Basing the economy on oil could prevent a strong relationship from developing between science and wealth.

Kioomars Ashtarian

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Kioomars Ashtarian

INTRODUCTION

In Iran, science, technology and innovation (STI) policy hinges on the country's status as an oil economy. Home to the second-biggest known reserves in the world after Saudi Arabia, Iran has invested in the oil industry to the point where receipts now represent more than four-fifths of GDP. No discussion of the evolution of STI policy in Iran since 2000 would thus be complete without an analysis of the impact of Iran's oil economy on STI policy.

In the present chapter, we shall argue that oil receipts can play a perverse role in S&T policy and development. This is because the windfall from oil revenue tends to stimulate consumerism and create a schism between consumers and the scientific community. With S&T policy relegated to the back seat, bureaucratic preferences take precedence over the development of science as a public good.

We shall also argue that an oil economy need not be an obstacle to the development of science and technology (S&T). Recent trends in planning and public policy-making demonstrate that Iranian officials plan to foster S&T, although the effectiveness of this policy will depend on its socio-economic orientation.

Iranians have a positive attitude towards science, so there is no major cultural barrier to the evolution of S&T. Scientific advances are easily accepted within the religious and political spheres. Yet, despite this positive attitude, science is neither an important part of economic life, nor considered an intellectual right.

Attitudes towards science are largely influenced by cultural and, to some extent, political considerations. As science is recognized as being the determining factor in the efficiency of Iran's political system, the elite has tended to mainstream scientific progress in its political discourse. As a consequence, expenditure on research and development (GERD) and research budgets in higher education have largely been spared from cuts, even in hard times.

Over the past decade or so, Iran has reacted to the imposition of trade embargoes by some Western countries by developing its own scientific and economic infrastructure. This has entailed expanding higher education and spawned the Southern Pars Oil Projects, national projects for the production of steel, cement and so on, and the local production of goods for domestic consumption, such as cars or electrical appliances. Nevertheless, research and development (R&D) have failed to target market needs. Iran has instead chosen to focus on such fields as peaceful nuclear technology, nanotechnology, satellite launching, the reproduction of stem cells, animal cloning and so on. As a result, S&T policy remains insulated from changes in the economic conjuncture.

High oil receipts in recent years have been a boon for science. At the same time, however, this natural wealth has divorced science from socio-economic needs and favoured government intervention in S&T policy: as much as 73% of research is government-funded. As we shall see later, the steep climb in oil revenue in 2004–2005 has been followed by a spending spree on science and social welfare but also by a burgeoning bureaucracy. This situation has not only favoured a science pull instead of a technology push; it has also nurtured the domination of S&T policy by a scientific elite in academia. This dual phenomenon explains the low contribution of S&T policy to industrial development and the high rate of resource-based exports for an industrial economy, about 50% (Iranian Centre for Statistics, 2004).

In addition to the country's economic dependence on oil, S&T policy in Iran is typified by an interventionist bureaucracy which can lead to wastage of public funds. The greatest weakness, however, is the lack of orientation of STI policy towards problem-solving. Although the focus of scientific research is gradually shifting towards national problems, much of policy research in Iran demonstrates no strong relevance to national issues. Demand push for research and technology, a knowledge economy and problem-oriented research are all fashionable concepts in S&T policy, yet it would seem that the interrelation of these concepts and their integration into the economy receive little consideration in the policy-making process in Iran, despite their social relevance.

S&T policy-making in Iran needs to pay attention to such notions as technology diffusion, standardization, legal system reform, commercialization of research, establishing a trade-off system, institutional reform, communication and so on, if it is to make a real connection between scientific research and society. In the policy agenda, government preferences and the science pull approach should come after the demand push for research. Iran needs to take progressing towards a knowledge economy more seriously because basing the economy on oil could prevent a strong relationship from developing between science and wealth.

High oil receipts in recent years have been a boon for Iranian science but have divorced science from socio-economic needs.

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SOCIO-ECONOMIC SITUATION

Healthy growth in GDP

Iran has enjoyed a healthy rate of economic growth since 2001, with a peak in 2007 of 7.8% (Tables 1 and 2). Overshadowing this performance, however, is an inflation rate that has fluctuated between 10% and 25% since 2000. As a result, Iran's standing among its neighbours, such as Saudi Arabia, Turkey and Pakistan, has oscillated at times.

GDP per capita has grown rapidly, from PPP US$ 6 820 in 2000 to PPP US$ 11 844 in 2007. Over the same period, Iran's human development ranking likewise improved from 98th to 88th place. This places Iran near the top of the list of countries with medium human development, between Georgia and Thailand (UNDP, 2009).

Slower population growth and better literacy

In the past decade, population growth has slowed from 1.6% per annum in 2000 to 1.4% in 2008. It is estimated that this rate will further decline to 1.3% by 2015 when Iran will have a population of about 79.4 million. Iran's young population could be an opportunity for the country's development but the high rate of unemployment could also cause socio-economic problems.

According to UNESCO (2010), 82% of Iranians over the age of 15 years were literate in 2007, a figure projected to rise to 88% by 2015. It is also expected that the literacy gap between men and women will shrink: 23% of women were illiterate in 2006, compared to 12% of men; the projected figures for 2015 are 12% and 8% respectively. At university, women made up two-thirds of the student body in 2009.

An economy dominated by oil

The share of non-oil economic activities in GDP has dropped during Iran's fourth *Five-Year Economic, Social and Cultural Plan* (2005–2009), compared to the previous plan. In parallel, oil revenue has climbed to US$270 billion since President Ahmadinejad took office in August 2005. One-third of the economy is now dependent on oil, especially since the downturn in the construction sector in 2009 caused by the global recession (Figure 1).

