WHAT A STATE CAN AND CANNOT DO TO PROMOTE INNOVATION-DRIVEN SUSTAINABLE DEVELOPMENT[1]

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I — Introduction

It is often assumed that science and technology innovations are the mother of (sustainable) development, and that innovations can be fueled or produced by federal or state governments. This belief is summarized in chain (1) below that consists of three concepts and of two causal relationships:

State —> Innovation —> Development (1)

There are obviously elements of truth in these two relationships. Over the course of history, science-based technological innovations have indeed been crucial for economic and social development. Income per capita did increase when and where such innovations were introduced and generalized. In many cases also, the role of governments, at both national and regional (state) levels, in the development of these innovations has been important. It might even be argued that these relationships are stronger to-day than yesterday and will be stronger to-morrow than to-day.

Yet, the vision implied by this chain is much too simplistic and deterministic. The three concepts utilized are very broad and multi-faceted. "State" has many meanings and means of action. "Innovation" is even more difficult to define, and can refer to completely different realities. The same is true of "Development", and the UN notion of SDGs (Sustainable Development Goals) has significantly broaden the notion, to include many social and environmental dimensions. In addition, the relationships between these concepts are complex, and certainly not mono-causal. Innovation does not depend only, and not even primarily, upon government actions. And there are many SDG for which innovation cannot do much.

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This brief note will briefly discuss the various components of chain (1): the many faces of innovation (section II), the various dimensions of development (section III), the arrow between innovation and development, that is the complex relationships between these two realities (section IV), the arrow between state and innovation, that is the potential interventions of governments (federal and state) upon innovation and development (section V), and conclude (section VI).

II – The many faces of innovation

Innovation is a fashionable, yet polysemic, word. It is widely utilized to mean very different things – which may be a reason for the success of the concept. If we are to understand each other when we use the word, an effort at clarification is useful. Table 1 suggests a typology.

Table 1 – Different meanings of innovation

Objects :
Product innovation
Process innovation
Domains :
Economic innovation
Societal innovation
Mechanisms :
Innovation invention
Innovation development
Innovation implementation

Objects - A standard distinction refers to the object of innovation and distinguishes between product innovation and process innovation.

Product innovation concerns a new product, that did not exist before and will exist after the innovation: electricity, railroad, the automobile, air conditioning, penicillin, etc. Product innovation can be more or less radical: black and white television was more radical than color television, which was merely an improvement of the former. There is no obvious relation between the radicality of an innovation, and its economic or social importance.

Rather different, but no less important, is *process innovation*, a new way of producing a service or a good. That good may be new, but it might also have existed for centuries. Clothes had been hand-made for ages, but the weaving machine at the end of the 18th century made it possible to make them much faster and cheaper: it was a key innovation that played a key role in the industrial

revolution. Similarly, the so-called “green revolution” did not produce previously unknown cereals, but new technologies (in this case, seeds) to produce — more - of the same cereals. Oil and gas fracking is a process innovation, another form of drilling; yet in a few years it did change significantly the world distribution of oil and gas resources.

Process innovations are often less visible than product innovations, but may economically turn out to be more significant. Nearly by definition, they increase labor and capital productivity. Most registered patents relate to process innovations.

Domains — Innovations take place in a large number of areas or domains. For instance, one could find examples in music (counterpoint, dodecaphony) or in literature (the epistolary novel, the crime novel) or in dancing. More significant for our purpose is probably the distinction between economic innovations and societal innovations.

Economic innovations are innovations that take place in the field of economics, that is in the production of goods and services. They include technological innovations, in the form of new goods or new processes, but also financial, managerial, and macro-economic policy innovations. The invention of the stock company, or of the stock exchange, or of the checking account, or of the computerized payment, or of the value-added tax, did contribute to economic development.

