

**DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY
COMMITTEE ON INDUSTRY, INNOVATION AND ENTREPRENEURSHIP
COMMITTEE FOR SCIENTIFIC AND TECHNOLOGICAL POLICY
COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY**

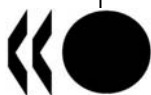
**A FORWARD-LOOKING RESPONSE TO THE CRISIS:
FOSTERING AN INNOVATION-LED, SUSTAINABLE RECOVERY**

**OECD Headquarters (Conference Centre), Paris
ICCP: 11-13 March 2009; CSTP: 24-25 March 2009; CIE: 2-3 April 2009**

For further information, please contact; Dominique Guellec, Tel: (33 1) 45 24 94 39, E-mail: dominique.guellec@oecd.org; or Jean Guinet, Tel: (33 1) 45 24 94 03, E-mail: jean.guinet@oecd.org,

JT03260090

Document complet disponible sur OLIS dans son format d'origine
Complete document available on OLIS in its original format



**A FORWARD-LOOKING RESPONSE TO THE CRISIS:
FOSTERING AN INNOVATION-LED, SUSTAINABLE RECOVERY**

Main findings

The economic crisis has prompted an immediate response by governments to avoid a collapse of the financial and banking systems and limit the economic effects of the credit crunch. Such policies aim at stabilising the economy and initiating a rapid recovery. But policies also need to ensure that the recovery is durable, *i.e.* is based on sustainable growth. The crisis should not damage the drivers of long term growth, but should instead be used as a springboard to accelerate structural shifts towards a stronger, fairer and cleaner economic future. Failing to do so might lead only to a temporary recovery as the macro-economic and structural roots of the current downturn would remain untouched. This implies integrating long term concerns in the short term policy packages currently assembled by governments and implementing specific policies aimed at strengthening the supply-side of the economy. While the impact of some of the latter actions may emerge in the medium- to long-term, they warrant consideration now because:

- They add credibility to government's borrowing demands that are imposing long-term debt, thus making a contribution to fiscal sustainability, and
- They take advantage of structural changes imposed by the crisis to accelerate a redeployment of resources from ailing activities to those that offer the largest longer term economic and social benefits.

Fostering innovation through promoting entrepreneurship, investing in smart infrastructure, encouraging R&D, green investment and upgrading the skills of workers is the foundation for these medium- and long-term initiatives.

As countries construct these packages, the following basic principles should be kept in mind so as to maximise the positive impact of innovation driven growth:

- *Promote innovation-oriented restructuring and Entrepreneurship.* Avoid bailing out firms that were performing poorly before the crisis, who have ailing business models or who exert considerable market power through their incumbent status – these firms will hinder the cathartic restructuring that needs to occur and will yield little to taxpayers when governments seek to exit ; A policy-mix of pro-competition measures, regulatory reform and public spending could be considered.
 - When bail outs are unavoidable because of the economic damage that could ensue; they should be conditional on strategic and managerial changes.
 - Assistance to firms should be an opportunity to enhance business dynamics, expand opportunities for emerging players and tap into new markets. It is therefore crucial that these plans be carefully monitored, *e.g.* by competition authorities.
 - As labour markets deteriorate, many workers, including highly skilled workers, will become unemployed. Starting a new business can be an attractive solution, with positive effects on economic activity. Well-designed government support can play a decisive role in alleviating capital shortages for new, small firms. Existing programs and agencies should be used for distributing the spending, as they are ready to do the task, whereas new