The proportion of non-oil industrial sectors shrank to less than one-fifth of total gross national income (GNI) between 2002 and 2007 (Iranian Central Bank, 2007*a*). These sectors include agriculture, industry and mining, electricity, gas, water and construction (Figure 2). Only mining managed to hold its own, even though it was progressing from a low starting point: 0.7% of GDP in 2002 and 0.8% five years later. The share of oil, on the other hand, nearly doubled, climbing from 15.1% in 2000 to 27.9% in 2007 (Iranian Central Bank, 2007*b*).

Imports represent an estimated 30% of GDP and exports 39% of GDP (2007). The share of goods and services in imports has not changed since 2006 but has risen more than 7% for exports. Exports of goods and services can be broken down into raw materials (88%), industrial products (9%) and advanced technologies (3%) [Iranian Central Bank, 2008].

Between 2004 and 2008, the share of oil revenue allocated to the government rose to US$60 billion. By 2007, the increase represented four times that forecast for the period of the *Fourth Plan* (2005–2009). Since the revolution of 1979, reducing government funding via taxes and non-oil revenue had become a priority. This led successive

Table 1: Socio-economic indicators for Iran, 2000–2007

	2000	2001	2002	2003	2004	2005	2006	2007
GDP per capita (PPP) US$	6 820	7 125	7 672	8 264	8 796	9 314	9 906	11 844
GDP growth (%)	5.14	3.66	7.51	7.11	5.08	4.31	4.57	7.82
Inflation rate (%)	–	–	15.8	15.6	15.2	12.1	11.9	18.4 **
Population (millions)	63.93	64.97	66.01	67.04	68.06	69.08	70.09	71.02
Population growth (%)	1.64	1.61	1.58	1.54	1.51	1.48	1.45	1.30
Human development index	0.721	0.719	0.732	0.736	0.746	0.773	0.777	0.782
Public expenditure on education (as % of GDP)	4.4	4.4	4.9	4.8	4.9	4.7	5.1	5.5
Gini* 0.4		0.4	0.39	0.38	0.40	0.39	0.4	0.39

* The Gini coefficient index is used to measure inequality of income or wealth. The coefficient varies between 0 (complete equality) and 1 (complete inequality).
** The inflation rate jumped to 25.4% in 2008 before dropping back to 16.7% in 2009 and about 10% in 2010; for HDI: UNDP (2009) *Human Development Report* and earlier reports

Source: UNESCO Institute for Statistics database, November 2009; Iranian Central Bank (2009) *National Accounting Report 2001–2009*

Table 2: Socio-economic indicators for Iran and other South West Asian countries, 2000 and 2007

	GDP (current PPP US$ millions)			GNI* per capita (current international dollars PPP)			High-tech exports (% of manufactured exports)		Internet users (% of population)	
	2000	2007	average growth rate (%)	2000	2007	average growth rate (%)	2000	2007	2000	2007
Afghanistan	19 429	27 139	5.7	–	–	–	–	–	0.1	1.84 $^{+1}$
Armenia	9 733	17 139	10.9	2 080	5 870	26.03	4.54	2.03	1.30	5.74 $^{-1}$
Azerbaijan	23 634	64 082	24.4	2 080	6 570	30.84	5.37	3.94	0.15	10.83
Bahrain	10 053	24 245	20.2	20 030	–	–	0.03	0.05	6.15	33.21
Georgia	–	–	–	2 150	4 760	17.34	10.77	7.12	0.49	8.18
Iran	374 582	776 538	15.3	6 790	10 840	8.52	1.89	6.17	0.98	32.38
Jordan	125 841	185 883	6.8	3 260	5 150	8.28	7.98	1.12	2.65	19.70
Kazakhstan	19 380	28 038	6.4	4 480	9 600	16.33	3.94	23.25	0.67	12.27
Kuwait	87 293	167 467	13.1	35 010	–		0.78	–	6.85	33.80
Kyrgyzstan	31 351	114 597	37.9	1 250	1 980	8.34	17.64	2.44	1.05	14.33
Lebanon	18 647	41 431	17.5	7 510	10 040	4.81	2.34	2.39	7.95 $^{-2}$	38.32
Oman	29 018	51 019	10.8	14 440	–		3.09	0.46	3.75	13.08
Pakistan	266 159	409 973	7.7	1 690	2 540	7.19	0.39	1.37	–	10.77
Qatar	43 811	56 303	4.1	–	–		0.00	0.01	4.86 $^{-1}$	41.98
Saudi Arabia	235 563	554 250	19.3	17 490	22 950	4.46	0.40	0.61	2.23	26.41
Syrian Arab Republic	57 561	89 759	8.0	3 150	4 430	5.80	0.53	0.82	0.18 $^{-1}$	17.45
Tajikistan	7 105	11 821	9.4	800	1 710	16.25	41.77	–	0.05	7.18
Turkey	455 336	922 189	14.6	8 600	12 810	6.99	4.85	0.38	3.71	16.45
Turkmenistan	20 567	22 607	1.4	–	–	–	4.89	–	0.13	1.41
United Arab Emirates	48 855	195 396	42.8	41 500	–	–	0.69	0.66 $^{-1}$	23.56	51.78
Uzbekistan	60 431	65 167	1.1	1 420	2 430	10.16	–	–	0.49	9.08 $^{+1}$
Yemen	15 634	52 285	33.4	1 710	2 200	4.09	–	–	0.09	1.61 $^{+1}$

-n/+n = data refer to *n* years before or after reference year

* Gross national income is made up of a country's GDP plus any income earned abroad, such as dividends or interest on loans, from which is subtracted similar payments made to other countries.

Note: The countries selected for this table correspond to Iran's 20-year vision of topping this list of countries by 2025 for various socio-economic indicators. Only Iraq is missing, for lack of data.

