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China's Path to the New Economy

An Institutional Approach

Richard Sanders and Chen Yang

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Richard Sanders: Reader in Political Economy and Director of the China Centre at University College, Northampton UK. E-mail: Richard.Sanders@northampton.ac.uk
Chen Yang: a PhD candidate and a part-time lecturer with the China Centre at University College, Northampton UK.

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Summary

As a driving force of the New Economy, the role of government in the development of high-tech sectors in China is the focus of this paper. Adopting an institutional approach, we argue that China has coped with simultaneous economic development and institutional transition within its unique 'contextual circumstances' and that gradualism and pragmatism have turned out to be the 'path dependent' solutions for China to deal most successfully with the 'churn' of transition. We argue that, with regard to China, the institutional arrangements of the Mao era (1949-76), with its features of rigid party/state governance structures and the political norm of the collective good, shaped both the evolution of the new institutional framework and the nature of the market in China-in-transition under Deng Xiaoping and Jiang Zemin in the succeeding twenty five years.

We argue that the springboard for growth of the high-tech sectors in China in the latter period was the science and technology and R&D capabilities that had accumulated under Mao in which a unique 'government-industry-university' partnership was forged. China's prior institutional framework allowed government and the universities to engage in activities that went far beyond basic research and which became the early driving forces for product development and commercial adventures in the high-tech sector. On the basis of an empirical study of high-tech university spin-offs we conclude that their evolutionary process has been characterized by 'fuzzy property rights' and 'public entrepreneurship', and through these concepts, attempt an explanation of the 'path dependence' of the Chinese high-tech sector.

1 The New Economy: an American Phenomenon?

In recent years, the 'New Economy' has been a highly nuanced concept. The term was originally coined to describe the performance of the US economy in the 1990s: often referred to as the 'American Phenomenon' and characterized by high productivity and growth rates, yet with low levels of both unemployment and inflation[1], it represented a stark contrast to the post-war decades of the 1950s through to the 1980s when economies seemed forever dogged, in traditional 'Phillips Curve' style, by periodic bouts of *either* inflation *or* unemployment. Subsequently, the term 'New Economy' became identified with those sectors of any economy characterized by high-tech industry, driven by ICT, enjoying booming capital markets and associated with intensified globalisation (in contrast to those elements of the economy dominated by traditional industry) promising a new economic dawn without periodic boom and bust. Despite enthusiasm for the concept of the New Economy, even at the crest of the wave, however, there have always been doubts as to whether such a thing ever really existed. Those doubts intensified once the ICT and dot.com share bubbles burst at the start of the new millennium and the economies of the USA and Europe joined Japan in suffering the cold winds of cyclical downturn.

Nowadays the influence of the New Economy, in terms of its intertwined fundamental tendencies of scientific and technological innovation (with the information revolution as its leading force) and globalisation, has clearly gone beyond the territory of the United States. Other countries, regardless of their different levels of development, have also embraced New Economy–driven changes. But while the American model of the New Economy represents the archetype for the ongoing science-based innovation-led changes in economies and society generally, "the concept of the 'new economy' and the innovative attempts at its theoretical explanation are (still) heavily biased in favour of the American outlook on reality" (Kolodko 2001). There is thus a need to identify the wide-ranging nature and characteristics of ongoing fundamental change involved in grasping the New Economy in parts of the world beyond the boundaries of the United States.

[1] See *Business Week*, Jan 31, 2000: "With the information technology sector leading the way, the U.S. has enjoyed almost 4% growth since 1994. Unemployment has fallen from 6% to about 4%, and inflation just keeps

2. The New Economy in the context of transitional China

2.1 New Economy - Driven Industrialisation

China has achieved both remarkably fast and generally stable rates of economic growth in the past 20 years. Having seen 'Made in China' products ranging from labour intensive low value-added goods such as toys and textile goods to high-tech high value-added computing and telecommunications products flooding world markets, some western observers argue that China has successfully turned itself into the 'workshop of the world.'