Societal innovations are those that occurred, and continue to occur in all other domains, such as health, housing, education, information, income distribution, and even in politics. They have been, and continue to be, particularly important in medicine and health: new diagnose instruments and techniques have revolutionized the identification of illnesses; new medicines and treatments have been developed; as a result, the length and the quality of life has considerably improved worldwide.

The distinction between economic and societal innovation is not clear cut. People who are better educated, healthier, better fed, and better housed will contribute more to economic development. Reciprocally, more economically productive people will enjoy a better health and education. The distinction is nevertheless useful, because some people tend to restrict the domain of innovation to economic development *stricto sensu*, thus ignoring a key finding of modern economic research: not

only are non-economic variables important *per se*, but they indirectly contribute to economic development.

Mechanisms — Innovation itself is a process, and consists of at least three fairly distinct phases: invention, development, and implementation.

Many — not all — innovations begin with a science-based *invention*. Inventions are very diverse, and range from the abstract and general to the applied and specific. The distinctive characteristic of general invention is that they cannot be patented: Archimedes, or Newton, or Einstein could not have patented their discoveries, and prevented someone else to use them.

An invention, or discovery is merely a starting point of an innovation. It has to be transformed into a new product or process. This is called *development*. A given invention can give birth to a number of different innovations. But innovations can also be developed incrementally, without recourse to any particular invention, by a sequence of minor changes in the parts or the design of an existing product or process. There are examples of both types of development. At one extreme, you have electricity, a radical innovation, which was certainly not developed by improving the candle. At the other extreme, you have the modern automobile, which is structurally similar to the early 20iest century automobile, yet so much more efficient, fast, confortable and safe that it can be considered another product.

Finally, the developed product or process has to pass the test of a successful *implementation*, if it is to become a real innovation. It has to be marketed, spread, widely used. It is not enough to be effective, it has to be cost-effective. It is not enough to be cost-effective, it has to be financially and commercially viable. Many developed inventions that looked beautiful failed to pass this test. Concorde, the anglo-french supersonic plane, developed in the 1970ies and operated in the 1980ies, is a case in point. It functioned very well, but at a prohibitive cost: only 20 aircrafts were sold, and the operation was finally abandoned in the early 2000. It is a classic example of an innovation that was a technological achievement and an economic failure.

III — The many dimensions of development

Development is the third concept of chain (1) above. It is nearly as diverse and protean as the concept of innovation. For long, development was understood as economic development, and synthesized in GDP (Gross Domestic Product). Growth, defined as an increase in GDP, was widely recognized as a key policy objective. The weaknesses and limits of GDP have been identified, and efforts have been made to broaden the notion. The most popular and successful is probably the United Nation Sustainable Development Goals (SDGs).

GDP and its limits – It is next to impossible to sum up the economic activity of a country or a region in just one number. For centuries nobody even tried to do it. It is only in the 1940ies that the GDP was invented and developed - a true innovation – to that purpose, first in the UK and in the USA, then in Western Europe, then in the rest of the world. The GDP, expressed in money terms, is defined as the sum of the value added by all economic sectors (the value-added is the sales of a sector minus the purchases of the sector)[3] during a given year. The GDP turns out to be also equal to incomes distributed, that is to the income of labor (wages) and of capital (interest, profits). Economic growth is the growth of GDP.

GDP is an imperfect indicator of welfare. It ignores income distribution, and the value of what is not sold on the market, such as health, beauty, environmental degradation or improvement, or the value of intra-family work[4].

The UN SDG – The realization of these limits of GDP has led to proposals to replace GDP by broader concepts, (such as Net National Happiness, or the Human Development Index for instance) or to complement it (by additional indicators). Few of these proposals have really been implemented, and GDP continues to be widely utilized to gauge the level and the growth of economic activity. The UN Development Goals, that have reached some currency in many countries, are a noteworthy exception. In 2000, the UN identified 8 goals for the period 2000-2015, called MDGs (Millenium Development Goals), such as Eradicate extreme poverty and hunger, Achieve universal primary education, Reduce child mortality, etc. They were taken

[3] The G of GDP means « gross », i.e. before taking into account the yearly depreciation of capital ; the D of GDP means « domestic », meaning produced within the country, as opposed to « national » which means produced by the nationals of the country.