Source: World Bank, World Development Indicators, July 2009

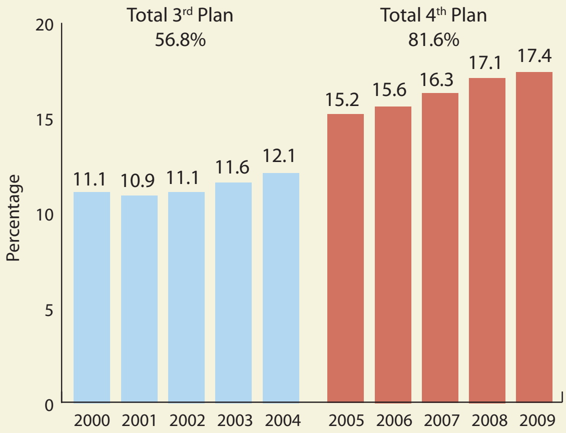
governments to assign a US$16 billion ceiling for government withdrawals of oil revenue during the country's successive development programmes, especially those since 1990. Oil revenue in the eight years of President Khatami's government (1996–2004) climbed to US$193 billion and in the first four years of President Ahmadinejad's government (2005–2009) to US$258 billion.

A trend towards privatization

More than 60% of industrial production in Iran is supplied by government companies. In 2006, the government announced an ambitious Industrial Privatization Programme to sell off the country's major companies to the private sector, such as the Ahwaz Steel Company or Iran's Communication Company.

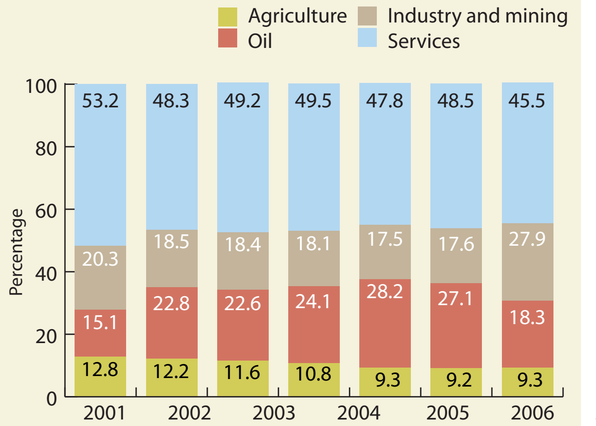
The financial sector remains dominated by state banks, even though four private banks were established in early 2000 and major public banks were gradually being privatized in 2009. Banks have become an important source of funding for the private sector. In 2007, they provided 94% of liquidities to private companies, compared to just 4% in 1990. This increase implies that the largely state-controlled banking system has been a significant contributor to economic growth. Borrowing facilities have grown along with the increase in the money supply: 60% of deposits held in Iranian banks were made available to borrowers in 1998, a share which had risen to 85% by 2007. The Iranian banking system has been harnessed to help the country improve its competitive advantage, upgrade technology and stimulate

Figure 1: Share of oil revenue in Iran's budget, 2000–2009 (%)



Source: Iranian Central Bank (2007*a*) *Economic Evolution*. Report. Tehran

Figure 2: Share of economic sectors in Iranian GDP, 2001–2007 (%)



Source: Iranian Central Bank (2007*b*) *National Accounting Report 2001–2007*, p.16

productivity and economic growth. As a consequence of being indexed on the economy, however, the banking system has also become dependent on the oil economy.

A slowly shrinking income gap

The income gap is shrinking in Iran but remains wide. Whereas the richest citizens earned 22 times as much as the poorest in 1990, this ratio had dropped to 17 by 2004. This is higher than the ratio for Pakistan (8:1), Indonesia (7:1) or Thailand (12:1). The picture is the same if we take some developed countries: France (9:1), Switzerland (10:1) and Germany (7:1) [Iranian Central Bank, 2008].

Some 4.5 million Iranians, or 1.5 million poor households, are covered by government social welfare networks and charities. Subsidies have a major impact on the economy. One of the most important challenges for the Iranian economy in recent years has been to reduce non-targeted energy subsidies, which constitute 10% of GDP and do not always go to those most in need.

In all, 48 million Iranians are entitled to health insurance provided by their private or government employer. A non-governmental charity, the Comit-e Emdad Imam Khomeini, provides additional coverage for four million poor. The country's social security system includes health care, training, retirement and unemployment benefits, as well as subsidies for energy, food, housing and other social services.

S&T POLICY CHANGES AND TRENDS SINCE 2000

Even after 60 years of experience, there remains a lack of methodological studies and critical reviews in policy-making and planning in Iran, particularly when it comes to technology policy. This dearth of action plans, programmes and overarching policies seems to be one of the main factors behind the difficulties encountered in implementing public policies up until now. S&T planning, like other areas of policy-making in Iran, is dominated by a comprehensive planning model which ignores priorities, thereby preventing a focus on the most important problems. By refusing to prioritize, this model leads to an unfair system of budget allocation (Tofigh, 2006).

The other characteristic of S&T policies is their inadequate orientation towards problem-solving. A centralized, bureaucratic approach to S&T policy-making allows academic, bureaucratic or political elites to impose their own priorities on the science agenda. Theories and models for S&T policies are 'imported' from abroad and consequently ignore Iran's socio-economic situation, be it the business world's preoccupations, trade, international collaboration or social problems. This weakens the private sector and could be a determing factor in the inefficacy and inefficiency of S&T policies.

As Shahmirzaii (1999) observes, 'because of the presence of a science pull approach in technological development, aspects like industrial standardization, the engineering regulatory system, support for design companies, collaborative research between industrial enterprises, the technical inspection system, export of technical and engineering services, spreading new technologies to industries … are ignored'.

As the highest authority for public policy-making in Iran, it is the Expediency Council which develops these 'grand policies' for the Leader of the Islamic Republic of Iran, including in the area of S&T.[1] Grand policies are elaborated to achieve the goals of the *Vision* document, which identifies the mains goals of Iranian society for the coming 20 years.