- programs or agencies take time to become effective. Millions of small checks (micro-credit) that stimulate entrepreneurship are worth considering as a useful complement to a few large checks to existing firms.
- Include strong measures to facilitate a pro-innovation adjustment on the labour market, focusing on unemployed workers through education, training and entrepreneurship programs.
- *Guide structural change to sustainable growth.* Invest in activities and sectors that will either address broader social challenges (e.g. improving the environment, aging populations, health care) or improving human capital (education / skills).
 - In most OECD countries, upgrading educational facilities, retrofitting public buildings for improved energy efficiency or improving the physical amenities for the aging are more needed than new highways.
 - Well-designed policies, regulations and support programmes can encourage new technologies (e.g. for more fuel-efficient cars), while pricing carbon should provide strong incentives to invest in carbon-friendly technologies.
 - Sustain spending in government and university research, in order to maintain the pool of scientific and technological opportunities in an environment where business will reduce its research effort.
 - *A Networked Recovery.* Broadband Internet access will do little immediately to boost productivity because the bulk of businesses in OECD countries already have access. The impact will be more indirect as an upgraded Internet lowers the barriers to entrepreneurial activities, and provides a means for the delivery of important social services – training, job search and networking.
 - Broadband, especially optic fibre is needed as a complementary investment to other infrastructure such as buildings, roads and electricity grids, allowing them to be “smart” and save energy, assist the aging, improve safety and be adaptable to new ideas.
 - In relative terms, the required investments in broadband are small, but government intervention needs to be carefully considered to maintain a competitive environment and reduce barriers to new entrants by ensuring that publicly funded networks are accessible on a non-discriminatory basis, cost-based “open access” terms.

In addition, a number of principles related to the design of policies might need to be considered, so as to maximise the positive impact of innovation driven growth:

- Focus on projects which are “shovel ready”, aimed at the right goals and mature enough to be implemented in an efficient manner right away; but start with no delay working on suitable new projects which will require more time to be designed and implemented.
- Use existing programs and agencies to distribute the spending, as these are ready to do the task, whereas new programs or agencies will take time to become effective. Use regional agencies to reach actors, especially new and small firms, which have weak connections with central government.
- Innovation is sustained through a complex “eco-system” of institutions and actors only a portion of which are public. Care should be taken to strengthen the functioning of this system and not

distort it with an enlarged public role.

- Spending by itself is not sufficient to realise the goal of restoring favourable conditions for innovation and long term growth. These expenditures need to be complemented by institutional and regulatory measures that reinforce the investments (*e.g.* investment in green innovations accompanied by rules that set certain efficiency standards).
- Strive to coordinate internationally: stimulus packages will be more effective if they are coordinated across countries, so as to minimise collective “leakages” and maximise efficiency. *A fortiori* no protectionist clauses should be included in recovery packages

The optimal policy-mix will depend on conditions specific to each country, such as their structural strengths and weaknesses; the institutional system which can be used for channelling the funds; and the budgetary situation of the country. An evidence-based approach is required in the selection and monitoring of projects, and beyond urgency measures currently taken, carefully designed additional measures will most likely be needed in the months and years to come.

In the medium and long term, countries can benefit greatly from the development of comprehensive strategies to foster innovation; work is currently underway at OECD to provide guidance to countries on the development of such innovation strategies.

1. Introduction

The current policies for addressing the crisis aim primarily at restoring the functioning of the financial system and stimulating demand. They are expected to lead to a sustainable recovery that can be reinforced by complementary measures to foster innovation, entrepreneurship, skills, ICT and green technologies, all key factors in ensuring that future growth will be sustainable and based on stronger productivity growth. The fact that a productivity slowdown was already underway prior to the crisis in many countries makes it even more urgent to act.

1. The economic crisis has prompted an immediate response by governments to avoid a collapse of the financial system and limit the economic effects of the credit crunch. Policy measures include both a financial component (rescuing fragilised banks, neutralising “toxic” financial products which paralyse the ability of banks to distribute new credit, *etc.*) and a demand side component, aimed at stimulating production and income in the short term by boosting public and private spending.