For China, grasping the New Economy has involved profound transformation of all industries. Such a change is equivalent in scope and depth to the rise in the west of the manufacturing economy in the 1890s and the emergence of mass-production and the corporate economy in the 1940s and 1950s. Yet while it has taken western developed economies a span of two centuries to go through the various stages of transformation, post-reform China has had to develop a manufacturing economy more-or-less from scratch in twenty years or so while *at the same time* engaging in its transformation into a New Economy.

Cornelius (2002, p10) argues "the transition through the different stages of economic development is not necessarily linear or gradual, nor does it happen automatically." As a large developing country, China has had to face the challenge of balancing the needs of development of high and new technology industries with traditional industries, of capital- and technology-intensive industries with labour-intensive ones. And unlike in 'core innovator' countries where, as the New Economy develops, increases in manufacturing productivity lead to a decline in the number of factory jobs and their share in total employment, in China, it has been necessary to ensure the sustainable growth of the traditional and new industries of mass production *at the same time* as promoting the New Economy given the need to absorb the vast numbers of endogenously displaced agricultural workers.

While China has achieved very high rates of growth, 'catch-up' growth with reliance on *technological diffusion* from abroad has had its inherent limits and has constrained the international competence of the mass manufacturing sector.[2] As a result, the Chinese

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getting lower and lower. Leaving out food and energy, consumer inflation in 1999 was only 1.9%, the smallest increase in 34 years."

[2] Chinese DVD manufacturers are the leading producing force of DVD, however, the 'core' technologies and patents of DVD are held by an international DVD manufacturing union of 6 multinationals from Japan and Europe – 6Cs. Chinese manufacturers only holds 6 core patents out of 32, although they have claimed the most patents in non- core technology and design of DVD. Therefore, Chinese manufacturers have to pay $10 as a patent fee to 6Cs for every DVD they sell.

government has recently proposed a strategy for accelerated development by 'taking a new road to industrialisation'[3] emphasizing the role of science in the development of high and new technology in order to provide breakthroughs in stimulating new economic growth and thereby reinforcing a strategy based upon the context of China as a developing country and the need to accommodate the challenge of the New Economy.

2.2 The gradualism and pragmatism of China's economic reform

As indicated at the Fourteenth National Party Congress in 1992, the fundamental goal of Chinese 'transition' was to establish a 'socialist market economy' through *reform, opening up* and *modernisation.* However, given the diversity of issues involved in the transitional process, in terms of policy strategy and theoretical base, there was no standard textbook, from within China or without, for Chinese policy makers to go by. Csaba (2002:p3) pinpoints the similar circumstances that puzzled policy makers engaged in the transition of the Soviet economy and eastern European countries: "(western) academic–and especially macroeconomic–departments had little idea, if any, about command economies in general and the social context of Central and Eastern Europe in particular". Thereafter, as Murrel (1995) argues, "the lack of knowledge of the specific post-communist context tended to be 'remedied' by reliance on a direct application of textbook solutions, without much care about the institutional or historic context into which these insights were to be transposed." The policies, with uncritical reliance on 'standard, pre-cooked solutions' adopted by some transitional countries in the 1990s[4], as Csaba argues, led to a neglect of the "*contextual circumstances"*, which "determine the success or failure of the application of a proven theoretical insight to policy-making." (Stiglitz 2000, pp.552-7)

An analysis of China's gradualism as a pragmatic 'bottom up' process correctly emphasises the importance of local conditions and initiatives rather than textbook blueprints as the key determinants of change. Lifting and relaxing the ideological constraints has encouraged local tests and trials and once they have been perceived as serving the principles of economic prosperity and social stability, the Party / State has pragmatically authorized and legalised them. As Gang Fan neatly concludes: "the definition and contents of 'the socialist market economy' (in China) change over time according to the changing circumstances.

[3] Speech by President Jiang Zemin at the 16th Party Congress in Beijing, November 2002.
[4] For example, voucher privatisation in Russia in 1992-4, privatisation of public utilities in Hungary in late 1995, the introduction of the private pension system in Kazakhstan in 1999

Talking only about 'what is achievable and acceptable' without specifying a 'final destination' (has) its pragmatic virtues and saves a lots of political costs." (2002, p.9). In appraising the 'bottom up' process, the most important feature of China's 'gradual' or 'incremental' approach to institutional transformation so far, as Gang Fan (2002, p.6) puts it, has been "the development of the market-oriented non-state sector, not the reform of the state sector….. the development of new sectors and associated changes to the economic structure (has) had to create and improve the conditions for the reform of the old sector".

