The Role of Government in Creating an Enabling Environment for Industrial Innovation in Lebanon

The publishers would like to thank
the International Labour Organisation
for their kind contribution to the study.

The Role of Government in Creating an Enabling Environment for Industrial Innovation in Lebanon[1]

By **Dr. Louis G. Hobeika**[2]

(1) Paper presented at the Second Conference on Industrial Research & Development at the Unesco Palace on November 13, 1998.

(2) Dr. Louis G. Hobeika holds a PhD in Economics from the University of Pennsylvania. He was Dean of the Faculty of Economic Sciences at Saint Joseph University in Beirut from 1980 to 1989. He then became an Expert at the World Bank in Washington, D.C. until 1994. Currently, he is Chairman and CEO of SODETEL, Secretary General of ICC-Lebanon and teaches Finance at AUB.

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Introduction

The purpose of this paper is to suggest to the Lebanese Government a specific and leading role in promoting creativity and innovation in the industrial sector. Clearly, the innovations should come from the firms themselves. The government should provide the healthy environment and legal grounds which allow the firms to innovate. Globalization and the telecommunications revolution have triggered in fact a shift in the comparative advantage of countries towards an increased importance of innovative activity. Innovations in product development, financing techniques, organizational work, and market strategies are in fact critical to the economic survival and expected prosperity of the Lebanese industrial sector.

Firms must be flexible to respond rapidly to competitive and market changes. Positioning, once the heart of strategy, is rejected as too static for today's

dynamic markets and changing technologies. Rivals can quickly copy any market position and competitive advantage is at best temporary. According to Porter[3], a company can outperform rivals only if it can establish a difference that it can preserve. It must deliver greater value to customers or create comparable value at a lower cost, or do both. Superior profitability then follows: Providing greater value allows a company to charge higher average unit prices; greater efficiency results in lower average unit costs. It is important to distinguish here between two concepts: Operational effectiveness means performing similar activities better than rivals perform them; strategic positioning means performing different activities from rivals or performing similar activities in different ways. Competition based on operational effectiveness alone is mutually destructive leading to wars of attrition. Firms end up buying their rivals through mergers and acquisitions, which is what is happening in many sectors today worldwide.

Competitive strategy is about being different. The success of a strategy depends on doing many things well, not just a few, and integrating among them. Why do so

(3) See Michael Porter. "What is Strategy?" in Harvard Business Review (HBR). Nov./Dec. 1996.

many companies fail to have a strategy? It depends mostly on leadership. Strategy renders choices about what not to do as important as choices about what to do. Strategy requires constant discipline and clear communication. Strategic continuity, in fact, should make an organization's continual improvement more effective. A company may have to change its strategy if there are major structural changes in its industry. Strong leaders willing to make choices are essential.

Lebanese firms should concentrate their efforts on upgrading their production processes and products. The economic competition in the next century will be based on creativity, innovation, and invention. Proper education of our managers, engineers, and labor force becomes of critical importance. The development of a proper patent system is necessary to protect innovators from imitators, so society and themselves can benefit from the fruits of their work and encourage them to do more and better.

Although strategic leadership and industrial innovation should come from within the firm, our view is that the government has an important role to play in continuing to stabilize the economy and in adopting selective microeconomic policies designed for the sector. The paper will concentrate its findings on the medium to

long term view which affect far more than short term policies the potential survival of the sector. Although what has been proposed by the Lebanese government to the sector so far regarding customs duties reliefs and some protective measures is helpful it is clearly insufficient to promote innovation and creativity necessary for the survival of the sector in the next century. A long term view is needed on the part of the Lebanese government. Our recommendations will benefit from specific lessons from the Asian and Latin American experiences. We find the case of Singapore particularly interesting due to its resemblance to the situation in Lebanon[4].

(4) See R.S. Sisodia. Singapore Invests in the Nation-Corporation. HBR. May/June 1992.

Lebanese Government Development Strategy

Proper and correct macroeconomic and development policies of today create the innovations of tomorrow. To achieve a satisfactory level of economic and social development, the strategy should concentrate on these challenges simultaneously:

A. Stimulate economic growth through policies that promote sustainable and equitable development.

In fact, real GDP growth rates of the Lebanese economy were 7% in 1995, 4% in 1996 and 3.5% in 1997. The GDP deflator decreased from 16% in 1995 to 14.5% in 1996 to 5.2% in 1997. The GDP per capita increased from $3800 in 1995 to $4700 in 1997. The economic challenge of the Government is to extend the development clearly seen in Beirut to all Lebanese regions.

In fact, the East Asian miracle economies built a stable macroeconomic environment conducive to investment

and enterprise. They used powerful market and non-market policies to guide resources and initiatives into efficient activities. They created a dynamic engine of growth which provided leadership for development. Their pragmatic, perseverant policy-making was facilitated by exceptional social and political stability. Much, but not all, of East Asian growth can be attributed to exceptionally large investment in human and physical capital[5].

East Asian economies derive nearly half of their output growth from "Total Factor Productivity" growth rather than from accumulation of resources. East Asian incentive systems ranged from unimpeded international competition in Hong Kong to vigorous government oversight in Korea. Growth engines varied from small scale manufacturing in Taiwan to foreign and government linked enterprises in Singapore. East Asian economies were excellent in fitting strategic growth policies to their domestic and external circumstances. The World Bank attributed their success to:

* an outward oriented trade strategy.
* conservative macroeconomic policies.

(5) See P.A. Petri. The Lessons of East Asia: Common Foundations of East Asian Success. The World Bank. 1993.

* vigorous investment in human capital.
* the maintenance of competitive markets for factors.
* the encouragement of the imitation of each other's policies.
* the promotion of the imitation of technology and business strategies.
* the facilitation of direct investment.

Although the Asian countries are passing by a very difficult crisis which started in July 1997 in Thailand[6], their success remains unquestionable as they are adjusting their economies to the globalized world. The Asian countries which protected and subsidized their economies and industries for many years are facing difficult circumstances after the Uruguay round and the consequent preservation of intellectual property rights. Imitation in this new globalized world has become nearly forbidden. Asian countries like the rest of the world have to start innovating and creating to be able to grow.

Although the Government succeeded in stabilizing the Lebanese pound and in controlling inflation through a

(6) See Louis G. Hobeika. The Asian Currency Crisis. The Lebanese and Arab Economy. Jan. 1998.

policy of high interest rates, investments were slow to pick up and the budget deficit soared. The policy of low income taxes clearly proved insufficient to encourage investments in the country. The government should do its best to rationalize and lower expenditures, improve tax collections, modify the tax system to target people equitably, and eventually start the privatization process of many services and utilities.

The balance of the 1997 budget showed a deficit of 36% out of a total of 6,375 billion Lebanese pounds, and consequently an increase in the volume of the public debt. Observers and economic experts are wondering how the Lebanese state will be able to pay back its debt and how long it will take us to go back to a normal financial situation. It is in fact quite difficult to reach budget equilibrium when it is hard to cut expenses and increase taxes. Quick solutions are unfortunately not available and if found, people might not accept them. We therefore will have to live for now with permanent deficits and increasing debts imposed by the current events and the scheduled government projects[7].

(7) See Louis G. Hobeika. The Economic and Financial Consequences of the Lebanese Budget Deficit. The General Manager. Feb./Mar. 1997.