2. Such policies aim at stabilising the economy, supporting demand and initiating a recovery. But policies also need to ensure that the recovery can be sustained and is durable. This is all the more important as productivity growth has been slowing down significantly in most OECD countries prior to the crisis. Only a substantial acceleration of productivity growth will allow a durable recovery, allowing countries to face long term challenges like the environment and ageing. Policies to overcome the current crisis should therefore not damage the drivers of long term growth but should be used instead as a means to accelerate structural shifts towards a more sustainable economic future. Failing to do so might lead to only a temporary recovery as the macro-economic and structural roots of the current downturn would remain untouched. This implies that long term concerns should be considered and integrated in the short term policy packages currently assembled by governments and that additional policy measures may be required to reinforce the long-term drivers of economic growth.

3. This long-term perspective is an essential component of policy for a number of reasons, including:

- **Credibility:** as governments are borrowing heavily to stimulate the economy, fiscal sustainability has become a major concern. Implementing policies that will strengthen future potential growth will improve government’s credibility.
- **Addressing underlying weaknesses:** Some structural factors influencing the current crisis, such as the high prices of oil and raw materials, will re-emerge as soon as growth recovers if no action is taken immediately to increase their efficient use.
- **Opportunity:** The “creative destruction” that occurs naturally in downturns can be used as an opportunity by policy makers to foster innovation and emerging industries.

4. As demonstrated by past experiences *e.g.* in Finland or Korea (Box 1), government can take sound and bold initiatives to take advantage of crisis, in order to accelerate structural changes that are needed, but which face high obstacles in normal times. Another lesson from experience is that such initiatives will only be effective if the proper framework conditions are set in place (Box 2).

5. In the current phase, where the first policy urgency is to cushion the immediate effects of the crisis, the introduction of longer-term considerations confront policy makers with major trade-offs: short term impact *versus* longer term benefits; speed in implementation *versus* accountability, effectiveness and

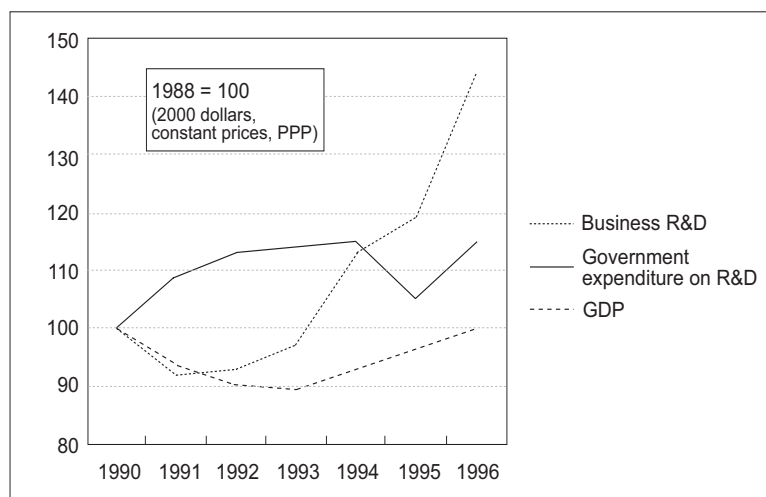
efficiency in government spending; support to existing activities and actors *versus* promotion of new firms and activities. For example, while “shovel ready” projects might have a higher impact on expenditure in the short term, they will not all bring the most benefits in the longer term; and some projects which are more beneficial in the longer term might take time to be designed and implemented, so that their impact on demand will not be felt rapidly. Reciprocally, some measures targeted to particular industries may bring short term benefits but have a detrimental structural impact by retaining inefficient companies which may later slow down the recovery. While governments have to address the various trade-offs taking account of country-specific conditions, including “fiscal sustainability” and institutional capacities, including ensuring that supply can respond to the demand stimulus initiated by the packages (*e.g.* sufficient scientists and engineers are available to conduct the R&D projects being funded) (see the Annex to this document).