3. The Evolution of China's High Tech Sector

3.1 Institutional Evolution

Studies on Chinese transition frequently contain themes of 'government vs. market' and 'bureaucratic (political) ends vs. economical efficiency'. We reject these frameworks. Rather, we take an institutional approach which involves interpreting the evolution of the high-tech sector as a process through which both 'economic rationality' and 'institutional (political) norms' at the macro level, and 'strategic and operational needs' and the 'desire to retain political control and placement' at the micro level are intertwined forces that dynamically shape the path of institutional change.

Institutional transformation cannot be explained by starting from an institution-free state of nature. Institutions involve rules, constraints, practices and ideas that can sometimes, regarded as constraints, *mould* individual purposes and preferences in different ways. Menger's 'bottom up' approach first analyses the role of constraints in institutional evolution, proposing that habit formation greatly enhances the formation and stability of institutions. The process of habit formation, resulting from institutional channels and constraints, is described as '*reconstitutive downward causation'* by Hodgson & Knudsen (2001), in which institutions and constraints have a capacity to mould individual preferences. Once habits become established they become a potential basis for new intentions or beliefs. As a result, shared habits become, dialectically, the constitutive material of institutions, providing them with enhanced durability, power and normative authority. (Hodgson, 2001)

Although few civil high-tech industries producing commercial products in the west existed in China at the end of the Mao era, this did not entail a lack of development of modern science and technology under Mao. However, most R&D capacity was concentrated in the military and defence industries which were given top priority at that time. The then planned

system was highly efficient in terms of mobilising available sources to complete key projects, notably in successfully launching 'two missiles and one satellite' in the 1960s and early 1970s. By the end of the Mao era in 1976, China had established R&D capability with teams of scientists and researchers based mainly at universities and research institutes attached to respective industrial ministries.

Thus the institutional arrangements and norms of 'party / state' provided the springboard from which the later reform started. At the micro level, the accepted norms and habits under the 'party / state' structure stressed the collective good and individualism was viewed as politically incorrect.

Under Deng Xiaoping's leadership from the early 1980s, ideological constraints were gradually lifted and the strategic priority was shifted from political struggle towards economic construction. At the macro level, the change started by a modification of the rigid planning system and incorporating market principles progressively. The economic structure was adjusted by transforming parts of the military and construction industries into civil production and stressing the importance of developing the tertiary sector previously neglected under Mao. At the micro level, the non state-owned sector was allowed to develop and State Owned Enterprises (SOEs) were allowed to generate and retain capital. People were allowed to pursue their individual interests.

From the start, Deng Xiaoping emphasised the importance of science and education for the economic development of China. He understood the need to apply the R&D strength that had accumulated under the Mao era in civil sectors to serve the long-term development objectives of the 'Four Modernisations.' This process was intertwined with the transition from planning to the market which started with the incorporation of competition and market principles into the system and which gradually progressed by building up market-oriented institutional infrastructures. It was a 'reconstitutive downward' process. People whose lives had been spent in military and political struggle gradually adjusted to the market economy. Meanwhile, in the science and technology sector, the institutional need was to bring together the technological strength already developed within public research institutes with the opportunity-seeking, flexible entrepreneurship that characterised the traditional Chinese model of doing business. This required an accommodation between the cultures of bureaucracy and enterprise and necessitated the establishment of an institutional norm of *entrepreneurship*. Nonetheless the formation of any new norms were constrained and 'moulded' by the prior planning system and the norm of the collective good.

3. 2 Government's role in the Development of Science & Technology

When the reform started at the end of 1970s, the state sector was the dominant force in Chinese economy, which, in 1978, contributed 76% of GDP, with the collective sector contributing the other 24%. Throughout the 1980s, the non-state sector, township and village enterprises (TVEs) in particular, flourished and increasingly contributed to economic growth in China. Thus, given the lack of a private sector and of market-oriented institutions, the development of the high-tech sector was initiated by public research institutions within the planned economy. Its growth was intertwined with the process of transition as market principles were gradually established and the non-state sector gradually outperformed the state sector. But the process leaned heavily on two key government initiatives, the 863 and Torch programmes.