Among the solutions found a few years ago to enhance the reconstruction program and the economy was the reduction of the highest income tax rate to 10%. This policy was designed to encourage companies to invest and make profits and to push individuals to work harder and save more. Apparently, it proved since it was adopted to have a positive impact on economic growth, the income per capita, and the index of country risk for Lebanon. But in fact, nothing proves the direct cause-effect relationship between the policy and the positive results. We can say that the improvement in the economic situation is basically due to the establishment of peace and security. In fact, similar reductions of direct taxes experienced by several countries around the world, particularly the USA, raise doubts about the rationality of such action in Lebanon.

If the government cannot make a drastic reduction of its expenses, it should at least reduce unnecessary expenses through real austerity, adopt a progressive income tax scheme (as in almost all free market economies) and raise the ceiling to 25% in order to increase its revenue, and promote equity and efficiency in the Lebanese society. The new tax law should include provisions which encourage investments such as "depreciation allowances" and especially an "Investment Tax credit". Indirect taxa-

tion on consumption should be avoided because it is regressive. Direct taxes on expenditures are theoretically appealing but hard to implement. A value added tax "VAT" is recommended but cannot be implemented in the present administrative context in Lebanon. Earmarked resources could also be used to finance specific expenditures or investments.

In the long-term, the current income tax policy could be harmful to the expected financial recovery. President Reagan's experience might teach us a lot in spite of the difference between the two countries. The reduction of income taxes led to an increase in the budget deficit in just a few years. The failure to reduce expenditures, the increase in interest rates, and the slow economic recovery explain the increased budget deficit, a case which mirrors what has happened in Lebanon so far. This was due on one hand to the fact that the American people and corporations did not increase their investments and savings, and on the other hand to the weak coordination between monetary and financial authorities.

All economists along with the IMF agree on the fact that in the long run the relationship between the budget deficit and the exchange rate is negative. This means that an increase in the deficit may improve the exchange rate of

a currency for a short period but will have a negative effect in the long run. We should then be concerned in Lebanon with our permanent deficit and debt. This on-going deficit will sooner or later have a negative influence on the Lebanese pound.

Although Lebanon emerges from a long and destructive war and investments are tremendously needed, national borrowing is potentially limited. The increased borrowing will lead to an increase in the inflation index if economic growth continues to slow down. The absorptive capacity of the Lebanese economy is also limited. The increase of internal and external borrowing will have a negative impact on the national economy if it is not covered by growth. Clearly, if the rate of economic growth exceeds the interest rate on public debt, it becomes easier to absorb these debts in the long run. However, this cannot last for a long time because the growing demand on the currency will push the interest rates upwards until it exceeds the rate of economic growth. What worries us today in Lebanon is the fact that the economic growth rate is lower than the interest rate, which reduces the possibility of servicing the debt in the future without causing a financial and monetary crisis.

International facts show that in the long run the budget deficit affects negatively economic growth and

economic and social development. The Lebanese government and Parliament are aware of the serious impact the budget deficit has on the economic and social situation as the last budget debate shows. The preservation of the current exchange rate of the Lebanese pound under the current expenditure policy relies for a large part on the assumption that current investments will strongly stimulate economic growth. Government income will then increase and exceed expenditure and help protect the pound and serve the public debt. The Lebanese government should implement financial and administrative reforms to be able to face the debt crisis. The timing of the recommended policies is also critically important for their success. Adopting a progressive income tax scheme with a ceiling of 25 % (with the mentioned provisions for investments) is the right policy to follow as Lebanon will enter the World Trade Organization "WTO" and therefore lower its customs duties.

B. Invest heavily in infrastructure to reach the stage of "intelligent country" such as Singapore which established the world's first fully networked society.

It demonstrates the capacity of a country with almost no natural resources to create economic advantages with influence far beyond its regions. It represents one scenario

for what can happen when a government assumes an instrumental position in shaping and managing the economic environment. The Singapore government invested in technology and human capabilities. Technology management and the effective use of information technology have become the central managerial concerns of our time. Singapore's Information Technology strategy has been the center- piece of its overall economic planning. It created an "intelligent island" through a plan called IT 2000 which provided the country with an ISDN (Integrated Services Digital Network) since 1989. Through their system "TradeNet", traders simply fill out one electronic form which is routed through a network to appropriate agencies and returned to the trader within 15 minutes. Application fees and customs duties are automatically debited from the trader's account.

The port in Singapore offers also more competitive rates than any other international port in the region. A system called "Portnet" similar to "Tradenet" has been set up. The airport is well managed and is supported by the worldwide success of Singapore Airlines. Its sea is very close to its mountains and is well covered by a performing road network. Lessons from Singapore to Lebanon are therefore quite clear. They encourage the government to

continue to invest in infrastructure in order to reach the stage of "intelligent country". The costs of these past and future investments and their quality should be reviewed by an independent panel, especially in this period of tight budgets.

C. Create enabling environments for human and physical capital to yield their highest returns[8].

Investment in human capital is essential for Lebanon's long term economic and social development. Human capital is knowledge and skills. Investment in education, training, health, nutrition, and other social services is needed to achieve rapid, efficient, and sustainable development. Over the past fifty years, the world has realized tremendous progress in human capital development. Per capita incomes have more than doubled, life expectancy has increased from 40 to 63 years, and infant mortality rates have been cut by two-thirds. Lebanon has made significant progress in these areas as life expectancy increased from 65 years in the 80s to 69 years today. Infant mortality rates dropped from 48 per thousand births in the 80s to 32 today. Although Lebanon made some significant progress

(8) See Louis G. Hobeika. "Building Human Capital in Lebanon". The General Manager. Nov./Dec. 1996.

in this area, it remains behind some other countries of comparable levels of developments, such as Sri Lanka and Korea.

Comparing East Asia and Latin America, 34% of the predicted difference in growth rates could be attributed to higher investment levels in education and 38% to higher enrollment rates. A World Bank study of 98 countries shows a strong and robust positive correlation between school enrollments and economic growth rates. Pakistan and Korea had similar income levels in 1960, but by 1985 Korea's GDP per capita was nearly three times higher than Pakistan's owing in large part to differences in primary school enrollment rates. Less than one-third of primary school-age children in Pakistan were enrolled in 1960, compared with 94% in Korea.

The positive correlation between education and earnings is indisputable and universal. Education increases productivity. In Malaysia, Ghana and Peru, one additional year of education has been found to increase a farmer's output by 2 to 5%, depending on farm size, inputs, hours worked, and other. In Thailand, farmers with 4 years of schooling are three times more likely to adopt new fertilizers and other inputs than farmers with one to 3

years of schooling. As the technologies become more complex, the premium on education is bound to increase.

In Africa, increasing female literacy by 10 % could lower infant mortality by 10%. In the developing world, there are 86 Females for every 100 Males in primary schools, 74 in secondary school and 64 in tertiary education. Between 1980 and 1990, primary school enrollments in all developing countries increased form 69 to 76%. Illiteracy among the adult population decreased from 54% in 1970 to 35% in 1990. However, more than one half of all women in developing countries is illiterate, in comparison with 28% of the men. Child labor has been decreasing and is being carefully watched by national and international organizations.

Experience and research suggest two basic principles for reform and investment in education. First, redirect more public resources toward primary and technical education, while relying more on private financing at higher levels; and second use educational outcomes as the criteria of the effectiveness with which resources are used. We believe that primary education deserves high priority for four reasons:

I. It is the foundation on which higher education must build.

II. The return measured by individual wage gain tends to be largest for primary education.

III. The poor benefit especially from public spending on primary education. Subsidies for higher education benefit higher income groups far more than they benefit the poor.

IV. Primary education brings broad additional benefits, ranging from lower mortality and fertility to better health and nutrition and literacy. Democracy is also strengthened. Families choosing to have fewer children are able to invest more in the health, nutrition, education and training of each. Governments can in fact influence the quality of education in several ways:

* Set clear and high standards of performance in core subjects.