[4] A gentlemen who marries his cook decreases GDP ; the work done by the pais cook was included in GDP, the (assumed identical) work now done by the housewife is not.

seriously by many governments, and in many countries substantial progress was made in the 2000-2015 period. In 2016, the UN identified 17 goals for the 2016-2030 period, called SDGs (Sustainable Development Goals), presented in Box 1. These goals seem to be what is meant by "sustainable development" in the title of this conference. As such, they deserve some comments.

Box 1 — List of the 17 SDGs

1. End poverty

2. End hunger, achieve food security and improved nutrition

3. Ensure healthy lives and promote well-being for all ages

4. Ensure inclusive and equitable quality education

5. Achieve gender equality and empower all women and girls

6. Ensure availability and sustainable management of water and sanitation for all

7. Ensure access to affordable, reliable, sustainable and modern energy for all

8. Promote sustainable economic growth, full and productive employment

9. Build resilient infrastructure, promote industrialization and foster innovation

10. Reduce inequality within and among countries

11. Make cities and human settlements inclusive, safe, resilient and sustainable

12. Ensure sustainable consumption and production patterns

13. Take urgent action to combat climate change and its impacts

14. Conserve and sustainably use the oceans, seas and marine resources

15. Protect, restore and promote sustainable use of terrestrial ecosystems

16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

The list is a check-list, a wish-list, not a prioritized program. It includes about all that is desirable in all areas (except perhaps culture). One can imagine how it was drafted by a committee. A member says: "cities are important (most people live in cities) and we

must say something about having good cities". Everybody agrees, of course. Another member says: "We must not forget people who live in the countryside. Let us add a reference to human settlements". How could anyone disagree? This produces goal n° 11.

The list is long on desirable objectives, but short on means to reach them. It completely ignores costs, and more generally policy instruments.

If there is a dominant theme in the list, it would be sustainability. The word appears in 10 of the 17 goals, and justifies the adjective of the title, the S of SDGs.

For the purpose of analyzing the relationship between innovation and development goals, it is useful to regroup these goals in three families: mostly economic (goals 1, 2, 8, 9), mostly societal (goals 3, 4, 5, 10, 11, 16), and mostly environmental (goals 6, 7, 12, 13, 14, 15)[5]. This classification is in part arbitrary, because a number of goals (for instance goal n° 6 on water and sanitation) are related to two or three of our families. Nevertheless, it is clear that the SDGs are mostly socio-environmental, and for a relatively small part (about one fourth) economic.

IV – Relationships between innovation and development

Innovation, in one or several of its different forms, can - and does - contribute to achieve various development goals, and is therefore desirable. This relationship, however, tends to be often exaggerated. It does not mean that innovation is a necessary and/or sufficient condition of development. In many cases, the role of innovation in development is inexistent, or minor, or conditional (upon other drivers). To discuss this issue it is useful to distinguish between economic and non-economic development goals.

Non economic development goals – As mentioned above, societal and environmental goals account for the bulk (13 out of 16) of SDGs. A mere look at the list suggests that in most cases, innovation cannot contribute much to achieve these goals. Take gender equality, or inequality reduction, or education provision, or peace and justice, or sustainable consumption and production patterns, or ocean conservation, it is very difficult to imagine how innovation could help reach these – very important indeed

[5] We failed to classify goal n° 17

– goals. They cannot be much innovation-driven. They require political decisions in regulations and resource allocation, that is laws, public expenditures, taxes. In some cases, some innovative technologies, such as electronic voting or computerized teaching, could be useful.