3.2.1 The National High Technology Research and Development Programme of China – The 863 Programme

" We must have our own 'fist' products, otherwise we will be bullied and beaten"
Deng Xiaoping 1992

In order to narrow the gap between China and high-technology frontiers, the Chinese government launched the National High Technology Research and Development Programme of China, referred to as the 863 Programme (representing March 1986, the date it was initially proposed). The policy makers of the initial programme took China's context into consideration when they made the plan. As a large low-income developing country, China was not capable of investing full-scale into new high-technologies and it was impossible (and, indeed, not necessary) for China to compete with leading developed countries in every high technology front. Therefore, the programme followed the guideline of adopting high technology according to the pragmatic demands and capacity of China, selecting seven priority areas (biotechnology, information, automation, energy, advanced materials, laser and space) covering fifteen subject topics as national key projects[5]. The programme currently covers 20 subject topics selected from eight priority areas.

[5] In 1993, telecommunication was added as a subject topic of the 863 Programme and from 1991 to 1995, there were other 4 subject topics added. In July 1996, marine was added as the eighth area of the programme

The main elements of the 863 programme were as follows First and foremost, under state direction, the universities, colleges and research institutes were the key forces employed to conduct projects nationwide. As indicated in the latest statistics from the Ministry of Science and Technology (MOST), the host institutions of projects under the programme in 2001 were distributed in 28 provinces, municipalities and autonomous regions across the country. More than 20,000 researchers and administrative staff from over 3,000 research institutions, universities and enterprises across the country were involved. Figure 1 makes clear the continuing importance of universities and research institutes to the work of the 863 programme.

Figure1: Distribution by the nature of project undertaken (2001)

	Research institutes	Universities	Enterprises
Projects	38%	50%	12%
Expenditure	43%	43%	14%
Personnel	39%	46%	15%

(Source: The 863 Program Annual Report 2001)

Secondly the funding system involved direct appropriation of central government funds to key projects, circumventing the bureaucracy and other obstacles of the then planned fiscal and financial systems that otherwise might have slowed down the programme. Reforms led to the allocation of funding directly to the projects rather than to the 'directing units' of the universities research institutions thereby putting limited sources together to pinpoint the project. Thirdly, the management of the programme was based on an expert management system established under MOST.

The 863 programme can claim progress on a number of fronts. Firstly, it has narrowed the gap between China and high-tech frontiers. In the biotechnology sector, new varieties of plants with high yields and tolerance were developed. Breakthroughs were made in developing new medicines, vaccines and gene therapy and in protein engineering. The government approved the first China-made anti-AIDS drug for clinical testing and China's human genome sequencing project was incorporated in the framework of the International Cooperation Programme. In automation technology, a breakthrough was made in the intelligent robot (IR) project and home-made robots were used in manufacturing industries; a

project involving robots working at sea in depths of 6,000 metres was successfully completed, allowing China to conduct scientific research in 97 % of the oceans of the world.

Secondly, under the 863 Programme, breakthroughs in high-tech frontiers and applied technologies have provided China with strategic home-supplied technologies and products to compete with overseas multinationals, breaking their monopoly and technology constraints, specifically in the areas of ICT sector including intelligent computer system, optoelectronic device & systems integration technology, information acquisition and processing techniques.

Thirdly the implementation of high technologies reshaped traditional industries and enhanced the productivity and the competence of China's manufacturing sector. The breakthroughs in information technology, biotechnology and other high-tech sectors have provided China with opportunities for China to build up its own New Economy sector[6].

And fourthly, the 863 Programme nurtured a new generation of leading scientists. The programme invested heavily in basic research and sponsored 70% of the papers in computing science published and presented by Chinese scientists in international journals and conferences. Within ten years, there were more than 30,000 scientists involved in the programme receiving funding providing the backbone of China's science & technology national effort.