* Develop policies to give schools flexibility in formulating their program and curriculum and in lengthening the school year if necessary.

* Indroduce policies to support inputs known to improve the achievement of students such as

training and instruction materials (books, chalk...).

Lebanon's schooling and university system is one of the most advanced in the region. The problem lies in the difference in the quality of the service providers. We have excellent, average and bad schools and universities. For this reason, the government should spend money on improving public primary and technical education, critical for Lebanon's long term economic and social development. The East Asian experience teaches us that we should pay more attention to the availability and quality of primary and technical education. Unfortunately, we see efforts and resources in Lebanon more concentrated on public higher education. This is not wrong in itself. What is wrong is the concentration of graduates in few fields. The Government has to choose and allocate or redirect our public resources efficiently. It would be preferable to give priority to primary and technical education in the poor and rural areas. Let us improve what we have in higher education institutions before licensing new faculties or before opening new universities[9]. The introduction of an

(9) Currently Lebanese universities graduate around 1000 engineers every year, adding to the existing 26000 members of the Order. Their potential employment should be the concern of the government.

accreditation system by ABET (Accreditation Board for Engineering and Technology) or other organizations as a quality assurance mechanism is recommended. An education strategy from a unified education ministry listing priorities and means to implement them is therefore necessary.

Health reforms are never easy to design and implement. The difficulties that faced the Clinton health plan are an example of the kind of obstacles that any new plan in any country could face. Diversity and competition in the financing and delivery of health services can help improve quality, widen choices and access, and lower the public expenditure burden. Well-regulated social and private health insurance can increase access to clinical services out- side the government's basic package. Investment is always needed to build new hospitals and improve existing ones. Public hospitals are needed in the rural and poor areas. Most businesses in Lebanon are offering their employees benefits which include health and educational benefits. This trend will increase over time as these services are bound to become more expensive over time.

Health care services are very important and hard to deliver in excellent quality at reasonable cost. Unfortunately,

there is no easy solution. An OECD study of health care systems shows that there is no proven advantage to any of them.

Although there are no apparent nutrition problems in Lebanon, many social indicators show that we are suffering from a qualitative nutrition problem. Life expectancy at birth remains low compared to western countries. This is due to health, nutrition and other factors. More efforts should be invested to improve the quality of nutrition especially in rural and poor areas.

In health and education, the responsibility of government in setting appropriate policies is particularly important. Private entities can and do make major contributions through direct provision of services. Countries should arrive at whatever form of public/private mix is best for their particular circumstances. In quality and efficiency, the private sector wins. Where families are not able to pay the fees that private service providers charge, the government has a responsibility to offer more affordable services. Currently, an estimated 50% of all global spending on health care comes from the private sector. Worldwide, an estimated 5.8% of GDP is spent on education, of which an estimated 70% is government spending and 30% private. The public-private mix in education is a direct result of a

political struggle to control the school curriculum. It is a reflection of cultural and religious diversity.

Changing the role of government from a service provider to a creator of an enabling environment for the private sector should be complemented by a transparent legal and regulatory framework. Government steps in where markets fail. Policies that are of general benefit such as investment in infrastructure, protecting the environment, and investment in people should be implemented.

To attain an optimal public private mix, we suggest the following:

1. The government should concentrate its efforts on setting up a regulatory framework that ensures a minimum standard of quality and prevents fraud. This includes access to information regarding the quality and effectiveness of social service providers. Governments can provide such information to users on a regular basis.

2. The government should guarantee access to basic health and education services for all. It should attempt to provide a combination of insurance schemes, subsidies, and tax credits that make

schemes, subsidies, and tax credits that make basic services affordable to all.

3. The government should price higher-level facilities realistically and reallocate public resources towards essential basic services. Basic health and education services have the highest economic and social payoff. A more equitable access to higher education and hospitals can be facilitated by scholarship, school loan programs, and health-insurance schemes.

4. The government should facilitate a pluralistic system of supply. Where private providers compete with public ones, consumers have a choice. Furthermore, competition increases overall quality and efficiency.

D. Undertake serious public administration reforms.

The great majority of governments in emerging economies, including Lebanon, need more efficient and effective institutions if they are to conceive, implement and sustain productive economic policies and projects. Effective public institutions are also necessary if the private sector is to grow and flourish. The concept behind strengthening core government organizations is that these coun-

and advise the highest decision makers, that set standards and evaluate performance, and that supervise activities across sectors[10].

The main lesson drawn from World Bank and country experiences is that public sector management (PSM) reform takes root and flourishes only over relatively long periods of time. This makes it hard to see the results of interventions; and when results occur, it can be hard to trace their cause to a particular action. Results vary greatly, depending on a country's administrative capability and how receptive it is to advice. In countries with an appropriate alignment of skills, commitment, and incentives, rapid and progressive change occurs. We hope this is the case of Lebanon now.

Strengthening budgeting procedures in emerging and developing countries has proven more difficult, partly because of the widespread weakness of basic accounting procedures. The management of public spending is at once a highly technical and an intensely political process; the challenge for Lebanon is to put into practice methods that are both technically sound and politically and bureaucrati-

(10) See Country Economics Department. The Reform of Public Sector Management: Lessons from Experience. The World Bank. 1991.

cally feasible. Lebanon clearly needs to improve its budgetary procedures.

The benefits of improved public sector management for Lebanon are enormous: lower costs, more effective production and delivery of goods and services by public agencies, heightened project impact, better policy formulation and implementation capability, more sustainable projects and programs, and an improved environment for the effective functioning of the private sector. But they have also been less than projected, difficult to conceive and implement, and slow to come to fruition. The reason is that public sector management actions reveal, and highlight, tensions between economic benefits and political costs.

On the other hand, civil service reform consists of two complementary efforts: short-term measures to contain costs and medium-term programs to strengthen personnel management and improve the efficiency and effectiveness of public agencies. Through privatization, liquidation, and expansion of the private sector, public enterprises now play a much less significant economic role in many countries than they did in the recent past. Lebanon should embark on a privatization program through a fair, legal, transparent, and effective process.

All aspects of civil service reform should go further in most countries, including Lebanon. Reform to date has been insufficiently ambitious and forceful to bring about the degree of change and savings needed. Deeper cuts should be made in numbers of employees and wage bills; but far more effort also has to go into medium-term measures that increase the competence and effectiveness of existing personnel and agencies. Civil service in Lebanon is larger than the country needs, more costly than it can afford, and less effective and productive than it should be. Adopting the best macroeconomic and sectoral policies means little unless the public sector can implement, enforce, and regulate them.

To be able to strengthen the civil service, the Lebanese government must be able to formulate and implement flexible personnel policies which focus on salary policy, the creation and maintenance of personnel management information systems, general employment policy, training, and policies for career development, promotion, and performance evaluation. The complex and expensive system of fringe benefits and bonuses needs also to be reassessed.

The Lebanese administration lacks efficiency and transparency and is corrupt. The Lebanese expect from the

new regime urgent and significant reforms which would help the private sector fulfill its economic role. The example of Singapore is relevant where it has invested heavily in the computerization of its civil service. The time needed to register a private company has for example dropped from 50 to 8 days and a sole proprietorship from 30 days to one. Admission to government hospitals takes about one minute. Civil service personnel are highly trained and top university students are targeted for recruitment by the civil service. All government employees receive bonuses based on the performance of the Singaporean economy.