Box 1. Pro-innovation responses to crisis – The examples of Finland and Korea

Finland experienced an exceptionally deep economic crisis during the first half of the 1990s. Within four years, *output* was reduced by more than 10% and the unemployment rate quadrupled to almost 17%. External shocks (the collapse of trade with the former Soviet Union in 1991, but also a sharp downturn in the OECD area), combined with a domestic banking crisis, and led to a collapse of consumption and investment spending.

Overcoming the crisis required drastic measures to improve competitiveness and to consolidate public finances – at the same time as very costly measures were needed to revive the banking sector. Most public expenditures were cut almost across the board, and some taxes were raised. The main exception to this was R&D spending, which was *increased* rather than *cut* (Figure 1). In particular, the counter-cyclical support of TEKES (the largest Finnish Public Research Organisation) proved very important in reducing the depth and length of the downturn in business R&D, which helped lay the ground for a strong rebound. The government decision to complement macroeconomic stabilization measures with sustained investment in infrastructure, education and incentives for structural change (representing around 10% of the budgetary cost of the overall recovery package) helped ensure that the economy would not only recover, but would emerge from the crisis on a stronger, more knowledge-intensive, growth path.

Figure 1. Finnish business and government R&D during the economic downturn



Source: OECD, MSTI database.

Korea's experience also illustrates how good crisis management can accelerate the structural adjustments that are needed in the long term, but that are often difficult to implement.

The Asian financial crisis of the late 1990s led to significant down-sizing among large firms in Korea. This process was characterized by mass lay-offs of highly-skilled personnel, and large reductions in corporate R&D spending. The response of the Korean government, in addition to boosting education expenditure, was to increase its R&D budget, to offset these declines in corporate R&D spending. But it also used the crisis as an opportunity to develop a technology-based SME sector, using the Special Law to Promote Venture Firms (enacted in 1998) to foster the creation of knowledge-intensive SMEs. A co-ordinated mix of policy measures was put in place: regulations (the government used the crisis as an opportunity to overhaul regulations, to create a more positive environment for venture start-ups and their growth); venture financing (government-backed venture funds and tax incentives were given to investors); and research support (e.g. R&D funding, tax waivers, tariff exemption for R&D equipment, and military service exemptions for researchers).

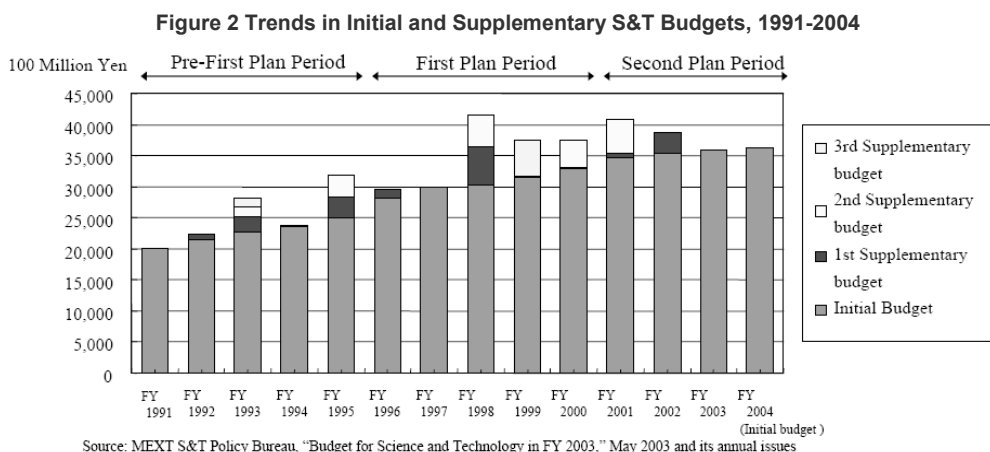
These measures fuelled rapid expansion in the number of corporate R&D labs (which numbered about 3,000 at the time of the crisis, but which grew to about 9,000 by 2001). SMEs accounted for 95% of this increase. On the eve of the crisis, there were about 100 "venture firms" in Korea. By the end of 1999, this number had increased to over 5,000, and by the end of 2001, it had grown to over 11,000. The long-term effects of these measures were striking. In 1997, SME spending accounted for just 12% of total business R&D, but by 2006, this figure had increased to 24%.