In other cases, such as health, or water and sanitation, or energy, it is true that technology, and therefore innovation, can play a somewhat greater role. The discovery of penicillin, of vaccines, or of surgical techniques did contribute to improve health and lengthen lives. But increased soap usage or hygiene practices - which have not much to do with innovation - probably contributed even more to the impressive infant mortality reduction registered in the past 15 years.

Economic development goals – The contribution of innovation to the four "economic" SDGs, or, to put is simply, to GDP, is certainly greater. But the equation

innovation = development

is very from from being verified. There are many cases of development without innovation, and of innovation without development. This is true of enterprises or sectors as well as of countries and regions.

Many enterprises developed on the basis of very simple and established products and processes. Yesterday and to-day. Just three examples. In 1873, in California, Jacob Davies and Levi Strauss transformed the traditional work pants into the jean by adding rivets to strengthen the pockets. This very simple idea, which can hardly be called an invention or an innovation (although it was patented), met with the tremendous success we all know. In 1965, in Veneto, Luciano Benetton and his family created a clothing enterprise, later named United Colors of Benetton, that did not rest on any innovation (all of its products are outsourced), but only on marketing, design and advertisement; it was nevertheless a remarkable world wide success story. Even more striking is the case of Amazon. In less than 20 years, this on-line retailer became one of the largest company in the world, and its founder, Jeff Bezos one of the richest person on earth. Yet, this extraordinary success owes practically nothing to innovation. Mail retailing had existed for decades. Amazon does make a wide usage of internet to manage its enormous logistics and financial requirements, but an intelligent usage of an established - and innovative - technology does not define an innovation. Innovation is

certainly not a necessary condition of enterprise development and success.

Nor is it a sufficient condition. Many enterprises built on an apparently attractive innovation failed to develop. We quoted above the case of Concorde. The majority of start-up companies, which are (nearly by definition) engaged in research and innovation, are very short-lived. Venture capitalists who finance start-ups are well aware of that. They know that 9 out of 10 such enterprises will never develop, but hope that the 10th will be highly successful and profitable.

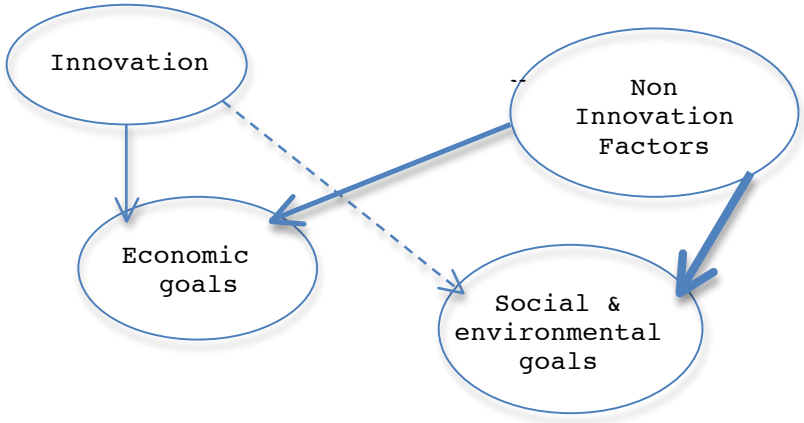
To sum up, innovation is not a magic bullet for success. Success has many other components: management, sense of timing, publicity, knowledge of demand, human relationships in the firm, and luck (which was the quality Napoleon I valued most in his generals). Beware of excessive focus on innovation, and keep in mind the conclusion of a comparison of Panzani (a successful Italian pasta producer) and Bull (a failed French developer of mega-computers): it is better to make money in the pasta sector than to lose money in the computing business.