The lessons for Lebanon are quite clear too. Public administration should serve the citizens and the private sector and not be a nightmare for them. All government procedures need to be changed and speeded up. Government operations have to become transparent and more efficient. Government employees have to be selected based on their merits and not political affiliation. Civil servants who do not do their job properly should be punished and eventually fired. Public administration reform in Lebanon is urgently and fully needed.

Microeconomic policies

In his opening speech to the "Council of Economic Analysis" on July 24th 1997 French Prime Minister Lionel Jospin said that "France has to develop a long term industrial development policy. Therefore we have to define the proper areas for public intervention and private initiatives so we can promote investments in infrastructure and new technologies"[11]. Innovation is not a series of isolated consecutive steps in the industrial process. It is a complete interactive and continuous process resulting in a new understanding of production, marketing, finance, and organizational structure in the firms and in the sector. Most studies have shown that innovations have come mostly from the internal efforts within the firm. In the production process outside sources from universities and research institutions help too. Firms innovate first, to in-

(11) See R. Boyer and M. Didier. Innovation et Croissance. La Documentation Francaise. 1998.

crease their share in the market and second, to improve their profitability.

In table 1, we show the share of specific expenditures in total spending on innovation in 8 OECD countries. Clearly, Research and Development (R&D) account for only a minor part in the total. Design, market analysis, patents, and licenses account for a significant share. The process of innovation goes beyond R&D and therefore should not be mixed with it. In table 2, we show the sources of innovation in France clearly confirming that internal sources are predominant. In table 3, we show the objectives of technological innovation in France indicating that maintaining or increasing market share is a top priority. The Association of Lebanese Industrialists (ALI) should lead an effort to develop similar statistics and information for Lebanon.

Why Public Intervention in Promoting Innovation?

Since research done inside the firm benefits also society, competition and the national economy, public sector intervention in the innovation process becomes justified and necessary. It is also estimated that the social benefits of innovations are generally superior to their private benefits necessitating government's intervention to

help in the finance of the process. This policy should affect all steps of the process, i.e. capital formation, protection of intellectual property, links between public research and the private sector, mobility of researchers, consultants, and engineers, the proper social and economic environment facilitating everybody's role. Public intervention relies in fact on two important principles: encouraging innovation and making it available to the public. Innovation, as Shumpeter[12] said, is the engine of development.

Does innovation create or kill jobs?

Both are right. It will kill some jobs which become irrelevant in the new production process. It will add jobs for qualified white and blue-collar workers, hence the importance of the education process at all levels. Jobs are much more protected in the innovative sectors. Innovative firms are able to improve their productivity and are more successful in exports. Innovation, growth, and productivity are positively linked. Of course, it is possible for the public sector to take care of the unemployed for a short period of time while it helps training them on the new production processes.

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(12) See J. Schumpeter. Capitalisme, Socialisme et Democratie. Payot. 1990.

In table 4, we show labor productivity in manufacturing in the major OECD countries for 1960, 1985 and 1995, calculated as value added per hour. Clearly, the USA, due to its huge innovative capacity, is leading the world in labor productivity and consequently in economic strength. In table 5, we show a ranking for competitiveness for major developed countries. The USA leads the world followed by Singapore which, as mentioned earlier, invested heavily in education and infrastructure. The origins of the lead of developed countries in economic growth can be seen in table 6 which shows the 13-year-olds average score in mathematics and sciences. With the exception of the USA, all countries which ranked well in these scores, witnessed an impressive economic performance. Education, again, is reflected directly in growth. The puzzle for the USA can be explained by its ability to import high quality scientists, engineers, mathematicians, and others from the rest of the world and to provide them with the proper environment for innovation.

All East Asian governments launched industrial policy schemes to upgrade their economic structure: Singapore attempted a "2nd" Industrial Revolution", Taiwan an "Industrial Escalation", Korea a "Heavy and Chemical Industry" drive, Hong Kong an "Industrial

Diversification" program, Malaysia a "Heavy Industrialization" push and so on. While selective industrial policies have been prominent at times in some East Asian countries, they have not played a consistently positive or even important role. The commonalties in East Asian development strategy must be sought not in policies, but in deeper functional aspects of the development process. Rapid development does not call for any specific policy package, but it does require policies that achieve certain fundamental goals. How these objectives are best achieved depends on a country's institutions and external environment. Replication of the East Asian experience is not easy, as the world has changed completely. Moreover, there is no single policy that can be copied in order to guarantee success. Each country did match its strategy with its institutional capacity and other aspects of its economic environment. Overtime, unsuccessful approaches were reformed and abandoned.

On the other hand in Latin America[13], the Mexican peso crisis of December 1994 changed the mood dramatically. In 1995, per capita income in Mexico

(13) See Burki S.J. and G.E.Perry. The Long March: A Reform Agenda for Latin America and the Caribbean in the Next Decade. The World Bank. 1997.

declined by approximately US$770 and in Argentina by about US$130. The Latin American and Caribbean (LAC) region's economic growth rate plunged from 5.4% in 1994 to 0.9% in 1995. A stronger than expected recovery in the Mexican and Argentine economies pushed the region's growth rate to 3.5% in 1996. Net private capital inflows increased from US$ 46.5 billion 1995 to US$62 billion 1996.

An agenda for reform, also relevant to the Lebanese situation, was designed by the World Bank to Latin American countries as follows:

* Quality Investment in human capital: Improve the quality and efficiency of basic education and health services, and reverse present day biases against the poor.

* Financial markets: Increase the efficiency of financial markets since weak financial sectors are a threat to macroeconomic stability.

* Legal and regulatory environment: Enhance the protection of property rights, the enforcement of contracts and the credibility of the legal and regulatory framework, in which the LAC region lags behind other.

– Labor market reform

– Regulatory frameworks for private investment in infrastructure and the social services.

* Quality public sector and governance: Introduce efficient decentralization of government, civil service reform and reform of the judiciaries.

* Fiscal strengthening: In today's world of extensive financial integration and volatile capital flows, fiscal prudence and flexibility are the cornerstones of macroeconomic stability, which is itself necessary to sustain high growth rates. Fiscal prudence and flexibility also help to keep national savings rates high and to maintain adequate levels of investment in human capital and infrastructure.

– Social security reform.

– Substantial government fiscal reform

The Lebanese government should implement the following microeconomic policies which will target the development of innovative activities in the sector:

A. Human Resources: As mentioned earlier, knowledge, education, research and training are very important for innovation in any economic sector. Because of needs,

the government should redirect its resources more towards technical and professional education and less towards public higher education. High quality higher technical education will remain a top priority for the Lebanese industrial sector.

The global demand for innovative products in knowledge-based industries is high and growing rapidly, yet the number of workers who can contribute to producing and commercializing new knowledge is limited to just a few areas in the world. Economic activity based on new knowledge generates higher wages and greater employment opportunities reflecting demand for new and improved products and services. There are many indicators reflecting the shift in the comparative advantage of the high-wage countries towards an increased importance of innovative activity. The demand for less skilled workers decreased dramatically throughout the OECD, where at the same time the demand for skilled workers exploded.

Firms exist exogenously and then engage in the pursuit of new economic knowledge as an input into the process of generating innovative activity. The most important although not the only source of new knowledge includes a high degree of human capital, a skilled labor force, and a high presence of scientists and engineers. The

most innovative industries such as computers, instruments, and pharmaceuticals also tend to be the most R&D intensive. Small firms account for a disproportionate share of new product innovations, given their low R&D expenditures.

Where do innovative firms with little or no R&D get the knowledge inputs[14] from other, third party firms or research institutions, such as universities. High context, uncertain knowledge is best transmitted via face-to-face interaction and through frequent and repeated contact. Geographic proximity is therefore important for knowledge spillovers. A close relationship can be seen between the availability of knowledge resources in a city and its innovative performance.