Once the grand policies have been developed by the Expediency Council, they are officially communicated by the Leader of the Islamic Republic of Iran to the legislative, executive and judicial branches. The grand policies for S&T in the *Fourth Development Plan* (2005–2009) are:

- Development of the higher education system, research centres, basic science and applied research;
- Optimization of education and research infrastructure, together with improving scientific productivity and efficiency;
- Education and training of researchers and university professors and, for those already in employment, development of their scientific and practical skills and ideological quality;
- Design of a system for ranking universities and researchers based on criteria such as efficiency and effectiveness, scientific productivity, applied research and technological development, or the problem-solving nature of their research;
- Collection of governmental and non-governmental statistics, development of a scientific information system. Creation of structures for applying the results of scientific research;
- A greater role for universities and research centres in promoting effective government and defending religious beliefs;
- Development of technological capacities and improvement of Iran's position in global technology, knowledge production, etc.

The *Plan* sets out to achieve these goals via action plans and policy packages collectively known as 'development documents' and a one-year budgeting system prepared by the Management and Planning Organization, which was renamed the President Deputy for Strategic Monitoring[2] in 2009.

As we have seen above, the centralization of S&T policy-making is one of the characteristics of government. The aim of this centralization is to co-ordinate all agencies and ministries. This is reflected in the transformation of the Ministry of Science and Higher Education into the Ministry of Science, Research and Technology (MoSRT) in the *Third Development Plan* (2000–2004) and its new mandate as co-ordinator of all scientific activities. However, in order to co-ordinate different activities and avoid overlap with the Ministry of Health and Medical Education, the Ministry of Energy and the Ministry of Agriculture, not to mention the many other institutions with a mandate for S&T, a new post was created in 2005, that of President Deputy for Science and Technology. This deputy reports to the president and is responsible for co-ordinating all S&T activities for which the budget and planning are centralized. Up until the creation of this post, the ministerial Supreme Council of Science, Research and Technology had fulfilled this role but had failed to fully achieve its objectives.

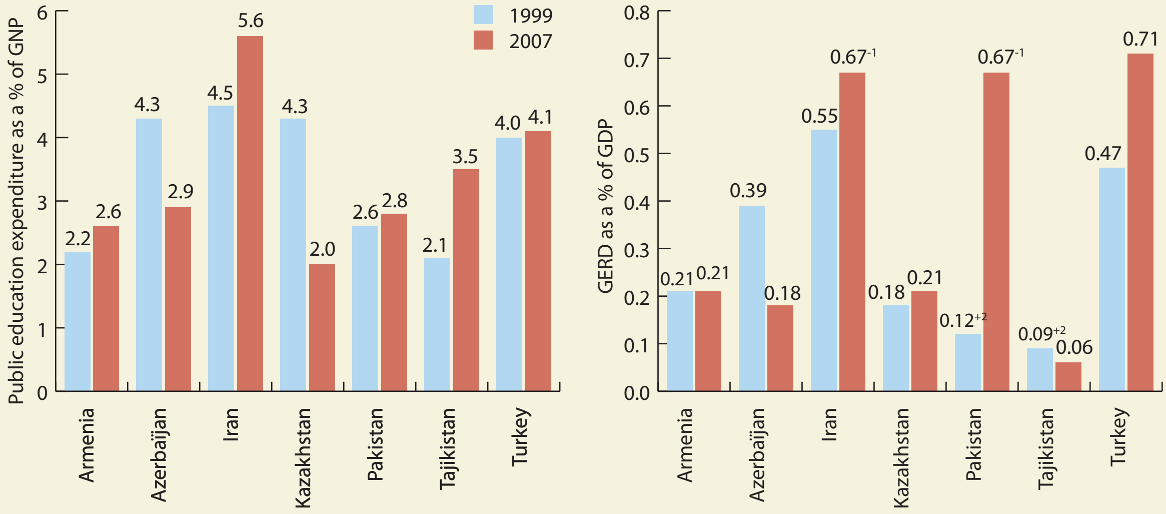
The other objective of centralization is to strengthen the national innovation system. This system is perceived as a means of avoiding the dispersal of public policies and budget wastage by facilitating interaction between

1. According to the *Constitution*, the Leader ratifies grand policies after 'consultation with the Expediency Council' (Article 110). The members of the Expediency Council are nominated by the Leader (Article 112), currently Ayatollah Ali Khamenei. They are political personalities drawn from different factions, as well as experts and officials such as the president, the chief of the judiciary and the speaker of Parliament.

2. The President Deputy is a full administration that is not subordinated to any ministry. On the contrary, the various ministries are expected to co-ordinate their work with that of the President Deputy.

Figure 3: Public expenditure on education and GERD in Iran, 1999 and 2007 (%)

Other countries are given for comparison



-n/+n = data refer to *n* years before or after reference year

Source: for education: UNESCO (2010) *Reaching the Marginalized. Education for All Global Monitoring Report*, Table 11; for R&D: UNESCO Institute for Statistics database, February 2010

multiple systems and sub-systems such as the national education and economic systems.

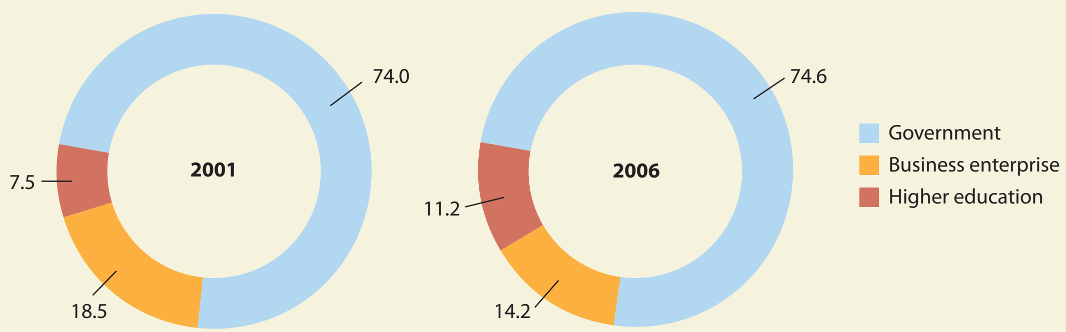
Policy-making in S&T is executed by different institutions that include the President Deputy for Science and Technology, MoSRT and the Ministry of Health and Medical Education. Although this demonstrates broad-based attention to S&T issues, the complex co-ordination mechanism and division of tasks this necessitates can complicate the execution of S&T policy.

