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THE CHALLENGE OF INNOVATION IN TURBULENT TIMES: A REPORT SUBMITTED TO THE GLOBAL AGENDA COUNCIL

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1 – Prelude

Our societies face *Grand Challenges* – all global and systemic – from health care to climate change and energy conservation, and from food and water security and to ageing populations. The good news is that we may be able to meet these challenges. From early in the 19th century onward the world has seen the emergence of modern economies – economies that possess the art of innovation. Many societies and their economic systems were able to produce great inventions, ranging from the Pyramids to Sputnik and from mathematics to architecture. Yet none was an innovation in the sense of the *creation* and willing *adoption* by managers or consumers of a new or improved process or product. This innovation is the forte of savvy entrepreneurs, not inventors, as Joseph Schumpeter emphasized. Such innovations did turn up in pre-modern history but only sporadically until the explosion of innovation in the early 19th century – in "modern times." In recent decades, lasting and sustainable innovation has become the rule in nearly all industries. The modern economy has been, as William Baumol put it, an innovation *machine.*

Intense innovation may be the way to manage all these potential crises. We know better than ever before how to innovate and this offers an element of hope - maybe the only one.

On the other hand, investing in commercializing *new technologies* now requires substantial funds and time and entails a strong dimension of risk and uncertainty. The variance of distribution of expected returns from investing in the development of new processes or products is much greater than in the case of other kinds of business investments. Like any other economic agent, potential innovators respond to incentives; they have certain private marginal return expectations. And so in most cases, given this great uncertainty and risk, as well as the positive externalities associated with the process of the generation of new knowledge and information, further incentives need to be provided through "innovation policy": Opening and integrating product markets, improving technology transfers, designing financial instruments better adapted to the funding needs of the different types of innovators, and creating strong universities are some of the most important policy directions. Private-sector investments will respond to the incentives created by public policies only to the extent that the policies are perceived to be credible – lasting and reasonably stable.

Moreover, we are now entering a time in which a modest degree of policy intervention is likely to be insufficient. Two recent setbacks raise new difficulties that must be overcome if business sectors are to regain enough dynamism – roughly, innovativeness – to make it feasible for our societies to meet the "grand challenges." First, there is an urgent need to address the structural damage done during the *economic crisi*s. The weakened state of the financial sector has added to the difficulties of the innovation system. Second, there is an equally urgent need to address a *secular* decline in economic dynamism. There is evidence that economic dynamism has declined in the U.S. over the past decade, if not longer, and a dearth of dynamism became evident in many European countries decades ago.In the next section we elaborate.

2 – A long haul to a good recovery

The west's structural slump a possible drag on innovation

The current economic downturn has posed challenges to advanced economies when it comes to following a path of innovation and knowledge creation. While the urgency of an innovation agenda has not changed, the economic context has shifted the nature of the debate. Before the crisis the focus was on how Europe could improve its innovation performance relative to the United States. The U.S. seemed to have been more successful in turning its innovations into changed processes, new products and services and, as a result, faster economic growth, especially higher productivity growth. The R&D deficit in Europe relative to the U.S. was one of the factors of concern, but problems extended beyond that to the failure to create a truly common "innovation space" in Europe. Following the emergence of the economic downturn in 2008, and once the fiscal and monetary stimuli have run their course to lift the economies out of the deepest holes, both the U.S. and Europe will be looking at innovation as the ultimate method to return to sustainable growth.

Unfortunately it is going to be a long haul, as neither Europe nor the U.S. will see an impressive recovery. Supply conditions seem to be improving in both regions, but at best represent a "return to normalcy" at best. Due to the systemic nature of this crisis there is little scope for a significant increase in demand – be it domestic demand or exports – catching up with supply any time soon. The current output gaps for individual countries are very large, which means that actual output levels are far below potential output levels, leaving huge amounts of underutilized capacity. It is not easy to estimate how long catching up will take, but it could well be 2020 before we have closed the output gap.

The counter argument is that economic crises have historically provided breeding grounds for economic renewal. The death of the residential housing industry may create new opportunities for investment elsewhere --- and for innovation. But this is easier said than done.

First, a loss of the old animal spirits – a heightened sense of uncertainty – has reduced the willingness of firms to supply innovative new products for try-out by households and businesses; further, the straitened circumstances of venturesome consumers and sophisticated businesses has weakened the demand for innovative new products. Several European countries, notably Germany, Italy and France, are something of an exception since they had little dynamism to lose.

