry of Education and Science (2003) illustrates the problem. This catalogue collects the most promising commercial developments from the Kazakhstan R&D system (Table 15).

Table 15: Catalogue of innovations developed within the public R&D system of Kazakhstan

	Number	Share
Developments ready for introduction	41	20.0%
Developments that have passed industrial pilot stage	50	24.4%
Developments that have passed experimental stage	46	22.4%
Developments at the technical documentation or patent stage	68	33.2%
Total	205	100.0%

The catalogue data show that only 20% of developments (41 out of 205) are ready for introduction from a technical point of view. Our interviews with local specialists who are familiar with Kazakhstan's technology market suggest that only one or two R&D results from this list are of interest commercially. Of course, this is a very imperfect

and possibly very partial assessment, but it is nevertheless an indication of the nature of the problem, and again raises the question of whether the lack of innovation in the Kazakhstan economy can be resolved within the logic of the linear innovation model. How far can R&D institutes be pushed to substitute for firms by commercialising the results of their R&D? Could the solution lie in re-framing the problem and orienting policy more firmly towards innovativeness within industrial firms?

Supporting the emergence of NTBFs via the formation of new organisations (cf. TPs) is a quite risky and not the most effective strategy to promote innovation in emerging economies. Very often, the bulk of the money going into TPs is invested in buildings, while other tasks – generating synergies among firms, bringing in innovative projects and developing incubation services – are awarded secondary status or not supported at all.

The key point is to distinguish between support for TP *activities* (cooperation with R&D and higher education institutions, active management of technology transfer, and support for technology-intensive activities) and support for TPs as *organisations*. Rather than being focused on TPs as organisations, policy must focus and prioritise its support, first, on innovation projects (grants), second, on the people who will be involved in managing innovation projects (skills), and, third on supporting TPs as organisations.

TPs are not places that facilitate commercialisation of innovations ready for the market. There is a danger that policy may be driven by simplistic models rather than an in-depth understanding of local needs and conditions. As Quintas et al. (1992: 18) point out: 'Bridging between academic research and commercial activity is unlikely to be easy or costless, and constructing buildings is unlikely to provide an adequate mechanism. Property development gives the impression that linkage is happening when in fact it is not'.

The record of business incubation by Kazakh's TPs seems better than that of support for innovation via NTBFs. In fact, Kazakh TPs are generally operating as business parks with large scope for improvements in terms of business incubation services. Support for business incubation would be justified in Kazakhstan under present conditions, followed by a gradual introduction of support for NTBFs. Only exceptionally, where the conditions for a genuine TP are met, i.e. in those cases that can gather a critical mass of NTBFs (usually attached to a research institute or university) would support for TPs be justified.

It is unrealistic to expect that the growth generated within TPs will spread to neighbouring regions, or that TPs alone can become sources of diversification of the economy and innovation promotion. The major difference between the situation in Kazakhstan and the majority of successful examples of TPs is the (non)existence of domestic demand for R&D and technology-based activities. Currently, Kazakhstan industry does not have a demand for R&D, and its sources of competitiveness lie in non-R&D activities. This suggests that innovation policy should assist companies in upgrading their technological capabilities to the level that they can articulate demand for R&D. Without this step, focusing on TPs as a mechanism to improve competitiveness and diversify the economy may be far too expensive and uncertain a policy option at this stage of economic development.

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