R&D INPUT

Growth in R&D expenditure

GERD rose by 41% in 2004, 64% in 2005 and 65% in 2006. According to the UNESCO Institute for Statistics, Iran devoted 5.1 billion rials to R&D in 2002, 8.3 billion in 2004 and as much as 13.7 billion in 2006. This translates into a GERD/GDP ratio of 0.67% in 2006, compared to 0.55% seven years earlier (Figure 3). More than 74% of GERD is provided by the government, the remainder coming from business

Figure 4: GERD by source of funds in Iran, 2001 and 2006 (%)



Source: UNESCO Institute for Statistics database, February 2010

(14%) and higher education (11%). Interestingly, the role of business R&D has even declined somewhat in recent years, in favour of the higher education sector (Figure 4).

When we compare Iran with a non-oil economy like Turkey, the reality supports the hypothesis that an oil economy has a negative impact on the business sector. In Turkey, business expenditure on R&D made up 48% of total GERD in 2007 (up from 41% in 2002), compared to just 14% in Iran (*see page* 205).

TRENDS IN HUMAN RESOURCES

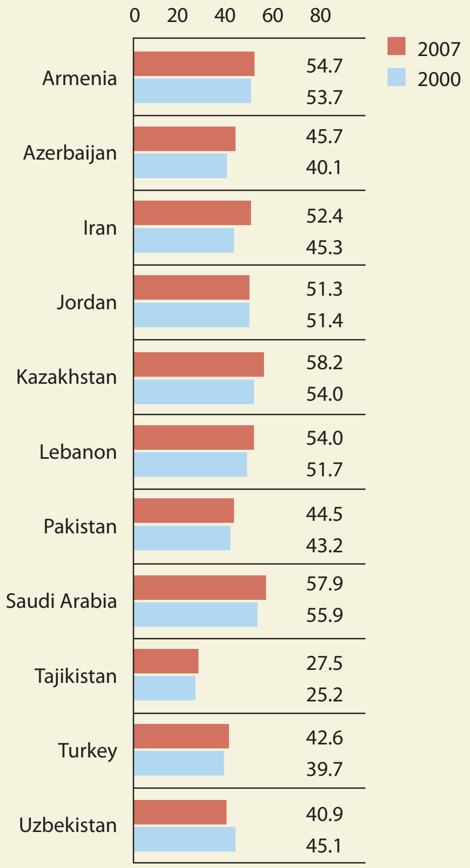
A gender imbalance that favours women

The share of female students in higher education has risen steadily from 45% in 2000 to 52% in 2007 (Figure 5) and even more than 65% in 2009, according to preliminary data. Consequently, public policy-makers need to acknowledge the changing roles of men and women in Iranian society by facilitating career opportunities for women and fostering a supportive cultural climate for women wishing to combine a career with raising a family.

A strong demand for higher education

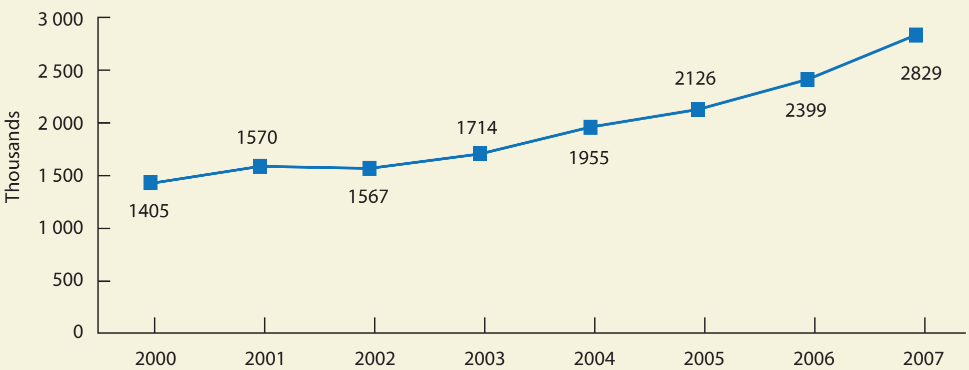
For the past 30 years, Iran has been expanding its university admission capacity. By the turn of the century, universities had a capacity of about 160 000 students. By 2009, this number had risen to 1 500 000 students. At the graduate level, the increase has been nearly as spectacular: 10 000 graduates in 2000 and 81 000 in 2009. Full and part-time enrollment in both public and private tertiary institutions doubled between 2000 and 2007 from 1 404 880 to 2 828 528 (Figure 6).

Figure 5: Female university students in Iran, 2000 and 2007 (%)
Other countries are given for comparison



Source: MoSRT

Figure 6: Trends in university enrollment in Iran, 2000–2007



Note: Data encompass both public and private universities and full and part-time study.

Source: MoSRT (2008) *Report for Scientific Road Map*

In the past 20 years, Iran has deployed students and researchers abroad, either to study or to present their scientific achievements in international scientific conferences. One example is collaboration between the UK and Iran in higher education and research (British Council *et al*., 2005). Today, numerous Iranian students are pursuing their studies abroad in different disciplines. The cost is borne mainly by the students themselves but the government also offers study grants.

R&D OUTPUT

Trends in scientific publishing

The expansion of higher education in general (Figure 6) and graduate studies in particular has in turn improved Iran's standing in international journals. The number of Iranian articles published in the natural and social sciences and engineering rose by 123% between 1995 and 2005, according to Thomson Reuters' Science Citation Index (SCI). In the seven months to July 2009, Iranian scientists published 10 991 articles in international journals. This compares with 10 361 in 2007 for the entire twelve-month period and 13 569 in 2008, according to MoSRT (Figure 7). Not surprisingly, the number of researchers per million population has similarly risen from 500 in 2000 to 850 in 2007, according to MoSRT.