Small and new firms are able to generate innovation output while undertaking negligible amounts of investment into knowledge generating inputs such as R&D. Large firms are more adept at exploiting knowledge created in their own laboratories, while small ones have a comparative advantage at exploiting spillovers from university laboratories.

(14) See D.B. Audretsch. Agglomeration and the Location of Innovative Activity. Oxford Review of Economic Policy. 1998.

The role of tacit knowledge in generating innovative activity is presumably the greatest during the early stages of the industry life cycle, before product standards have been established and a dominant design has emerged. New economic knowledge embodied in skilled workers tends to increase the propensity for innovative activity to cluster spatially throughout all phases of the industry life cycle. On the other hand, other sources of new economic knowledge such as university research, tend to elevate the propensity for innovative activity to cluster during the introductory stage of the life cycle, but not during the growth stage, and then again during the stage of decline.

B. Tax reliefs (or exemptions) should be given to companies which heavily invest in research and product development and in improving the productivity of capital resources. Because of the telecommunications revolution, firms will be forced to rethink the strategic fundamentals of their businesses. The new economics of information will precipitate changes in the structure of entire industries and in the ways companies compete. The modernization or replacement of these resources will help minimize costs and produce better products more efficiently.

Technology Policy?

The long run performance of any economy depends upon its success in innovating new products and processes. The three stages in the process of technological change are: Invention (generation of new ideas), innovation (transformation of those ideas into new marketable products and processes) and diffusion (spread of use and ownership of new technology). Technology policy is defined as the set of policies involving government intervention in the economy with the intent of affecting the process of technology change:

* The incentives that firms have to invest in technology are diverse.
* Technology change and thus technology policy proceed in an environment of uncertainty and often very incomplete information.
* Several government policy instruments have interacting effects on incentives to advance technology.
* Several difficulties of measurement.
* Problems of evaluation.
* Assessment of the national return from technology policy is complicated by international rivalry.

Unassisted market forces cannot secure an efficient allocation of resources to technology activities. There are several reasons including externalities, scale economics, market power attitudes to risk, and information asymmetries to expect that market forces will not result in desirable levels of technological activity and dynamic efficiency if left to themselves. Additionally, international competition may motivate governments to intervene which was the case in Japan. Because of market failure, the government needs to develop technology policies.

Technology change is concerned with the production of new information. Information is unlike any other commodity. Once discovered it can usually be made available at very little cost. The conflict between the public interest in dissemination and the private interest in exercising exclusive property rights over information is known as the appropriability problem. Although each firm may have less incentive than socially desirable to engage in technology activity, it is possible that there will be too many firms engaging in such activity. This is the potential problem of duplication of research efforts. Too much R&D input and too little R&D output, are a double inefficiency. On the other hand, rivalry in R&D can have advantages:

* Desirable when independent

* Diversity

* Priority in discovery

In view of the difficulties of measuring R&D inputs and prospective returns, R&D funding is beset with acute problems of asymmetric information, and the market for R&D finance is likely to be highly imperfect. Financing via long-term relationships with banks may be more effective than stock market financing due to closer monitoring arrangements and better information flows.

The externalities between firms, and between firms and consumers, are the principal sources of market failure in technological activity. The problem of appropriability is particularly important. What are the policy instruments needed to develop an effective technology policy?(15)

• The patent system helps to protect the innovators for a few years so that they benefit from their work and creativity, while at the same time make their product available to everybody inside and outside the country. The absence of such a system will obviously discourage

(15) See P. Stoneman and J. Vickers. The Economics of Technology Policy. Oxford Review of Economic Policy. 1988.

innovators and investors and consequently the economy will lose.

- Public provision: Each government will need to set up public research institutions to advise industrialists on what and how to produce and more importantly on how to engage in a fruitful innovative process. The Lebanese government needs to provide full support to existing ones and finance their operations. Their terms of reference may need to be defined as the government provides them with the means to hire human and physical resources.

- R&D subsidies to the extent of the public benefits from private research could be recommended for the continuation of the innovative process. Lebanese universities are full of qualified researchers in engineering departments and business schools which could do an outstanding job if provided with the needed resources.

- Co-operative R&D: In the Lebanese case where firms are generally small by international standards, it is recommended that many firms in a particular sector or in complementary ones join their efforts in research and innovation.

- Other: risk sharing, diffusion policies, competition policy, trade policy, education and training policy,

procurement policies, defense policies, policies on standards and compatibility.

In mission-orientated countries (U.K, US, France), science and technology is applied to big problems (space program, Concorde...) in the search for international strategic leadership. In diffusion-orientated countries (Germany, Switzerland, Sweden...), technology policies aim to promote a capacity for adjustment to technology change throughout the industrial structure by the provision of R&D related public goods, notably in education, product standardization and cooperative research. In Japan, vigorous policies to promote national technology goals have been pursued in tandem with diffusion oriented policies.

Competition Policy?

A precondition for a successful market economy is the existence of an effective competition policy[16]. Adam Smith said:"People of the same trade seldom meet together. When they do, it is usually a conspiracy against the public, or increasing prices". The role of competition should be to promote economic efficiency. Economic analysis is

(16) See D. Hay. Competition Policy. Oxford Review of Economic Policy. 1993.

generally ambiguous, a priori, about the efficiency effects of particular market structures and conduct. The appropriate design of policy and policy institutions is crucial to a successful competition policy. International harmonization of competition policies is essential, and probably a supranational competition authority is needed as well. Competition helps innovation and monopoly kills it. The optimum degree of competition varies across countries and sectors.

*Tax reliefs (or exemptions) should be given to companies which locate their production in designed areas, especially in rural regions. Industrial location is in fact very important for economic development and for cost minimization. In fact, new ideas need new space. Greater geographic concentration of production actually leads to more, and not less, dispersion of innovative activity. Knowledge spillovers play an important role within a given geographic location in stimulating innovative activity. It is communication between individuals that facilitates the transmission of knowledge across agents, firms, and even industries, and not just a high endowment of human capital and knowledge in the region. These facts constitute the rationale for setting up industrial zones.

It is believed that an increased concentration of a

particular industry within a specific geographic region facilitates knowledge spillovers across firms. Matters differ when we consider the inter-industry knowledge spillovers which are a source of considerable innovation. According to Jacobs[17], it is the exchange of complementary knowledge across diverse firms and economic agents which yields a greater return on new economic knowledge. She emphasizes that the variety of industries within a geographic region promotes knowledge externalities and ultimately innovative activity and economic growth. The industrial zones should therefore contain many industries facilitating the exchange of information and spread of knowledge.

Competition is more conducive to knowledge externalities than is local monopoly: Competition of ideas. More than simply an endowment of knowledge inputs is required to generate innovative activity. The underlying economic and institutional structure matters, as do the microeconomic linkages across agents and firms. Globalization combined with the telecom revolution has drastically reduced the cost of transporting not just material goods but also information across geographic space.

In Chart 1, we show the influence of technical

(17) See J. Jacobs. The Economy of Cities. Random House. 1969.

cooperation on the sales of new or improved products. Clearly, the effect is strongly positive confirming the importance of that factor. Chart 2 shows that the most advanced countries in science and technology grew from 1986 to 1994 three times as fast as the rest of the world. Successful innovation systems can be quite different as Chart 3 shows. Each country can and should design a system convenient to its situation and endowments.

Importance of New Knowledge?

High wages are increasingly incompatible with information-based economic activity, which can be easily transferred to a lower cost location. By contrast, the creation of new ideas based on tacit knowledge cannot easily be transferred across distance. The comparative advantage of the high cost countries of North American and Western Europe is increasingly based on knowledge driven innovative activity.