3.2.2 The Torch Programme and the Introduction of High-Tech Development Zones (HTDZs)

In August 1988, MOST launched the Torch Programme. While the 863 programme put emphasis on long-term R&D in the strategic and cutting-edge high-tech sectors, the main mission of the Torch Programme was to focus on the *application* of completed R&D and on the commercialisation of market-oriented technologies that would benefit business quickly. Between 1988 and 1999, the Torch Programme made significant progress with a total of 18,888 projects completed, 5,045 classified as 'nation level projects'. The scientific breakthroughs under the 863 Programme and the pragmatic application of schemes under the

[6] Contemporary Integrated Manufacturing System (CIMS) technology which started from scratch at the outset of the 863 Programme had within ten years established ten CIMS training centres nationwide and given CIMS training to 400,000 people including 37,000 chief engineers and company experts. The CIMS Centre at Tsinghua University and Huazhong University of Science & Technology were awarded University Lead Awards by the Society of Manufacturing Engineers (SME) in 1994 and 1999 respectively. Their achievements made China only the second country to receive the award more than once, the USA being the other.

Torch Programme provided the essential foundation for the formation of clusters of high-tech industries[7].

With the purpose of filling the gap between basic R&D and commercialised application, the government adopted the method of fostering Science & Technology Industrial Parks. At the same time, MOST instituted a network of High Technology Development Zones (HTDZ) across China to facilitate the Torch Plan and support the commercialisation of basic R&D at local level. The most important element of the Torch Programme was that it was (and is) *state-led*, collectively conducted through cross-ministry co-operation.

High-tech companies registered in HTDZs under the Torch Programme benefited from a range of favourable policies. In terms of taxation MOST and the State Bureau of Taxation consistently provided significant tax breaks for high-tech development. With regard to financial arrangements, from 1990 MOST and the China Industrial and Commercial Bank, Construction Bank and Agricultural Bank jointly issued regulations that favoured high-tech companies in the provision of special loans for R&D and applied high tech projects. In terms of customs policy, high tech companies registered in HTDZs were allowed to set up duty free storehouse and manufacturing plants within the zone. In 1991 MOST issued new regulations that simplified the application process for going abroad from high-tech company chiefs. Meanwhile, cross-ministry co-operation has played a key role in fostering the cluster of high tech industries. For example, in 1998 six ministries, including the State Planning Committee, Ministry of Education, MOST, Ministry of Electronic Industry, China Academy of Science and the Bureau of Technology Supervision, worked together on a national strategy to foster the development of the software industry primarily in HTDZs[8].

Secondly, as with the 863 programme, the implementation of the Torch Programme has fundamentally relied on R&D strengths in the universities and research institutes. Indeed, one of the main missions of HTDZs has been to provide guidance and support for academics

[7] In the ICT area, leading companies including Huawei Technology, ZTC, Great Dragon Technology and Giant Tang Technology formed the cluster for telecommunications equipment and Chinese manufacturers are capable of competing with multinational giants Northern Tel, Cisco on international markets. With 7 semi-conductor companies, China currently holds the second largest manufacturing power in producing computer chips, with America being the first.

[8] To date, 22 'software Industry Bases' have been established with more than 3,700 registered companies hiring 170,000 employees. By 2000, the total turnover of software companies registered in 22 bases exceeded 65 billion Yuan.

from university and research institutes to 'commercialise' their research outcomes[9]. Most HTDZs were established in university districts.

4 The *Evolution* of the Government-Industry-University Partnership in China

So far, we have examined the macro-level decision-making concerning the development of the high-tech sector in transitional China. However, appropriate macro-level conditions are necessary but not sufficient in themselves to provide opportunities to generate prosperity and create wealth. Wealth is actually created at the micro-level by individual enterprises.

In China, as elsewhere, institutional arrangements constrain individual habit and behaviour. After 1980, the reforms allowed research institutes to pursue their own benefits and the chase by individual researchers after wealth was no longer regarded as a vice. The capacity to generate by turning research outcomes into commercial ventures turned out to be an assessment criterion as important as basic academic achievements for promotion, both political and academic, within the system. The interplay of these forces helped to create new positions for individuals and gave them an opportunity to play a part in the new order. As a result, the direct and indirect consequences of the reforms had the effect of creating new interests and groups, some with an explicit commitment to the reforms themselves, others seeking to find a role as the reforming measures began to erode their hitherto secure status.