Figure 8 illustrates the contribution of different scientific disciplines over the past sixteen years. Iran has been consistently strong in engineering but clinical medicine has replaced chemistry as the second most prolific field of Iranian science in recent years.

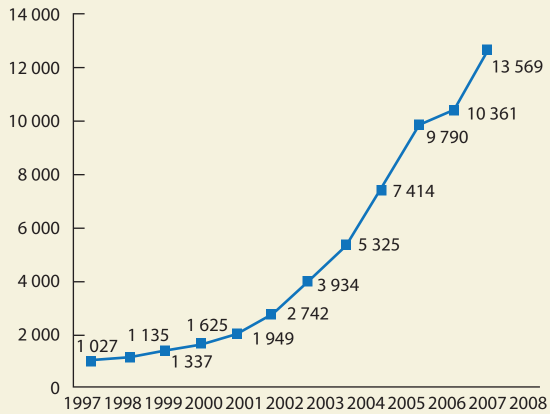
Since 1999, Iran has overtaken Pakistan, Malaysia and South Africa in scientific publishing. According to MoSRT, scientific publishing has grown faster in Iran than anywhere else in the world in recent years. International collaboration as measured by scientific articles has also increased markedly (Figure 9).

Today, the Iranian government is attempting to use another international index known as the Islamic World Citation Database (ISC). This database recorded more than 73 000 articles for Iranian scientists from 2000 to 2008. The Council of the Cultural Revolution and the MoSRT have put incentives in place to encourage scientists to submit papers to the ISC, such as the promise of promotion to a higher grade for university professors.

POLICY ENVIRONMENT FOR BUSINESS R&D

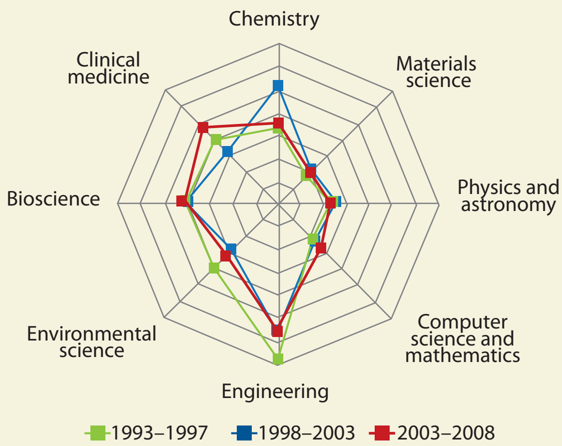
Progress in developing new technologies is hampered in Iran by the cost of setting up a business, weak intellectual property rights and government domination of large enterprises. Over the past 15 years, the government has set up high executive councils in nanotechnology, biotechnology, fuel cell technology and information and

Figure 7: Articles published in international journals by Iranian scientists, 1997–2008



Source: MoSRT (2008) *Report for Scientific Road Map*

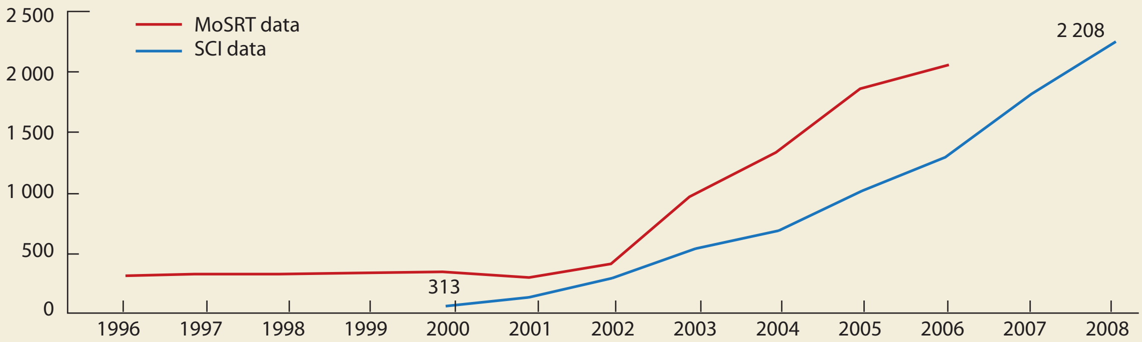
Figure 8: Share of scientific disciplines in Iranian publishing, 1993–2008



Source: MoSRT (2008) *Report for Scientific Road Map* communication technologies (ICTs) to support the development of new technologies and protect them from market fluctuations (see also Box 1).

The Centre for New Industries was established within the Ministry of Mining and Industry during the *Third Development Plan*. The role of this centre is to define

Figure 9: International scientific co-authorship in Iran, 1996–2008



Source: MoSRT (2008) *Report for Scientific Road Map; Thomson Reuters' Science Citation Index*. Compiled for UNESCO by the Canadian Observatoire des sciences et des technologies

Box 1: Biolarvicides and beauty products from biotechnology research

The Persian Gulf Biotechnology Research Centre was set up on the island of Qeshm in southern Iran in 1997 by Nasrin Moazami, founder of the Biotechnology Research Centre at the Iranian Research Organization for Science and Technology (IROST) in Tehran in 1982. The plant develops plant propagation using the tissue culture of bananas, orchids and date palms to increase agricultural productivity. It also explores the qualities of coral for health applications. Coral is strikingly similar to bone, with a 98% degree of compatibility. This makes coral a potential substitute for bone transplants in patients, as there is no risk of rejection by the human body.

The sea offers endless possibilities for product development using biotechnology. Algae, for example, can be used as a biofertilizer for agriculture; it can be fermented to produce methane and methanol for use in cooking and to fuel cars. Algae can also be marketed on the food, health and beauty markets.