Second, the huge amount of underutilized capacity as a result of the output gaps reduces incentives to innovate through investment in new machinery and equipment. (The value of added capital is depressed while the opportunity cost of acquiring added capital by diversions of some labor and capital from the production line is not necessarily depressed.) Companies will stick with their current stock of machinery and reduce orders for the latest updates.

Third, the long recovery path also poses risks beyond investment in tangible capital as recovery can also lead to an erosion of intangible capital. In particular, the human capital of high skilled workers quickly erodes as worker training is postponed. Forward-looking activities in companies, such as R&D programs, are also coming under pressure as earnings fall and opportunities for the marketization of new innovations decline.

Finally, as the systemic crisis in financial markets will take time to resolve itself, it will continue to limit access to capital and – important for innovation – the quality of capital. Access to venture capital has been seriously hit, and will need to get back on line, in particular to fund R&D and innovation in small and medium-sized enterprises who cannot rely on retained earnings as large firms do.

A secular shift toward reduced dynamism

Worse yet, even before the crisis, most advanced economies experienced a decline in innovation. This has been most evident in Europe. It has been clear for decades that continental western Europe lost its zeal and its zest; the only question is when this happened. Catching up with other counties' past innovations, as the Continent did from 1950 to 1980 – the thirty glorious years – is not the same as indigenous innovation. And a spate of indigenous innovations in a good decade is not the same as high economic dynamism with inevitable fluctuations. In any case, a dearth of innovation has been conspicuous on the Continent for at least the past two decades. As a result, investment activity has been low, productivity growth has been slow and employment moderately low – the low investment activity not having been offset by export activity.

The U.S. now joins Europe in showing structural signs of a weakening of dynamism. In the past decade the financial sector has become less oriented toward financing business than ever before. And the business sector has become more short-termist than ever before – driven by pressures to meet quarterly earnings targets. ICT production and use has been waning. It is no wonder, then, that in the U.S. productivity has grown more slowly since around 2003 and business investment did not regain the level reached during the internet boom of the 1990s. Barring unanticipated breakthroughs, current innovations are likely to represent small incremental steps with unhappy results for productivity, employment and everything else.

As a result of all this, the strategic and policy challenges to support technological change and innovation are huge in the current economic environment. The depth and length of the recession has pushed many firms closer to the survival line. It has increased the pressure to focus on short-term operational issues, notably cost-savings. The more medium tactical issues, such as improvement in performance and the development of new markets, or long-term strategic issues like deeper reforms or attempts to achieve global leadership, are put on hold.

We will see in the near future some major changes in the business landscape, with many losers and winners emerging in coming years. These changes provide an important dynamic to renewed growth and recovery – provided markets show greater dynamics on the demand side. At the same time, new competitors from emerging economies are changing the contours of the global business landscape as well.

Policy makers in advanced economies have a major task on their hands to provide a breeding ground for renewed organic growth. Policy instruments will need to focus not only on closing the output gap in the short term, but also on strengthening potential output and productivity growth itself in the medium and longer term. The current fiscal stimulus plans cannot be the only or even the most effective tool for long term recovery.

Three main aspects of the global innovation policy challenge are explored in the rest of the paper.

3 – Establishing new institutions for an economy of entrepreneurs and fast movers

Some general principles

It is extremely important to grasp the modern theory of indigenous innovation – the theory originated by Hayek, Michael Polanyí, Nelson and Phelps, Frydman and Rapaczynski, Bhidé and a few others. The pluralism and insight with which the financial sector selects among alternative projects that might lead to successful new commercial products, the prevalence of businesses having the vision and daring to invest in long-term projects of a radically novel character and uncertain profitability, and the existence of end-users, consumers and mangers alike, capable and curious enough to try unfamiliar products are all important determinants of a country's indigenous innovation. Obviously, the extent to which imaginative and creative business people and business students wanting to start a new company can expect to find such a financier and such an entrepreneur determines the degree to which innovation can come from the grassroots, not just from the top.

The evidence for this theory is in front of us. Huge and successful innovators like Wal-Mart, Fed-Ex, Amazon and Cisco have grown not so much by mastering the intricacies of physics, chemistry and molecular biology as by structuring human work and organizational processes in radically new ways. The same is true of companies based on more radical innovation, such as the network firms Google, YouTube, eBay and Yahoo. All the above companies have added hundreds of billionos to the annual gross domestic product with only modest contributions from industrial research as it has been traditionally understood.

The social significance of this activity transcends the gain in incomes of some and the gain in GDP of the country. The indigenous innovation in a country and especially grassroots innovation – with the attendant creativity, problem-solving, and exploration – are hugely important determinants of job satisfaction, employee engagement, and job creation as well as a nation's league standing in productivity.