Central government policies played a vital role in creating an appropriate environment to foster the transformation of S&T research outcomes into commercial ventures. Research institutes and individuals were encouraged to co-operate with industry, firstly with SOEs and thereafter with the non-state sectors. The reforms were implemented at different rates, depending upon the initiative, energy and norms of the local officials, university leaders and scientists. It was a process which involved education and S&T officials, R&D leaders and otherwise well-connected individuals within the system using the capital and influence they had accumulated in the previous era to pursue business ventures in the new one. The practical

[9] For example, the Beijing HTDZ was located at Zhong Guan Cun where Beijing University, Qinghua University, the China Academy of Sciences, Peoples University and other important research institutes are based. Zhong Guan Cun has been transformed from a suburb campus into a high tech zone with world leading ICT manufacturers and their associated research institutes, including Chinese groups such as Legend, Founder, Sitong, DaTang, originally spin-offs of universities in that zone, and American blue-chips such as Microsoft China and Motorola China.

consequences of the reforms were less clear-cut and took time to emerge, often shaped by the personalities involved. As a result there were diverse forms of business venture, including industry-university (research institute) partnerships which varied not only for businesses developing in different regions and from different universities, but also for businesses originating from the same university.

In terms of the changing nature of ownership of high-tech enterprises, the development has proceeded through gradual reassignment of specific property rights within the party/state administrative hierarchy (from higher government agencies to lower government agencies and from government agencies to enterprises, managers or individuals. As ownership has moved gradually away from traditional forms of state and collective toward a mixed economy, high-tech enterprises have been pervaded by various forms of ownership over time: reformed state and collective, various forms of private enterprise – the family firm, the elite industrial empire, and the private companies owned by government agencies and enterprises. With the creation of market institutions and the incorporation of non-state sectors, mechanisms to specify and enforce property rights have been gradually decentralised alongside the expansion of high-tech enterprises.

5. University Spin-offs

Among different types of business ventures in the high-tech sector, university spin-offs in China have had a distinctive development path. China's high-tech industries have from their inception been dominated by spin-offs (Gu, 1994, Baark, 1994). As we have argued earlier, universities and research institutions have played a vital role in the transitional development of high-tech sectors. But in contrast to the model developed by Vannevar Bush[10] which was presumed appropriate to the post-war American market economy in which "government should keep mission-oriented research in the hands of federal agencies and be the main founder of scientific (basic) research in universities, allowing individual scientists to decide how research funds are allocated and how research is conducted and applied", China's prior institutional framework allowed government and the universities to engage in activities that have gone far beyond basic research and which have been the early driving forces for product development and commercial adventures. And unlike western counterparts, Chinese universities were permitted to set up departments of 'industrialisation' and 'industrial-

[10] Vannevar Bush: a noted MIT electrical engineer, he proposed the model in his 1945 report to President Truman with the title "Science: The Endless Frontier".

academic-research' committees to organise and develop business spin-offs. These spin-offs represent a fundamental institutional innovation which has had a major impact on the organisational relationship between R&D and entrepreneurship. Figure 1 shows the evolution of university high-tech spin-offs in China in terms of property rights arrangements, management style and organisational structure.

Figure 1: Development stages of high tech spin-offs

		Period	PR	Ownership	M Style	O Structure
1	*Start-up*	80s-92	Contract Responsibility / Contract leasing	The reformed collective firms	University DS Individual E	Unstructured
2	*Survival*	90s e-m	Contract Responsibility / Contract leasing	Contracted public firms / leased public firms	University SS Individual E	Simple
3	*Growth*	92 onwards	Joint Stock	Mixed ownership (Including private)	Entrepreneurial, Co-ordination	Functional, Centralised
4	*Expansion*	92 onwards	Joint Stock Shares offered on stock exchanges	Mixed ownership (Including private)	Inception of Professional Administration	MES Dec-en
5	*Maturity*	90s m o	Joint Stock Shares offered on stock exchanges	Mixed ownership (Including private)	Professional Administration	MES, Multinational (De-cen)