The centre is also exploring the potential of *Aloe vera*. This plant can be marketed as a highly nutritious supplement or even in the form of a moisturizing cream. As it stimulates the body's immune system, it is also effective in healing intestinal diseases.

Qeshm island has also been the theatre of trials to test a biolarvicide known as *Bacillus thuringiensis M-H-14*, which was also successfully tested elsewhere in southern Iran and in Sudan before being registered at the European Patent Office in 2003. This toxin hones in a on a receptor in the gut that only the *Anopheles* mosquito possesses, making the biolarvicide innoccuous to all other living species, including human beings. The bacterium was isolated from dead *Anopheles stepehensis* larvae, a major vector of malaria in Iran. The biolarvicide was developed by a research team led by Nasrin Moazami at the Biotechnology Research Centre in Tehran. Since November 2004, it has been manufactured under the trademark of Bioflash by the Iranian Nature Biotechnology Company, founded in 1999.

The Biotechnology Research Centre is a member of UNESCO's global network of microbial resource centres in developed and developing countries, which co-operate in microbiological and biotechnological research.

Source: Moazami (2005)

For details: moazami@hotmail.com

Box 2: Developing high-tech industries via IDRO

Since its inception in 1967, Iran's Industrial Development and Renovation Organization (IDRO) has established and developed general contractor companies in different fields. Today, it promotes domestic and foreign investment in minority holdings it owns in new, high-tech and export-oriented industries in particular. These high-tech areas include ICTs, advanced materials, biotechnology and life sciences, electronics, micro-electronics and nanotechnology.

According to Article 44 of Iran's Constitution, all large-scale industries are public property. IDRO controls about 290 companies, making it one of Iran's largest holding companies. Major companies owned by IDRO include Industrial Projects Management of Iran (IPMI), the Rail Transportation Industries Company (RTI), Pars International Development and Engineering Company (PIDECO), the Iranian Offshore Engineering and Construction Company (IOEC), Construction Projects Management of Iran (MAPSA), the Langroud Gas Production Company (GTL), the Arya Oil and Gas Development company (ARYA) and the Iran Industrial Consultant Engineering Company (IIC).

IDRO supports high-tech development from the earliest stages of a project, when it is still no more than an idea, through to the delivery of products and services to the market. IDRO develops an entrepreneurship development plan and innovation development plan for affiliated companies wishing to set up pilot plants to scale up research projects. It also runs a Small Business Development Centre.

As part of its mission for attracting local and foreign investors to high-tech industries, IDRO prepares a feasibility study and business plan, and identifies potential investors and technology providers in order to establish partnerships and joint ventures. IDRO also sets up small and medium-sized enterprises with local and foreign partners to execute approved projects and commercialize technology. Partners invest in industrial plants set up through technology transfer.

IDRO has founded special-purpose companies in each high-tech sector to co-ordinate investment and business development. These entities are the Life Science Development Company (LIDCO), Information Technology Development Center (MAGFA), Iran InfoTech Development Company (IIDCO), Advanced Materials Industrial Development Company (AMIDCO) and the Emad Semiconductor Company.

In 2009, IDRO was planning to set up a venture capital fund to finance the innovation cycle. The fund will focus on the intermediary stages of product and technology-based business development. One of IDRO's subsidiaries, the Entrepreneurship Development Company of Iran, has done a lot of preparatory work for this fund.

By March 2010, it is expected that IDRO will have offered private investors shares in 150 industrial companies. IDRO has privatized 140 of its companies in the past for a value of about 2000 billion rials (about US$ 200 million). This strategy follows an amendment to Article 44 of the Constitution in 2004 which set in motion a ten-year plan to privatize 80% of Iran's state-owned assets

Source: www.idro.org ; Press TV (2009)

policies and implement strategies to develop new industries in high technologies in particular. It also promotes a business climate for private enterprises.

The centre's first step has been to prepare a strategic plan for electronic industries encompassing communication technology, micro-electronics, the automation industry and so on, as well as for new materials, biotechnologies, information technologies, civil airspace, laser technology and optics, and nanotechnologies.

Iran's Industrial Development and Renovation Organization (IDRO) has established joint ventures with the private sector since the beginning of the *Third Development Plan* to develop new industries (Box 2). As of 2002, five foreign investment projects had been set up with a budget of US$ 300 million (MPO, 2003).

With regard to infrastructure, the government had planned to develop the country's technology parks, incubators, visionary technology institutions, techno-markets and clusters during the *Third* and *Fourth Development Plans*.[3] The success of this kind of policy

3. As of 2010, Iran had 21 science and technology parks and more than 60 technology incubators.

Box 3: The Iranian Fisheries Research Organization

One of the country's major research centres is the Iranian Fisheries Research Organization (IFRO).

IFRO performs applied research to determine how best to protect aquatic organisms and their environment. The aim is to replenish fish stocks and exploit them sustainably in Iranian waters. This goal is mentioned in Article 3 of the constitution of the Iranian Fisheries Company, adopted in 1985. It also figures in the second law governing the protection and exploitation of aquatic resources, adopted by Parliament on 5 September 1995.

IFRO pursues scientific co-operation with the United Nations Food and Agricultural Organization, INFOFISH, the Southeast Asian Fisheries Development Centre, FISHBASE, the World Conservation Union's NACA network of aquacultural research centres across 18 countries in the Asia–Pacific region, the Indian Ocean Tuna Commission, World Fish Centre (GOFAR), the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and Gent University in Belgium. IFRO is also a member of the European Aquaculture society, Marine Technology Society, Asian Fisheries Society, World Aquaculture Society and World Sturgeon Conservation Society.

Source: IFRO

depends on macro-economic conditions, intellectual property regimes, international co-operation and trade to reduce the risks, particularly for small and medium-sized enterprises and the broader private sector. To create conditions that will be conducive to the development of infrastructure, you need to improve supporting networks and providers, and to develop R&D in the private sector. Without these foundations, the private sector remains weak, increasing the need for government intervention. As the government itself is faced with budgetary limitations, this creates a major problem. Moreover, centralized public policy breeds supply-oriented – as opposed to demand-driven – S&T policy, as stated earlier.