What is true of enterprises is also true of nations or regions. Economic growth is not always innovation-driven. There are indeed countries or regions which have greatly benefitted from research and innovation: Israel, Finland (thanks to Nokia), California, New England, Scotland (in the 18th century and in recent decades). But there are as many or more nations and regions which have achieved high rates of growth without much recourse to innovation. Consider Japan, Singapore and Veneto. Immediately after WW II, these three areas were extremely poor, poorer than many Latin American countries (certainly much poorer than Argentina). Forty years later, they were amongst the richest areas in the world. This phenomenal growth owes very little to innovation. Japan developed a strong industry in “classical” and even pre-war sectors (shipbuilding, steel, automobile, textile, cameras, optics), mostly copying or buying patents from the then developed countries; only in recent decades did Japan put the emphasis on research and innovation. Singapore largely built its wealth upon trade and finance and relatively simple industry (such as oil refinery); it is now actively engaged in research and innovation. Veneto, in North East Italy, was a very poor agricultural region, out of which hundreds of thousands, perhaps millions, of people were out-migrating to France, Germany, the USA, Argentina, Brazil or Venezuela. Its development was based on

Benetton-type family enterprises producing quality goods in textile, furniture, leather, lamps, appliances, spectacles, food, etc. Design, reliability, marketing, and hard work - not innovations — account for the transformation of one of the poorest European region to one of the richest.

Figure 1 below summarizes this discussion of the relationships between innovation and sustainable development goals. The wider the arrow, the stronger the relationship. It shows that non-innovation factors are much more important than innovation in development, particularly for social and environmental development goals.

Figure 1 — Relationships between innovation and SDGs



V — Potential role of the State

The limited importance of innovation (particularly relative to dominant expectations) in the promotion of development goals does not mean that this importance is negligible. It is not, and governments must define and conduct policies to maximize it.

What to expect? — Innovation, as mentioned in section II above, is produced by a complex machinery. The three main clogs of the machine are:

(i) universities, and more generally centers of learning and research that are (or are not) a source of inventions and ideas, as well as the providers of educated and informed people;

(ii) firms, and more generally businessmen, that will (or will not) pick up inventions and ideas generated by

universities, transform them into innovative products or processes (this is called development), often with the help of universities, and eventually market these innovations;

(iii) banks, and more generally financial institutions, together with consulting enterprises that provide money and assistance to firms in their innovation efforts. Their role is important because innovation is financially risky and intellectually challenging.

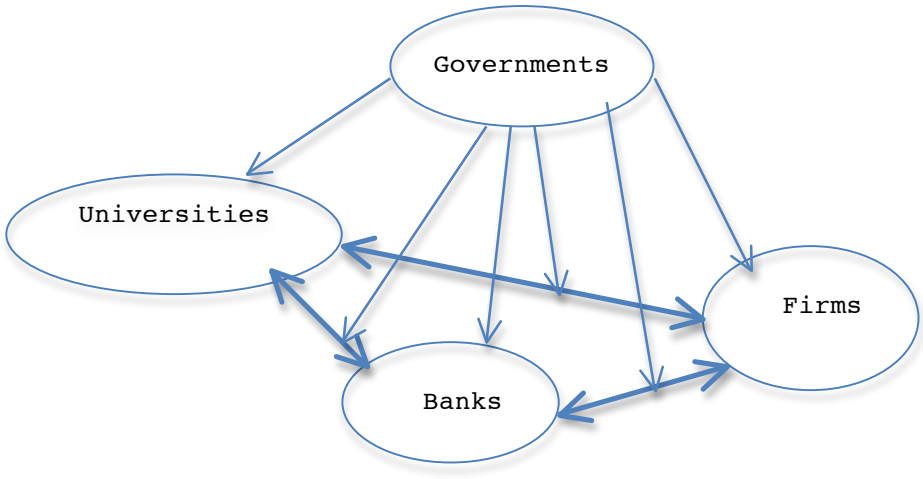
This highly simplified presentation could be enriched. For instance, enterprise size matters. Very large enterprises do not need universities and banks as much as small enterprises, because they have in house researchers and finance. This is why Schumpeter though they were the main vectors of innovation. But Schumpeter did not realize that large, established, often monopolistic, enterprises do not need innovation as much as small enterprises. And experience suggests that many innovations are brought about by small and medium enterprises, for which innovation is often the only or main way to success.