(PR: Property Rights, T M: Top Management, M: Management, O: Organisational
DS: Direct Supervision, SS: Supervised Supervision, MES: Modern Enterprise System)

According to Gu (1994), most high-tech enterprises operating nationwide in 1993 were set up with assistance from public institutions. Universities have not only acted as organisers and liaisers but have also converted themselves into corporations. Most high-tech spin-offs were registered as 'collectives with a supervising unit' (Gu, 1994), even when the universities and other public institutions they belonged to initially engaged in the top

management and remained as the ultimate controller, in terms of voting rights by shares, after they had grown into multinational publicly listed companies.

Property rights arrangements in university high-tech spin-off ventures were fuzzy at the start-up stage and continue to remain unclarified. The paradox is that university spin-offs have performed impressively through intense competition in innovation-based sectors, their growth dependent upon the sophistication of clusters, company strategies and strong operating practices, despite the inadequately developed microeconomic business environment[11] and the unclarified institutional arrangements.

For the purpose of interpreting the above paradox, we examined the evolutionary process of university spin-offs. We conducted a survey of 23 high-tech companies currently listed on the two Chinese stock exchanges initiated as university spin-offs. These high-tech shareholding corporations are ultimately controlled and owned by universities and state research institutions and were listed among the top 100 publicly listed high-tech companies at the end of 2001.[12] The research observed the change of ownership and control in terms of the major players involved.

[11] To include the extent of bureaucratic red tape, the quality of infrastructural facilities, the condition of governance, the lack of sophistication of market institutions, constraints on the liberation of trade and quality of S&T research institutions and police protection of business.

[12] All samples are shareholding corporations listed and trade on Shanghai Stock Exchange (SHSE), Shenzhen Stock Exchange (SZSE) and Hong Kong Stock Exchange (HKSE). Data of all companies included in this research project are obtained from the China Securities Regulatory Commission (CSRC) official database and various data relevant to companies.

Figure 2: Leading University Spin-offs

	City	Status	No. PLCs	Industries
Beijing University	Beijing	LC	4	ICT, CS, BT
Tsinghua University	Beijing	LC	2	ICT, BT, MT
Fudan University	Shanghai	LC	1	Mixed
Shanghai Transportation University	Shanghai	LC	2	Mixed
Tongji University	Shanghai	LC	1	BT
Zhejiang University	Hangzhou	LC	2	ICT
Nankai University	Tianjin	LC	1	MT
Tianjin University	Tianjin	LC	1	ICT
Dongbei University	Shenyang	LC	1	ICT, CS
Xian Transportation University	Xian	LC	1	ICT
Huazhong University of Sci.& Tech	Wuhan	LC	1	CIMS, MT
Wuhan Institute of Telecommunication Sci.	Wuhan	ML	1	ICT
Yunnan University	Kunmin	LL	1	BT
Chinese Academy of Science	*Various*	ML	2	ICT, BT, MT

(LC: Leading Comprehensive University under State Education Committee, ML: Leading University under direction of the Ministry, LL: Leading University under direction of Local government;
ICT: Information Communication Technology, MT: Material Technology, BT: Biotechnology)

Figure 2 identifies key sample universities in our study. Most universities in charge of publicly listed companies are leading comprehensive universities under the direction of the State Education Committee (SEC), the rest are either directly controlled by parent industries or supported by local government. Almost all sample university companies are located in the regions receiving most government funding for S&T and high tech projects and are mainly engaged in ICT, computing science and biotechnology.

Our empirical study of university spin-offs indicates the *bargained* nature of their property rights. With regard to the right to residual income, from the time the company began making a profit, profit-sharing arrangements were bargained annually and worked out informally through discussion between the university director and the head of the company. Yet with regard to the rights of control and utilization of the company, the founder managers often exercised enormous personal power over the firm. The university exercised a limited

degree of control over the appointment of the general manager, often the result of informal bargaining between the university and the appointee him/herself. Ultimately, the university retreated from the productive function, strategic decisions and employment contracts of the company, leaving the rights of control in the hands of the founder. Agreeing with Francis (1999), we conclude that the bargaining of property rights may have helped the spin-offs resolve problems of entrepreneurship, resource allocation, investment, soft budget constraints and other institutional and economic challenges at the initial stage while the university authority remained the legitimate owner of the company, often holding the majority share in the company.