Both public and private enterprises are involved in international co-operation in licensing and technology transfer in various areas, such as ICTs and the oil industry. Examples are the involvement of the Mouj enterprise in point-to-point radio and digital switch technology in collaboration with the Republic of Korea and the sale of the *Samand* automobile license belonging to the Iranian Khodro company.

Iran is developing scientific co-operation with the Organization of Islamic Countries (OIC). It also plays an active role in the Indian Ocean Rim Association for Regional Co-operation[4] and in the Economic Cooperation Organization (ECO),[5] for which it was the host country in 2004, 2005 and 2006. Iran is also spearheading an agricultural biotechnology network to connect national biotechnology institutes, researchers, scientists, engineers, and policy-makers from ECO member countries and promote the continual exchange of knowledge and research results (see also Box 3).

PROGRESS TOWARDS AN INFORMATION SOCIETY

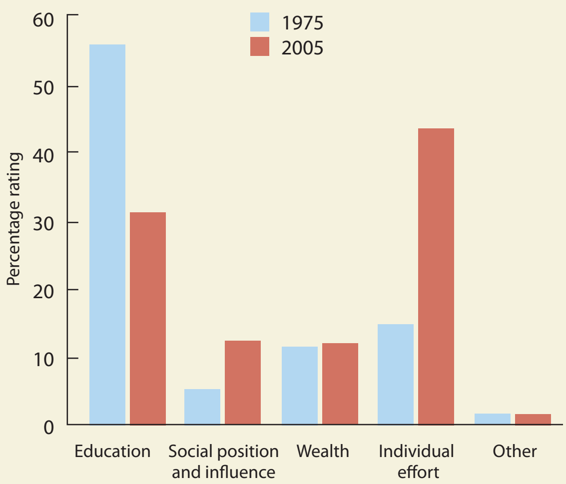
E-readiness refers to the state of play of a country's ICT infrastructure. In this index, Iran ranked 69th in 2007 and 65th a year earlier (Economist Intelligence Unit, 2007). This index has been developed by the Economist Group. 'The ranking model evaluates the technological, economic, political and social assets of 69 countries and their cumulative impact on their respective information economies.' Iran's ranking might improve if scientific and educational criteria were factored into the model. The index for high-tech acquisitions by developing countries ranges from 0.51 to 0.74. On this scale, Iran is indexed at 0.26 among active acquisition countries like India, Brazil, and Egypt (MPO, 2003).

In terms of access to technology, Iran has made rapid progress. About 32% of the population used Internet in 2007, for example, up from barely 1% seven years earlier (Table 2).

4. The association promotes linkages between businesses in member states (see Annex I for a list of countries). Projects and programmes are run under the umbrella of three separate working groups: the Working Group on Trade and Investment; the Indian Ocean Rim Business Forum; and the Indian Ocean Rim Academic Group.

5. See Annex I for the ECO and OIC member states.

Figure 10: Iranian attitudes toward towards success in life, 1975 and 2005



Source: Goodarzi (2008) *National Survey on Cultural Change and Social Attitudes of Iranians* 2005, p.214.

PUBLIC ATTITUDES TOWARDS SCIENCE

Among residents of Tehran, as many as 85.8% of respondents to *A National Survey on Socio-cultural Attitudes* in the 1990s considered science and knowledge to be 'a very important social value' (Mohseni, 1996). A further 13.7% considered them to be 'more or less important' and just 0.6%, or 15 respondents out of 2320, 'not important at all'. These results were mirrored in the rest of the country. In the respondents' ranking of social values, science came after reputation, health or honesty but before wealth, position and fame.

Another national survey in 2005 studied cultural changes within Iranian society. It found that Iranians equated success in life first with individual effort then with education, followed by position then familial influence and, lastly, wealth. In a similar survey in 1975, Iranians had placed education ahead of individual effort, education being still a scarce resource at the time (Goodarzi, 2008). Thanks to improvements in education, equality has progressed in Iran, making individual effort more important than before (Figure 10).

In sum, we can conclude that Iranian society greatly values science and that this has been one of the main factors behind the development of both public and private higher education in Iran. In spite of economic difficulties, people spend a large share of their budget on private tertiary education. Privately owned Azad University has even become one of the biggest universities in the world thanks to its paying students.

CONCLUSION

We have seen in these pages that the particularity of an oil economy is that it can invest in S&T regardless of the social and scientific contexts. S&T policy should insist on the role of the private sector in R&D. A move towards participatory planning with the co-operation of the private sector could offer a valid alternative to centralized, bureaucratic planning in S&T policy. This would create an environment conducive to substituting the current science pull for an orientation towards technology push, thereby allowing socio-economic factors to play a role in S&T policy.

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Indian Ocean Rim Network, information focal point for the Indian Ocean Rim Association for Regional Cooperation: www.iornet.com/

Industrial Development and Renovation Organization of Iran: www.idro.org

Iranian Fisheries Research Organization: www.en.ifro.ir

Islamic Republic of Iran: www.dolat.ir; www.iranculture.org/COMMISSION/CSCM_MAP

Kioomars Ashtarian was born in the Iranian city of Kermanshah in 1963. He has been Assistant Professor at the University of Tehran within the Faculty of Law and Political Science since 1999.

He holds a PhD in Political Science with a focus on technology policy from the University of Laval in Quebec, Canada. In 2008, he was Research Supervisor of the Fifth Industrial Development Plan Project co-ordinated jointly by the University of Tehran and the University of Industries and Mines attached to the ministry of the same name. In 2001, he was appointed Director-General of the Public Sector within Iran's Management and Planning Organization.

Kioomars Ashtarian is the author of more than 30 articles and other publications in the fields of technology policy, innovation policy and public policy-making. His main fields of research are industrial development strategies, technology transfer policies and public policy in Iran.

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