We can hope – but we cannot expect – that reliance on the innovation agenda of a few elites will deliver the *rate* of innovation of which the grassroots are capable. For most people at any rate, the extent to which jobs will once again offer rewards from the experience of participation in grassroots innovation will be crucial to the degree of human fulfillment obtained from work and career. Some elites don't need dynamism in the business economy, except maybe indirectly, but ordinary people have much to gain.

This is a message that governments and even universities appear not to have underare not getting out to general public.

The organization of innovation has changed

Experts and policy makers have not gauged the magnitude and centrality of the structural changes in innovation occurring in advanced countries – most strongly in the US over the last 25 years and at a more modest pace in Europe and Japan. Perhaps the most pervasive and important type of structural change, one that is observed in many “new” industries, is vertical specialization – the development of an industry structure populated by firms that specialize in one or a limited set of activities who contract with other firms that specialize in different activities within the industry. We see therefore an increasing vertical specialization in inventive activities and the

creation of much more complicated industry structures involving new firms entering in narrow segments of the industry value chain, placed in the upstream phase of the innovation process. This type of organization differs considerably from the operations of firms that are vertically integrated in all functions ranging from R&D through manufacturing to marketing.

We need to observe also that the new structure, while potentially efficient, is also likely to be more fragile and vulnerable to macro-economic financial shock and recession. Even if in many industries the fundamentals of innovation economy are strong (plenty of technological opportunities and no decrease in demand for innovative products), the viability of sustaining innovation through vertically disintegrated, undiversified, cash hungry externally financed firms is now in question. Any shutdown of VC and IPO is severely pressuring them even if they are "technologically good"!

Today we are left with an economy that – potentially, at any rate – can still derive innovation from both sources – from the giant firms and from start ups and independent inventors. There is therefore a need for institutional adjustments so that our institutions better match the new structures and organization of innovative activities in the emerging fields.

Changing the economic structure to support innovators, entrepreneurs and fast movers

The amount of entrepreneurial activities and competitive entry into new emerging industries depends heavily on the prevailing "rules of the game", i.e. the reward structure in the economy. Framework conditions have to be established so that innovations in services and industries are becoming an activity that promises the greatest monetary (or other) returns.

We need, therefore, the proper institutions for an effective development of *this economy of start ups, fast movers and new industries*; for creating a certain atmosphere of frenetic innovators exposed to high-powered incentives and ready to work day and night and take a lot of risks because the reward can be very high and the potential failure not particularly catastrophic!

Institutions in many advanced economies are now rather weak in promoting economic dynamism, both in terms of promoting entrepreneurship and the ability of financial markets to steer finance towards worthy innovations. In fact, they tend to be good at suppressing this dynamism. In other words the relative poor economic performance of many advanced economies results in both the underdevelopment of capitalist institutions like VC and equity finance, and the overdevelopment of corporatist institutions that suppress innovation and competition. These corporatist institutions impose penalties, impediments, prohibitions and mandates generally intended to damp down creative destruction. Among these impediments are licenses and permissions to set up a new plant or firm, the need to consult with workers on changes in the mix of products or plants, and employment protection legislation. There are some self-reinforcing mechanisms between the underdevelopment of the capitalist institutions and the overdevelopment of the corporatist institutions: because the latter are designed to suppress changes inherent in unbridled capitalism, they also lead to underdevelopment of the former such as the stock market, resulting in lower ratios of stock market valuation to GDP in continental Europe than in the US (Phelps, 2003 in Aghion et al.).

For most countries, the main agenda should be about helping society and its social groups to promote the dynamism of its own economy by opening it up to outsiders, competition and "creative destruction" There is a case in many countries for a new balance between capitalist institutions and corporatist institutions. Many institutional changes are needed. In the next

paragraphs we will only focus on three which are of particular relevance in these times of massive challenges and crises.

Three key institutional changes

There are three areas in which some radical reshaping is clearly necessary, whether or not there is yet a consensus on the best design.

Restructuring finance to serve business. The advanced economies require radical reform of institutions in the *financial* sector. There is an egregious need to create or reform institutions so as to replenish the supply of finance for business investment projects of a highly innovative nature. The banking industry has become so little oriented toward lending to businesses, which a wide range of banks, big and small, did in the 19th and much of the 20th century, that the large companies have sought their financing increasingly through issues in the corporate bond market. But that market is not equipped to judge the promise of corporate investment plans. A direct way to address this deficiency in the financial sector is to institute a new class of banks that are dedicated to lending for innovation. Such a plan, one modeled somewhat after the Farm Credit System in the U.S., has recently been outlined (Phelps and Tilman, 2010).