Government does not appear in this schematic presentation of the innovation machinery. The reason is that it is not really a clog. As a matter of fact, many important innovations appeared and developed without *direct* government intervention. This would be the case of the automobile, or of electricity, or of penicillin, or of fracking, or of the self-driven automobile. And most innovation-rich regions appeared without government intervention. The two most important such regions are probably the Route 128 around Boston, and the Silicon Valley, south of San Francisco. Their creation was predominantly spontaneous. They appeared next to some of the best world universities (Harvard and MIT in the first case; Stanford and Berkeley in the second case), but they were in no way designed or planned or organized by the States of Massachusetts or California, and even less by the US Federal government.

It does not follow that government has no role to play in the innovation machinery. It is not a clog, but it is (or should be) the oil that greases the clogs, and makes the machinery function smoothly and efficiently. In modern economies, government intervenes heavily, by imposing all sorts of regulations (on production, consumption, finance), by its many taxes, through its expenditures (from 30% to 55% of GDP). Government intervenes on universities, on enterprises, on banks, and

on the relationships that exist between these various groups of actors, as shown in Figure 2[6].

Figure 2 – The innovation machinery



The issue therefore is not whether governments should intervene (yes, they should, and in any case they do), but whether they intervene in ways which are conducive to innovation.

Actions on universities – Universities, and more generally education and research institutions are a key clog of the system. What can governments do to make them more efficient ?

A short answer is: not much. For several reasons. First, by tradition, and even by the Constitution in many Latin American countries, universities enjoy a great autonomy, and they do not like government interferences. Second, research is a complicated matter, and governments are not intellectually equipped to manage and control it. Science and research is basically what researchers do, and want to do. They must retain a large degree of freedom to work on the topics and areas they, not the government, consider important. "Government science" is no science. The very concept of top-to-bottom government-imposed "research programs" is highly questionable. By most rankings and accounts, the USA has the best (i.e. the most

[6] This presentation is very much akin to the presentation offered in the *Global Innovation Index 2017* (in its Figure 1 entitled Agricultural innovation system). The difference is that in the latter, governments are not mentioned although their action is presented under two headings: bridging institutions and enabling environment. These headings correspond to the arrows originating in the box "Governments".

efficient in terms of research) universities in the world; yet, the USA has no minister of research or of higher education; this may explain that.

"Not much", however is not: nothing. In practice, governments finance a share of university and research budgets, often a very large share. Elected politicians are responsible for how tax-payers money is spent. This gives them some legitimacy to make their voice heard in university and research centres. Government grants can take diverse forms. There can be block grants, used discretionary by teachers and researchers. But there can also be conditional or specific or matching grants that orientate university activities in directions deemed (by governments) desirable for innovation. Two policy directions, in particular, are desirable from the view point of innovation: universality, and quality.

It is often thought, by researchers and even more so by government officials, that institution of teaching and research should be specialized: in energy, or in maritime studies, or in forestry, or in organic chemistry, or in electronics, for instance. The alleged justifications are that this makes it possible: to reach a "critical mass" in the chosen area, and to respond to the presumed needs of the economy of the region. This is a dangerous trend. Research innovations often, and more and more, originate from cross-fertilization, from ideas, tools, approaches used in one discipline and applied to another. In economics, for instance, many Nobel laureates have been scholars who borrowed ideas from mathematics, history, political science, psycholology, or sociology; had they worked in a purely "economics university", without day-to-day contacts with non-economists, they would probably not have made the contributions that were rewarded by a Nobel prize. It is not by chance that "university" and "universal" have the same etymology. All the leading universities, even when they are small, are omni-disciplinary[7].