Of course, this success cannot be explained by policy intervention alone. The world-wide shift to a digital economy as well as the rapid growth of information and communications technology, both provided exceptional business opportunities for people with technology and ideas – notably those being laid-off by large firms. Nevertheless, the government's intervention helped new businesses capture these emerging opportunities.

Box 2. Innovation policy in times of stagnation/recession – The example of Japan

Japan presents the example of a country that tried to counter the effect of prolonged periods of economic stagnation/recession on business R&D by increasing government R&D, but with mixed results. Its experience demonstrates that science, technology and innovation policy cannot compensate for adverse framework conditions (e.g. dysfunctional financial systems). R&D policy has its own limitations when it is not part of a comprehensive approach which addresses all the impediments to innovation, such as weak industry-science linkages. Nevertheless sustained public investment in research has not only helped Japan to progress towards a knowledge society but has also had, in the long term, a positive impact on the technological competitiveness of firms.

After the first recession in the 1990s, as part of several recovery packages (between 1992 and 1995 six spending programmes totalled 65.5 trillion yen, more than 13% of the 1995 GDP of Japan), the Japanese government decided to provide additional government R&D spending on top of planned increases in public funding of R&D in the context of successive national Basic Plans for Science and Technology (Figure 2). Most of the additional public R&D went to the university sector and government research institutes where it was used for investments in large research facilities, for the acquisition of expensive research equipment or for carrying out costly R&D projects or speeding up projects that were already in the pipeline.



These supplementary budget expenditures contributed to the continuous growth of Japan's scientific capabilities and output, as illustrated by data on PhDs, scientific publications and patents, including university patents; data on spin-offs also show a rise from the mid-1990s.

The impacts on private R&D and innovation capacities are more difficult to assess. It is probable that in the short-term, spill-overs to the business sector were limited especially since construction of new infrastructure takes time. Furthermore, during the beginning of the 1990s industry-science linkages in Japan were limited by the lack of university autonomy, regulations on university funding and faculty employment rules limiting entrepreneurial activities, and under-developed patenting and licensing capabilities in universities.

While public R&D continued to rise steadily and business R&D spending recovered towards the end of the 1990s, the nature of R&D in the business appears to have changed. Indeed, firms tended to re-allocate R&D spending towards more developmental and applied research, partly as a response to cost pressures (high level of corporate debt and price competition from emerging neighbours in Asia) and partly due to increasing opportunities to outsource R&D to higher education and public research institutes.

While innovation performance in post-bubble Japan has not been sufficient on its own to boost productivity and growth, increased government support combined with regulatory reforms in public research have nevertheless helped Japan to maintain its position as a leading technological player in established high tech industries but also in emerging technologies such as biotechnology and nanotechnology.

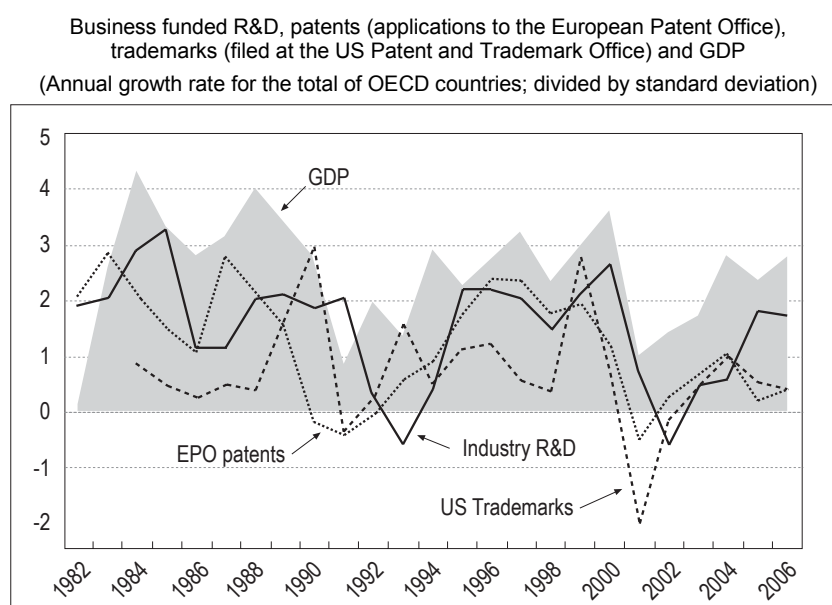
2. The prospective impact of the crisis on long term growth factors