Reforming corporate governance. An institutional reform is needed to correct the way corporations function. It was always that case that joint stock companies exposed shareowners to the moral hazard that the management might pursue its self-interest over a horizon of a decade or two, rather than taking chances that would pay off in the long run – in blooming profits and a high share price. Now short-termism has been aggravated by the financial sector. Mutual funds have stooped to the practice of extorting from the CEO of a company in which they hold shares an agreement to focus on meeting earnings targets one quarter ahead; the CEO who focuses instead on innovation for the sake of the long-term will find that the fund managers will dump the company's shares. Moreover, the pay of the mutual fund managers themselves, rather than being based on the price performance of the shares in which they invest, is based on the expansioni of their shareholdings, no matter how badly performing in the future. It is extremely important, therefore, that institutional reforms be made that would align fund managers toward the long-term and, for good measure, that would liberate the CEOs of businesses from the tyranny of quarterly earnings targets.

Addressing egregious mis-pricing of risk. Finally, the prevailing concept that rating agencies can judge the uncertainty posed by a given type of bonds and the notion that financial sector can reduce risk by selling credit default swaps has led to mis-pricing of a range of financial assets and consequent over-borrowing and over-lending by banks and various other financial companies. Once institutional reform forces banks and other financial companies to internalize the risks of the assets they acquire, they will look with greater favor at investing in a range of directions where the risks are understood – including lending to or investing in innovative businesses.

Knowledgeable and sophisticated end-users

Another crucial condition to transform innovation into activities that promise the greatest monetary (or other) returns deals with the demand side. Productive use of a General Purpose Technology (GPT) – i.e. the ability of users to co-invent an application – creates an externality in increasing the private and social marginal returns of inventive activities.

We know from recent studies that a significant part of productivity growth comes from the productive use of ICTs in sectors like retail, wholesale, financial services. The final episode of the "new economy" was actually the one where GPT spillovers were spreading into the whole economy and generating positive externalities between the increasing size of the GPT market (due to the co-invention of applications in large user sectors), which in turn improved the economic return on invention activities.

Deploying and using ICTs productively and efficiently in important sectors of application and coupling them with new models of organizational practices, knowledge management and business methods make a great difference. In fact, Europe was not only worse than America at inventing ICTs but also at using them.

4 – The management of global knowledge for innovation

In the 21st century, though, there is a need for a culture of innovation, not only some needed changes in institutions and regulatory policy. This requires investing in the creation of "organizational capabilities, aiming at supporting the identification, documentation, memorization and circulation of the cognitive resources, knowledge and information, learning competences and skills which are all necessary to enhance innovation capacities. These new organizational capabilities should include:

A worldwide platform for open knowledge: Innovation requires access to knowledge. A culture of innovation requires the population of tinkerers and creators in society to grow which will be encouraged if knowledge is made much more available. Systemic thinking and truly international research collaboration will only be possible when the world's scientific knowledge is open and free. Beginning in 2010, all non-military publicly-funded scientific research should be free and open to the world online.

A world bank of experiments: Experimentation is fundamental to acquiring new knowledge. Doing small experiments, making small innovations, is basic. End users of potential new products and services, both consumers and managers, must be encouraged to experiment too. But how do we share the knowledge created by these small experiments – in teaching, development, climate policy, etc. – with other stakeholders outside one's discipline? There is value to knowing what works but also what doesn't. A bank should operate as a global online platform for sharing the results of small experimentation.

A pedagogy of innovation. Educational programs and educational technologies must be developed to foster a pedagogy of innovation: Fostering a robust global culture of innovation requires that education systems be rebooted to incorporate:

a. New Skills: (i) systemic thinking; (ii) science literacy that emphasizes understanding the scientific method; (iii) design and a propensity to prototype.
b. New Language of Innovation: the world now creates more data each year than the combined sum of all prior human history. With this immense amount of data, we have the potential for new innovations (for example in healthcare through personal genomics) and the opportunity to foster a new common language for multi-disciplinary dialogue and innovation.

With data openness and literacy, and the rise of distributed computing and simulation capability, we envision a future that invites and supports universal participation in innovation.