6 Fuzzy Property Rights and Public entrepreneurship for the collective good

Schumpeter (1993[1991]) was the first to explore the entrepreneurial function and its role in social change. The very core of the 'Schumpeterian entrepreneur' rests on the importance of vision and imagination for overcoming uncertainty (Kuhnert, 2001: 14). Kwiatkowski (2002) argues that building elements of entrepreneurial society is vital for post-socialist countries to take opportunities for achieving economic growth.

We borrow Olson's concept of 'public entrepreneurship' to describe the nature of university spin-offs in China as discussed above. Relying on the institutional approach involving 'a shift of perspective from the determinism of conventional physics…to the non-teleological, creative, and non-determined nature of evolutionary process' (Buchanan/Vanberg 1991:168), we gain an evolutionary perspective of the growth of university spin-offs and step towards an explanation of the phenomenon.

We argue that China's institutional framework directed individuals to socially beneficial decisions. Specifically, the legacy, derived from the Mao period, of pursuing the collective good prior to individual benefit had a crucial influence on their behaviour. However while people were no longer judged politically progressive or backward simply by whether they owned property as they had been under Mao, they *remained judged* by their political awareness and consequently by *how* they acquired and used their property, and by *ho*w they contributed to the cause of building 'socialism with Chinese characteristics' through their work. We argue that, in this one crucial aspect, fuzzy property rights helped them cope with economical uncertainty: on the one hand, such fuzzy rights allowed the collective unit, not the individual, to bear the prospect of any business failure and on the other, such fuzzy property rights helped individuals to avoid ideological puzzles and constraints which existed

during the early stages of reform. The set of institutional arrangements that allowed individuals to take different and even contradictory actions thus helped them to cope with the *ideological* uncertainty of the transition.

In the initial stages of reform, *public entrepreneurs* in China had to deal with 'uncertainty', with the 'imperfect' knowledge of the 'right' way and of the unintended consequences of actions taken to realise desired outcomes. The rewards for public entrepreneurs varied significantly. In exchange for the investment of their time, resources, skills and capital, they expected power, honour, fame and a change of social status. Some pursued substantial control of the company and began to transform themselves into individual entrepreneurs. But in order to mobilize investments and opportunities beyond the capacity of relatively small-scale individual firms, individual entrepreneurs had to develop new forms of shareholding structure associated with mixed ownership and thereby regain 'public' status. And in so doing, those *individual* public entrepreneurs operated to further the *collective* good.

7. Conclusion

The 'New Economy' offers great potential for sustainable economic growth. However the full potential of the 'New Economy' cannot be achieved automatically without establishing a new framework for government and public policy. Less developed post-socialist countries like China have to cope with the challenges of developing the 'old economy' and fostering the 'new' simultaneously and there is thus a need for government policy to balance the process of 'development' and 'transition'.

Since science-based high technology is the driving force of the 'New Economy', this paper has examined the development of high-tech industries in China in the past two decades in which China's government has taken an active approach to taking the 'new road to industrialisation' and fostering the 'New Economy'. We argue that efforts to move quickly to the theoretically optimal condition may entail unacceptably high social and political costs. Gradualism and pragmatism as key principles of government policy in the reform process generally in China have been successfully applied to the evolution of high-tech industries there.

We have identified the key 'path-dependent' features of China's high-tech spin-offs: *fuzzy property rights* and *public entrepreneurship*. We argue that what is optimal in theory (for example, clarified, private property rights) is not necessarily achievable in the real world and that, as a result, the set of institutional arrangements that allows different and even

contradictory individual actions to occur may help to cope with the uncertainty of transition. We believe this to have been the case in China in the last twenty-five years as it has struggled to come to terms with the New Economy.

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