In education and research, quality is what matters. It is more important than relevance. To produce innovations (in bio-chemistry, or in management, or in any domain) a good course in greek literature is more useful than a bad course in computer science. Efforts must be

[7] The MIT is occasionaly said to be an exception. The name is misleading. It is not merely a technology university, and most disciplines are taught at the MIT, including mathematics, political science, climate science, economics, architecture, urban planning, management, even music.

made to attract, and reward, faculty members that carry out quality research. This author once found a (private) university in Buenos Aires where the publication of an article in a good quality peer-reviewed academic journal automatically increased the salary of the author by a substantial amount for several years: this was a powerful incentive to increase the publication output of the university. Also, providing professors with teaching assistants and/or research assistants multiplies the quality of their output by a significant coefficient. Such initiatives should be encouraged.

The action of governments on firms — Firms are the principal clog in the innovation machinery. They need university inputs, and bank support, but firms are the prime movers, at least in the development and implementation phase of the innovation process. Without innovation-oriented firms, no innovation will take place. What is needed to that effect?

Primarily an enabling environment, which is largely provided by government. For the most part, this required environment is the one needed for enterprises to function and prosper in general, not specifically to innovate. It includes: a supply of qualified labour; good transport, communication, water and energy infrastructure; efficient banks and services (to be discussed below); a moderate, but above all simple and stable, tax system; and a clear and stable and well-administered regulatory system. All this is well-known, and constitute a *sine qua non*, i.e. a necessary, although not sufficient, condition for the creation, and even more the success, of innovation-based firms.

Specific innovation-targeted tools and assistance can also be utilized, albeit with moderation and prudence. Actions aimed at specific enterprises, or even sectors, must generally be avoided, for two reasons. First, governments are generally quite bad at picking up winners, be it firms or sectors. This difficult exercise is the business of bankers and entrepreneurs. Even them (who have appropriate training and experience, as well a direct financial interest at making good choices) often err. The probability of failure by much less competent and well informed bureaucrats and politicians is obviously much greater. Second, targeted assistance opens the door to corruption, or to the suspicion of corruption. Actions less specific and more general should therefore be preferred.

An interesting example is the French research tax credit. Enterprises can deduct from their corporate income tax 30% of their research expenditures. The amount thus deducted is very important: more than 5 billion euros per year (about 6 billion US$). This is supposed to lower the cost of enterprises research, and therefore to encourage it. It is difficult to evaluate the efficiency of this "tax expenditure" (as tax rebates are often called). Enterprises are enthusiastic about this 5 billion euros tax rebate. Universities and public research institutions are very critical of it: they claim that the same amount given to them would produce much more research. Parliamentary reports mostly reflect these contrasting, and interested, views. There are presently no independent academic evaluation reports. Two points can be made. First, the administration of the system is cumbersome. The definition of "research expenditures" is not obvious; firms have to present complicated documents detailing such expenditures, which are appraised by administrative authorities. Preparing such documents is difficult, and it is argued (quite convincingly) that large enterprises are much better than small and medium enterprises at doing it. They seem to be the main beneficiaries of the system. Second, the system is not specific, and does not involve administrative selection of firms or sectors (the picking up of winners), which is a major advantage.

The action of government on banks — All enterprises need short-term and long term financing. Innovative enterprises need it more than others. The reason is that innovation is inherently a riskier business. Nearly by definition, it involves untested products and processes. And it is often undertaken by entrepreneurs with limited commercial experience and shallow financial backing. The probability, and the number, of failures are high. On the other hand, in case of success, the rewards are potentially very high. This distinct profile of risks and rewards has made it necessary to develop specialized financial institution known as venture capitalists. In theory, market forces will provide this sort of financing. In practice, it might not always be the case, and some sort of government intervention might be necessary to support, or encourage, or facilitate much needed venture capitalism.