5 - Improving the rate – and influencing the direction – of innovation

Much of the long term policy framework, particularly in Europe and in the new "catching-up" economies, will need to continue to focus on improvements in operational efficiency; that is, narrowing of the gap between average and best practices among businesses by putting the emphasis on diffusion of technology and innovation practices. Many of the policy instruments to achieve this goal are not exclusively related to research and innovation policies, and need to be an integral part of a broader policy framework in order to be effective. Such an agenda should clearly go beyond any kind of R&D target, and put greater emphasis on diffusion of technology and innovation, schooling and training, market reforms (notably in services), etc..

But, in addition to strengthening the diffusion of innovation, policies targeted at strengthening the growth environment must focus on new strategic growth initiatives. This requires a policy framework which is explicitly geared towards the creation and use (commercial and non-commercial) of knowledge in certain domains such as climate change, energy or health – such areas where the centrality of R&D and innovation is emerging as a solution to structural problems. These knowledge areas and the associated general purpose technologies, require a comprehensive innovation strategy that involves government, business and society in creating demand and supply for research, development and applications.

The United States has traditionally supported and nurtured strategic innovation initiatives, and the new Obama administration has pledged to strengthen such initiatives in several areas, including environmental technology, biotechnology, ICT and combinations thereof. They have committed significant public investment in infrastructure, energy, science, and health. As the current and future (medium-term) economic environment will be characterized by continued underutilization of tangible capital and a potential threat of erosion in human, knowledge and other intangible capital, the most urgent matter is to devise national and/or regional investment plans for innovation. Such an investment plan for innovation to address the Grand Challenges is a concrete step that can be taken as a follow up to the short term fiscal stimulus plans that emphasize the role for innovation as the main driver for long term growth.

As we are entering the era of crises and grand challenges – climate change, foods, water, and health, it is a good time to revisit the argument in favour of modest and neutral policy intervention. Increasing the rate of innovation is not enough; we do not necessarily want to increase the rate *randomly* in the system but in certain domains and sectors such as climate change or health. It appears to be the case today that in order to cope with these major challenges and risks, we cannot simply proceed as usual with neutral allocation of R&D subsidies, tax credit, framework conditions, and an effective patent policy. Rather, there is a need to accelerate the rate of advancing knowledge and implementing solutions *in certain directions*.

In what sense is a policy addressing a grand challenge different from a classic policy that is designed to address chronic underinvestment in R&D on decentralized markets? In the latter class of policy, the main goal is to increase the rate of technical change while in the former the

goal is to influence both the rate AND the direction of technical changes. But then the central question is about the design of such policies: how to increase some kind of command-and-control on the direction of innovation while not attempting to impose predefined technologies, freezing or petrifying competition and finally dissipating the extraordinary power of a free market economy in boosting large numbers of experiments in a decentralized way?

6 - Conclusion

Our societies need to repair the innovation machinery. This includes improving and strengthening the conditions for entrepreneurs and fast movers who need to invest in translating good ideas into new products and processes, to enter new markets and to grow. This is the *alpha* and *omega* of any innovation policy. This involves dramatic institutional adjustments in some countries, more specific actions to help firms to cope with the new economic environment in the countries where the basic conditions were largely present before the crisis.

The needed rehabilitation must also extend to the financial sector. Our societies must recognize that it is essential to restructure the financial sector so that it once again has the spirit and the expertise to finance investment projects in the (nonfinancial) business sector, particularly projects of an innovative character. The proposal to institute a new network of banks dedicated to the financing of innovative business projects – a network rather like the Farm Credit System in the United States – deserves urgent consideration if it is to get off the ground in time to cut the risk of a lost decade.

On the whole, the financial sector must be weaned from short-term borrowing on the liability side and encouraged to engage in long-term investing and lending on the asset side. Residential mortgage finance should not be allowed to crowd out long-term financing.

As commercial innovation and thus rapid productivity growth begin to return to the advanced economies of the west, these nations can begin introducing new national and global initiatives of the sort described in Section 5.

In a way, the main message of this paper is about getting out the right sequencing of actions and policies. In the future we will need to attempt some heroic state-led innovations involving the development of new collective goods in order to address global challenges – thus to rescue the planet and its Hume-Hayek grassroots system of indigenous innovation. Financing these heroic initiatives will require an increase in tax revenue, so the world cannot afford to shelve even temporarily the maintenance and improvement of grassroots innovation – the innovation emerging from the imagination, experimentation and exploration of business people. The world is not going to leave behind the innovative capitalism of the 19th century and much of the 20th. On the contrary, capitalism must be overhauled to strengthen its capabilities and its drive to innovate. For the present century at least, the “proper business” of the national economies “is business.”