The spillover of knowledge from the firm or university creating that knowledge to a third party firm is essential to innovative activity. Such knowledge spillovers tend to be spatially restricted. An irony of globalization is that even as the relevant geographic market for most goods and services becomes increasingly global, the increased

importance of innovative activity in the leading developed countries has triggered a resurgence in the importance of local regions as a key source of comparative advantage.

As the comparative advantage in Western Europe and North America has become increasingly based on new knowledge, public policy towards business has responded in two ways.

• Shift the policy focus away from the traditional triad of policy instruments essentially constraining the freedom of firms to contract (regulation, competition policy or antitrust, and public ownership of business). The new policy focuses on enabling the creation and commercialization of knowledge (encouraging R&D, venture capital[18], business incubators[19] and new start-up firms).

(18) Venture capital addresses the common scarcity of equity finance. It is capital at risk in a project, usually long-term finance and invariably involves an equity component or the potential for profit participation as the price for providing the risk capital.

(19) Business incubators are business assistance programs targeted to start-up and fledgling firms. Small businesses (tenants), housed in incubators, receive both business and technical assistance through in-house expertise and a network of community resources. The business incubator provides an environment which supports young companies during their critical start-up period. Incubator tenants receive below market leasing rates for prime office and/or light manufacturing areas. In addition, they have access to basic business support such as telephone answering and clerical services and shared office equipment including copy, postal and fax machines. In

• Shift involves the locus of such enabling policies which are increasingly at the state, regional or even local level. The increased importance of innovative regional clusters as an engine of economic growth has led policy-makers to abandon the policy cry frequently heard two decades ago "Should we break up, regulate or simply take over GM, IBM and US Steel?" for a very different contemporary version "How can we grow the next Silicon Valley?"

C. Financing Issues: A well-functioning financial system is critically important for sustained economic growth.

It plays a major role in mobilizing savings, allocating capital, exerting corporate control, and easing risk management. Most measures of banking development are strongly correlated with economic growth. The functioning of equity markets affects liquidity, risk diversification, and information acquisition about firms, corporate control, and savings mobilization. By altering the quality of these services, the functioning of stock markets can alter the rate of economic growth[20].

1980, less than 10 incubators existed worldwide. Today, there are more than 1100 and nearly half of those are located in the United States.

(20) See R. Levine and S. Zervos. Stock Market Development and Long-Run Growth. The World Bank. March 1996.

One way stock markets may affect economic activity is through their liquidity. Many high-return projects require a long run commitment of capital. Investors, however, are generally reluctant to relinquish control of their savings for long periods. Without liquid markets or other financial arrangements that promote liquidity, less investment may occur in the high-return projects. Stock markets may arise to provide liquidity: savers have liquid assets, like equities, while firms have permanent use of the capital raised by issuing equities. Specifically, liquid stock markets reduce the downside risk and costs of investing in projects that do not pay off for a long time. With a liquid equity market, the initial investors do not lose access to their savings for the duration of the investment project because they can quickly, cheaply, and confidently sell their stake in the company. Thus, more liquid stock markets ease investment in the long run, potentially more profitable projects, thereby improving the allocation of capital and enhancing prospects for long term growth.

Risk diversification through internationally integrated stock markets is a second vehicle through which stock market development may influence economic growth. Greater risk diversification can influence growth by shifting investment into higher-return projects. Intuitively,

since high-expected-return projects also tend to be comparatively risky, better risk diversification through internationally integrated stock markets will foster investment in higher return projects.

Stock markets may also promote the acquisition of information about firms. Specifically, in larger, more liquid markets, it will be easier for an investor who has gotten information to trade at posted prices. This will enable the investor to make money before the information becomes widely available and prices change. The ability to profit from information will stimulate investors to research and monitor firms. Better information about firms will improve resource allocation and spur economic growth. Well-functioning stock markets quickly reveal information through price changes. This quick public revelation will reduce, not enhance incentives for expending private resources to obtain information.

Stock market development may also influence corporate control. Efficient stock markets help mitigate the principal-agent problem and make it easier to tie manager compensation to stock performance. This helps align the interests of managers and owners. Moreover, takeover threats induce managers to maximize the firm's equity price. Thus, well-functioning stock markets that ease

corporate takeovers can mitigate the principal-agent problem and promote efficient resource allocation and growth. Large, liquid, and efficient stock markets can ease savings mobilization and increase the chances for implementing feasible investment projects. Since some worthy projects require large capital injections and some enjoy economies of scale. Stock markets that ease resource mobilization can boost economic efficiency and accelerate long run growth.

The example of Singapore is well suited for Lebanon. Its financial system is very sound. The stock exchange is technologically sophisticated. Similarly, Lebanon needs to develop further its financial markets. Bank lending to the industrial sector remains very weak in the order of 12.5% of total credits. As the Government was not able to set up an industrial bank due to the lack of interest in the private sector, long-term financing should become more available especially from regional and international bilateral and multilateral organizations such as the IFC which have these resources. International financial markets should be considered too. Government should extend its helping hands to innovating firms in negotiations and possibly providing guarantees for exports.

D. Market Issues: The development of a regional

common market is critical to the economic survival of all Arab economies. The recent industrial agreement with Syria is one important step in the right direction. The industrial sector will benefit further from larger markets once a technology policy has been adopted and implemented. The Lebanese industrialists' creative mind should be completely invested in creating innovative ideas for their sector. We still have the time and opportunity to make it in this tough globalized world. The Lebanese government should, through its network of commercial sections in foreign capitals, help the sector find overseas markets. Joint government- private sector advertising campaigns and visits to main markets are recommended. Well designed bilateral and multilateral agreements should help too.

Chart 4 shows that an innovation system has a set of complementary components which cover technology, finance, education, the macroeconomic environment, and market issues. Creating a proper and productive environment for innovation means developing all the components discussed in the paper. The cooperation of the public and private sectors is therefore needed to implement the various policies designed to promote innovation in the Lebanese industrial sector.

Recommendations

Paul Samuelson taught us over sixty years ago that there is no free lunch in economics. His statement is more true now than ever. We have to work harder than ever to earn our living and compete in the national and international markets. With the help and cooperation of the ALI, the Lebanese government should develop new long term policies which will enable the creation and commercialization of knowledge. Solutions to the sector's problems are not easy and cannot be found in simple short term and short sighted policies such as lower customs duties or cheaper fuel-oil prices. What we need is creativity and innovation which are the only guarantees for the future survival of the sector. It is very important to remember that in this world of globalization, a national industrial policy is obviously constrained by the size of the country and cannot yield full benefits unless countries in the region internalize the process of innovation and cooperate together in this regard.

Singapore's only natural assets were its strategic location and deep-water harbor. The Government has concentrated on developing an infrastructure that compensates for the country's lack of natural resources and small size. Advantages have to be created and continously renewed:

* World class transportation and materials handling facilities.

* Sophisticated communication and information technology infrastructure.

* Continuously upgrading the skills of its workforce. Knowledge constantly makes itself obsolete, with the result that today's advanced knowledge is tomorrow's ignorance. The only comparative advantage of the developed countries is in the supply of knowledge workers. The new economics of information will precipitate changes in the structure of entire industries and in the ways companies compete.

* Closely monitoring relevant global technology developments, absorbing them as quickly as possible.

Other major recommendations for the Lebanese

government include:

*Public administration reform.

*Competition Policy: Competition promotes innovation. What is the best degree of competition depends on the products. In heavy industries and due to huge investments, a lower degree of competition is desirable for innovation.