In this respect, it is interesting to note that most corporate income tax systems discriminate (involuntarily) against risky activities. By taxing corporate benefits, government is a partner in success. But it is not a partner in failure. In the case of deficits, government raises zero in tax, but does not contribute to cover the

deficits. This asymmetry is illustrated in the simplified hypothetical case presented in Table 2.

An investor operates in a country with a corporate income tax of 20%. He can chose standard, non risky, investments of 50 in enterprises A and of 50 in enterprise B that will both yield a yearly return of 10%, that is 5 each. The total tax take will be equal to 2. Our investor can also chose innovation investments of 50 in enterprise C and of 50 in enterprise D. The risk associated with these investments is high, and it might well that the yearly return of enterprise C will be negative (-10) whereas that of enterprise D will be very high (20). The tax take on C will zero, and the tax take on D will be 4. The total tax take will be 4.

Table 2 — Corporate tax take, standard and innovation investment

	Investment	Return	Tax take
Standard investments :			
Enterprise A	50	5	1
Enterprise B	50	5	1
Enterprises A & B	100	10	2
Innovation (risky) investments			
Enterprise C	50	-10	zero
Enterprise D	50	20	4
Enterprises C & D	100	10	4

Note — In this hypothetical example, the corporate income tax rate is constant and equal to 20%, investments are of the same magnitude, but returns are similar for the two standard enterprises and very different for the two innovation enterprises.

In our two cases, the initial investment is the same (100). So is the total or average return (10). But the tax take is very different: it is equal to 2 on the standard investments, and to 4 — twice as much — on the risky innovation investments.

The action of governments on the relationships between actors — In principle, relationships between universities and firms, firms and banks, or banks and universities should normally exist and function. They are of mutual interest to all parties. In practice, for historical and sociological reasons, these relationships are often underdeveloped: some researchers do not care to talk to enterprises, and even more so to banks; enterprises do not trust banks, and even less researchers, etc. This lack of inter-relationships is very detrimental to innovation. Governments can play a useful go-between role, by creating clubs, centres, conferences, meetings, information platforms, joint projects, common study tours, etc. Governments should resist the temptation to behave

like bosses or leaders. The oil should not think it has become a clog.

What level of government should be involved? — We have so far talked of "government" as if it were a single unit. It is not. There are at least three distinct levels of governments: the national or federal government, regional or state governments, and local governments. Which level should do what in innovation promotion? What division of labour (if any) should intervene? This decentralization issue is a complex but important problem. Its solution is country-specific, constrained by the constitutional and historical constraints of each country, and also by the way the main groups of actors (universities, firms, banks) are themselves organized at various geographical levels. Two general points can nevertheless be tentatively made. First, there are actions that are primarily in the hands of central governments, such as national taxation; other actions that are best suited for regional governments, such as labour markets; yet other that mostly make sense at the local government level, such as the efficiency of cities. Second, there are government actions that require the joint involvement of all three levels, such as the provision of infrastructure like roads, energy, water, or communication, as well as education and heath. It is often as difficult to make the various levels of government talk to each other as it is to make universities talk to firms and to banks, but it is absolutely necessary.

VI — Conclusion

Two conclusions emerge from this brief review. One is that one should not exaggerate the role that government can and must play in innovation-driven sustainable development. Innovation cannot do much to achieve most social and environmental SDGs, and even in the case of economic SDGs, innovation is neither a necessary nor a sufficient engine of success. Other policy engines must be mobilized.

Another conclusion is that, nevertheless, government actions may promote much needed innovation. Governments, at the national, regional and local levels, are not the major actors of the innovation game, but they can — and must — intervene to facilitate the inventions, development and implementation that define innovation. Thinking that they can do it as bosses, by preparing a top-down plan telling would-be innovators how to proceed, would be vain, and often counter-productive. Governments must do it

mostly in an indirect fashion, as facilitators and go-between. They must study and understand the innovation ecosystem, or ecosystems, at hand, identify where and why and when they do not perform, and imagine ways of unlocking existing potentials.