Historical precedents and early indicators of current trends suggest that the financial crisis and ensuing economic downturn are likely to weaken and distort key determinants of sustainable growth, notably innovation, business dynamics and entrepreneurship, human capital and “green investment”.

Investment in innovation is pro-cyclical

6. Innovation involves the introduction of new products, new processes, new services and organisational methods. It can be technological or non-technological. Technological innovation relies notably, although not exclusively, on research and development (R&D) expenditures, which have been tracked statistically for decades and whose dynamics are the best known. Patents are one of the outcomes of R&D investments.

Figure 3. Cyclicity of innovation



Source: OECD, Patent database.

7. Business R&D and new patents increase when GDP increases, and slow down or shrink when GDP slows down or declines (Figure 3). New patents and business R&D were directly hit during the two most recent downturns, in the early 1990s and early 2000s. Estimates for the United States, for example, suggest that 1 point of change in GDP translates into 0.5 to 1 point of change in business R&D, and the effect of economic growth on R&D is almost immediate.¹

1. The effect differs across industries: it is stronger in IT industries, which have a short product cycle and higher volatility of demand; and weaker in drugs, which have a longer R&D and product cycle, as well as more stable demand. As for innovation at large, beyond R&D, it has been shown that it increases with turnover at the enterprise level and that it is sensitive to financial constraints. (Barley 2007)

8. The cyclicality of R&D is reflected in the cyclicality of patent filings, as patent protect inventions which, in most cases, result from R&D. Not only technological, but also non technological innovation is cyclical. Figure 3 reports also new trademarks issued by the US Patents and Trademarks Office. Trademarks are legal protections for distinctive signs of products, such as names or logos. They correspond most often to product or marketing innovations. Hence, trademarks cover also non technological innovations and reflect the more downstream stage in the innovation process, the commercialisation of the new product. New trademarks, as well as patents and R&D, were hit during the two downturns of the early 1990s and early 2000s.

9. The major reason for the pro-cyclical character of innovation is that investment in innovation is highly sensitive to the financial constraints faced by firms, which is more stringent in downturns. Various studies show that R&D, more than other types of investment, is financed from cash flow, which contracts, along with demand, in downturns. In addition, external funding (by banks, markets or investors) of innovation is also sensitive to the business cycle. Innovation is mainly financed by cash flow because external parties, notably banks, are often reluctant to fund innovation that is risky and results in intangible assets which are often not accepted as collateral by banks and financial investors as their value is often uncertain. This reluctance of financial institutions to fund innovation could be even stronger in the current downturn, which originates from over-lending (although not primarily to innovative firms) by the financial sector. The current economic context tends to discourage risk-adverse behaviour by financial institutions and markets, and innovation could suffer as a consequence.

10. Another reason why the downturn may affect innovation is that certain high technology goods are more prone to a reduction in demand than other types of goods, in many cases their purchase can be more easily postponed than, *e.g.* food or pharmaceuticals. For instance, for the first time since mobile phones were commercialised, demand is expected to decline in 2009 according to market research firms. Moreover, many companies in high tech industries like IT hardware and software have announced massive lay-offs for the first time in their history. This is also exemplified in the aeronautic industry, where some orders have been cancelled because airline companies are faced with declining demand and bank credit.