*Technology policy to be clearly defined.

*Improve and strengthen the laws regarding the protection of intellectual property and specially the patent system.

*Improve the efficiency of our education system.

*Introduce an accreditation system similar to ABET's.

*Improve the efficiency of the research institutions of the public sector.

*Provide the proper financing from the public sector to these research institutions and improve the efficiency of research spending.

*Encourage researchers in competing firms to discuss ideas and hold closed seminars for everybody's benefits. Networking among firms and strong

linkages with universities and government research institutions are bound to benefit all branches of the industry.

*Promoting business incubators.

*Encouraging firms to be set up in industrial zones.

*Extend its helping hands in financing and market issues.

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Table 1:

Spending on Innovation. Share of specific expenditures in total expenditures On Innovation

Shares	Italy	Germany	Belgium	United Kingdom	Holland	Denmark	Norway	Ireland
R & D	32.9	27.1	44.7	32.6	45.6	40.1	32.8	22.2
Patents, Licences	6.0	3.4	1.5	2.7	6.1	5.3	4.2	4.3
Design	31.9	27.8	11.3	28.4	7.6	15.8	14.2	22.0
Market Analysis	5.3	6.1	6.6	8.9	19.8	8.2	5.5	38.5
Others		29.2	21.2	15.9	20.2	9.0	17.6	20.4

Source: OECD, 1997: An empirical comparison of National Innovation Systems.

Tableaux98/Spending Innovation

Table 2:

Sources of Innovation in France

	In % of Innovating Firms	Importance given by the Firms
Internal Sources		
Internal Research	**57**	**3.3**
Other Departments	**17**	**2.1**
Research Groups	**17**	**1.8**
Other Departments	**6**	**1.4**
Public External Sources		
Public Laboratories	**5**	**1.4**
Universities	**4**	**1.4**
Other external Sources		
Technical Centers	**7**	**1.6**
Provision of Services	**6**	**1.5**
Consultants	**4**	**1.4**
Providers of materials	**20**	**2.2**
Equipments	**22**	**2.3**
Clients	**22**	**2.3**
Competitors	**10**	**1.8**
General Information		
Data Banks, Patents	**7**	**1.6**
Meetings, Publications	**12**	**2**
Exhibitions	**20**	**2.3**

The first column gives the proportion of innovating firms which use the source.

The second column is an average calculated from firm's answers.

tableaux98/Source of Innovation

Table 3:

The Objectives of Technological Innovation in France

	1	2
To maintain or increase market share		
Replacing obsolete products	31	2.5
Improving the quality of existing products	56	3.3
Extending the range of products	58	3.4
Looking for new geagraphic markets	33	2.6
Increase profitability		
By giving more flexibility to production	22	2.3
By decreasing labor costs	22	2.3
By decreasing the consumption of materials	20	2.2
By decreasing the consumption of energy	10	1.8
By decreasing the rate of defects	30	2.5
By shortening design cycle	29	2.5
Diminishing the damage to environment	24	2.3
Improving work conditions and security	32	2.6

1: In % of innovating firms
2: In given importance

Source: Inquiry "Innovation"- SESSI

Tableaux 98/objectives

Table 4:

Labour productivity in manufacturing, value added per hour, United States = 100

	1960	1985	1995
United States	100	100	100
Japan	19	69	73
W. Germany	56	86	81
France	46	86	85
Britain	45	60	70
Canada	69	84	70
Australia	51	57	52
Netherlands	51	107	97
Sweden	50	87	90

Source : OECD

Seminar/Labprod

Table 5:

Competitiveness
World rankings

	1995	1996	1997
United States	1	1	1
Singapore	2	2	2
Hong Kong	3	3	3
Finland	18	15	4
Netherlands	8	7	5
Norway	10	6	6
Denmark	7	5	7
Switzerland	5	9	8
Canada	13	12	9
New Zealand	9	11	10
Japan	4	4	11
Britain	15	19	12

Source : IMD

Seminar/CMPWDRKG

Table 6:

13-year-olds'average score in TIMSS*
(Int average=500)

	Maths		Science
1 Singapore	643	Singapore	607
2 South Korea	607	Czech Republic	574
3 Japan	605	Japan	571
4 Hong Kong	588	South Korea	565
5 Belgium (F)	565	Bulgaria	565
6 Czech Republic	654	Netherlands	560
7 Slovakia	547	Slovenia	560
8 Switzerland	545	Austria	558
9 Netherlands	541	Hungary	554
10 Slovenia	541	England	552
11 Bulgaria	540	Belgium (F)	550
12 Austria	539	Australia	545
13 France	538	Slovakia	544
14 Hungary	537	Russia	538
15 Russia	535	Ireland	538
16 Australia	530	Sweden	535
17 Ireland	527	United States	534
18 Canada	527	Canada	531
19 Belgium (W)	526	Germany	531
20 Thailand	522	Norway	527
21 Israel	522	Thailand	525
22 Sweden	519	New Zealand	525
23 Germany	509	Israel	524
24 New Zealand	508	Hong Kong	522
25 England	506	Switzerland	522
26 Norway	503	Scotland	517

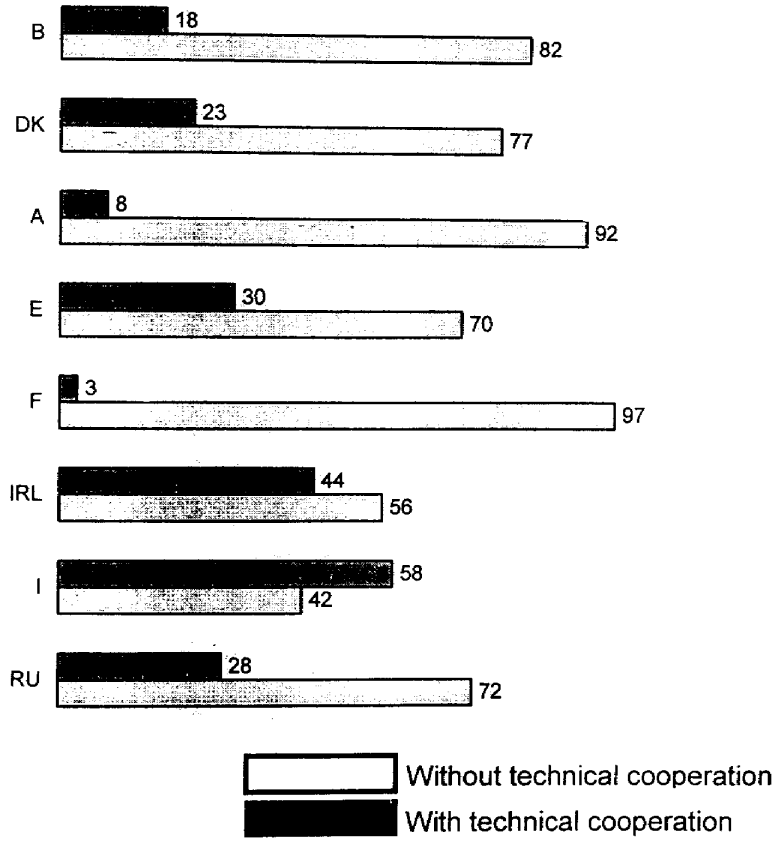
27 Denmark	502	Spain	517
28 United States	500	France	498
29 Scotland	498	Greece	497
30 Latvia	493	Iceland	494
31 Spain	487	Romania	486
32 Iceland	487	Latvia	485
33 Greece	484	Portugal	480
34 Romania	482	Denmark	478
35 Lithuania	477	Lithuania	476
36 Cyprus	474	Belgium (W)	471
37 Portugal	454	Iran	470
38 Iran	428	Cyprus	463
39 Kuwait	392	Kuwait	430
40 Colombia	385	Colombia	411
41 South Africa	354	South Africa	326

* Third International Maths and Science Study
Source:TIMSS

Seminar/Mathscis

Chart 1:

The influence of technical cooperation on the sales of new or improved products.

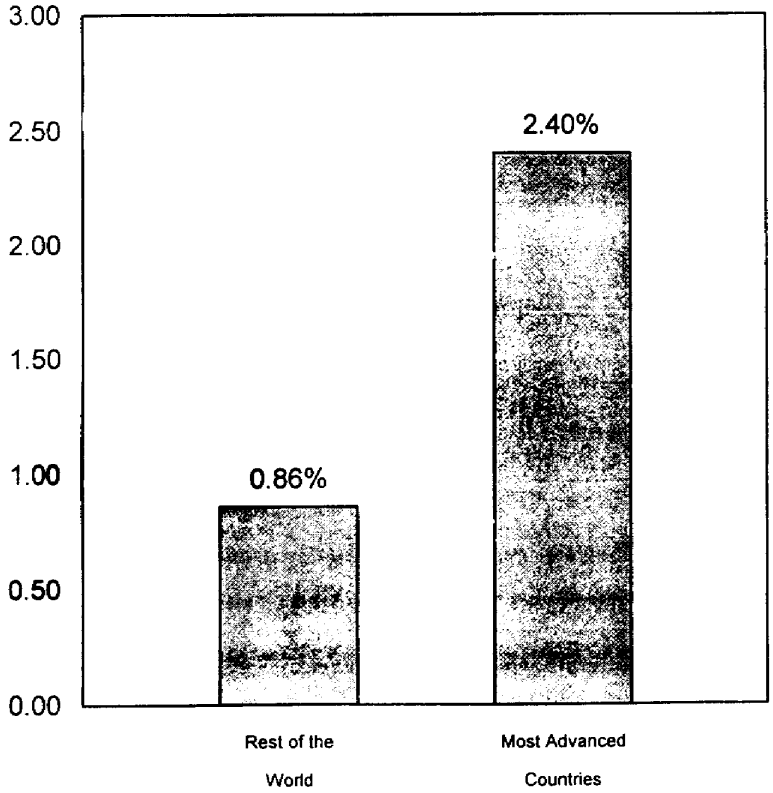


*Source:*Study on innovation in Europe.

Conf98/

Chart 2:

The most advanced countries in science & technology grow faster than others. (1986-1994)

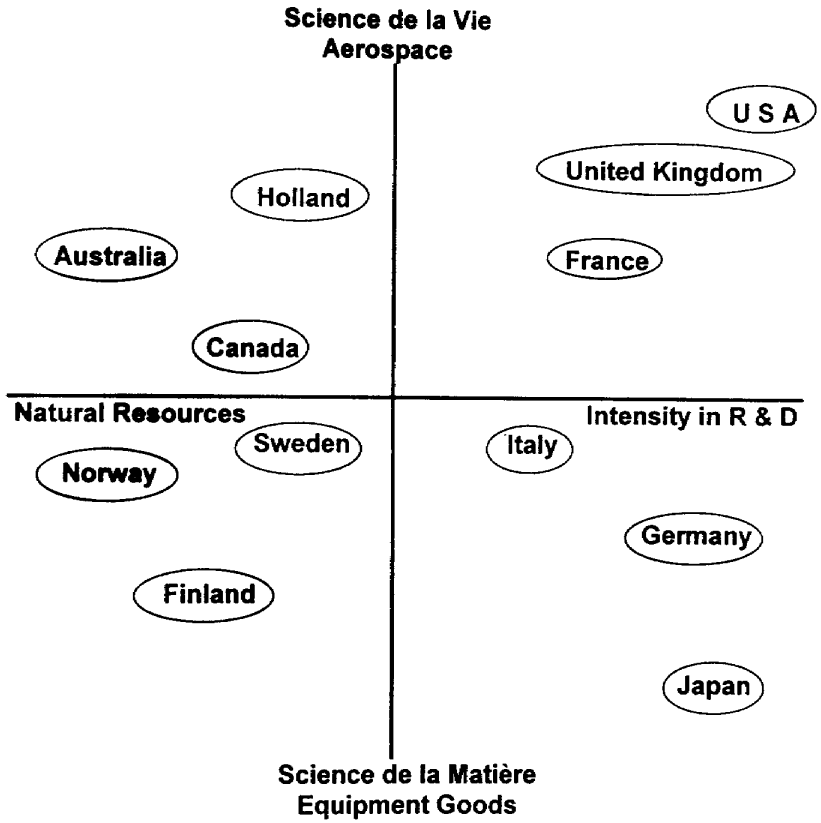


Source: European Commission (1997): Second European Report on S &T indicators 1997,p.9

Conf98/

Chart 3:

The scientific & technological component of innovation systems

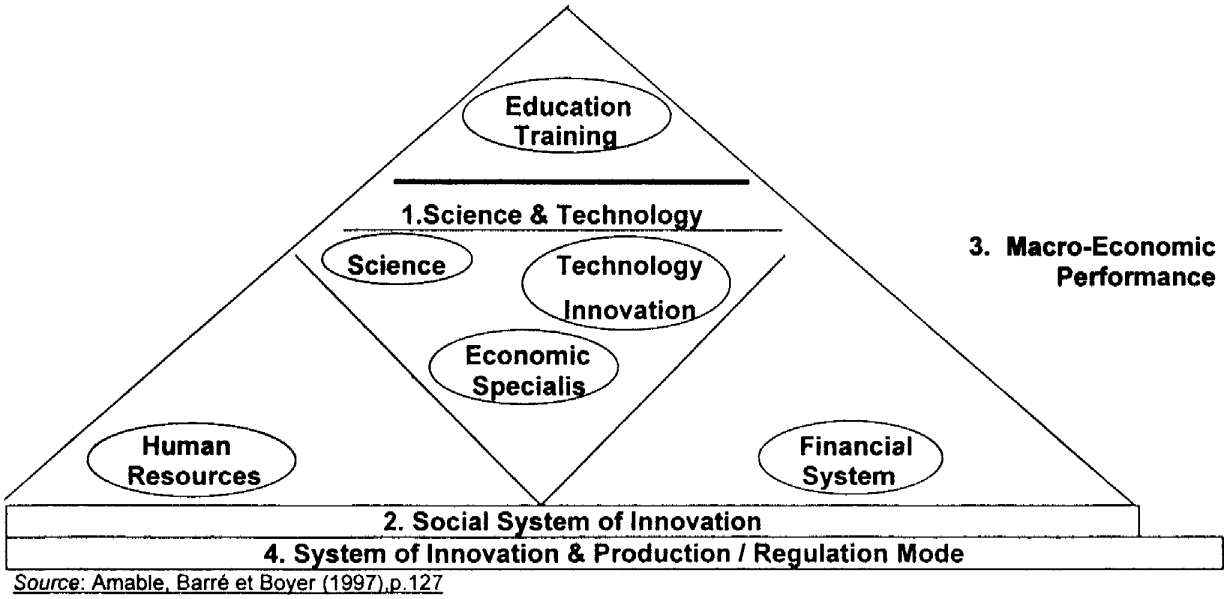


Source: Amable et alii (1997)." Les systèmes à l' ère de la globalisation", Economica. Paris.p.147

Conf98/

Chart 4:

The Complementarity of the Components of a System of Innovation



Source: Amable, Barré et Boyer (1997),p.127