11. There is also a risk that some of benefits of pre-recession expenditures on innovation might be lost, *e.g.* if research projects which were started before the downturn are prematurely interrupted -- especially if this would occur at the stage of commercialisation, which is the most expensive phase in the innovation cycle. Moreover, many firms will have a strong incentive to temporarily redirect their innovation capacities towards cost-cutting projects, to the detriment of more ambitious market-expanding endeavours. In this sense, while R&D projects usually take some time to formulate, many are "shovel ready" as the crisis forces companies to abandon or significantly cut-back existing projects.

12. Finally, as innovation investment declines and certain companies fail, it is possible that knowledge networks are disrupted. Recent years have experienced the emergence and increasing importance of innovation networks, which involve partnerships between firms or between businesses and universities (OECD, 2008). These networks are linked to the development of value chains across industries and countries and are aimed at accessing knowledge and at reducing the costs and risks of innovation. In the current crisis, companies may re-internalise some activities as they want to protect themselves against the possible disruption of these chains, on the other hand companies may try to reduce costs by externalising some of their activities further, notably to low-cost countries. As innovative firms increasingly rely on such (often global) networks for their innovative activities, the possible rise in protectionism is particularly threatening as it might increase the costs of innovation.

13. All in all, the negative impact of the recession on private investment in R&D and innovation will be biased against certain types of firms – younger and smaller firms,² which play a vital role in modern innovation systems³ -- and against certain forms of innovation investments. As a result, not only the level, but also the efficiency, of total business investment in innovation might be reduced.

Entrepreneurship and business dynamics in the downturn

14. Economic crises are historically times of industrial renewal, or creative destruction, as less efficient firms fail while more efficient ones emerge and expand. Creative destruction is an essential engine of long term efficiency in market economies, and is intensified in downturns. New business models and new technologies, particularly those allowing a reduction in cost, often emerge in downturns, as was the case with low cost airlines which emerged from the recession of the early 1990s. Many of today's leading firms such as Microsoft or Nokia were born or transformed in the “creative destruction” of economic downturns. It is essential that government do not hamper business dynamics and the resulting process of structural change, but instead facilitate and support the process.

15. However, the economic crisis can also have detrimental effects on the creation of new, innovative businesses, if these face heightened barriers to entry, *e.g.* resulting from the greater difficulty in accessing finance. This is detrimental to economic growth in the long term as new firms tend to explore the most venturesome innovative avenues and exercise competitive pressures on established firms, hence pushing them to innovate.⁴

16. Some new firms and entrepreneurship are primarily “innovation-oriented” (creating or exploiting a new market opportunity), whereas others are more “necessity-driven” (a substitute for being unemployed). “Innovation-oriented” entrepreneurship is highly pro-cyclical⁵, contrary to “necessity-driven” entrepreneurship.⁶ Studies for the United States, for example (Lee and Mukoyama, 2007) show that fewer manufacturing firms enter during recessions, but that these firms are (on average) larger and

2. Young and small firms typically differ from large and established firms in both their innovation style and their way of interacting with other actors in innovation systems. Large, established firms often have the market power that helps them to appropriate economic returns from innovative activity, and are generally better able to reduce the risk of R&D by diversifying across projects. But large firms often have vested interests (*i.e.* high sunk costs) in existing technological trajectories, and are therefore reluctant to invest in areas that are remote from their core competencies. Small and young firms, conversely, specialise in innovative activities which do not require large R&D expenditures, but which benefit from entrepreneurial dynamism, internal flexibility, responsiveness to changing circumstances, and technological expertise in highly specialised fields.

3. One study, based on French data (Aghion *et al.*, 2008) finds that firms which are faced with a more stringent liquidity constraint are smaller, with less cash flow and less collateral: this is typically the description of a “high tech start-up”. Similar findings have been confirmed for the United States (Rafferty and Funk, 2008).

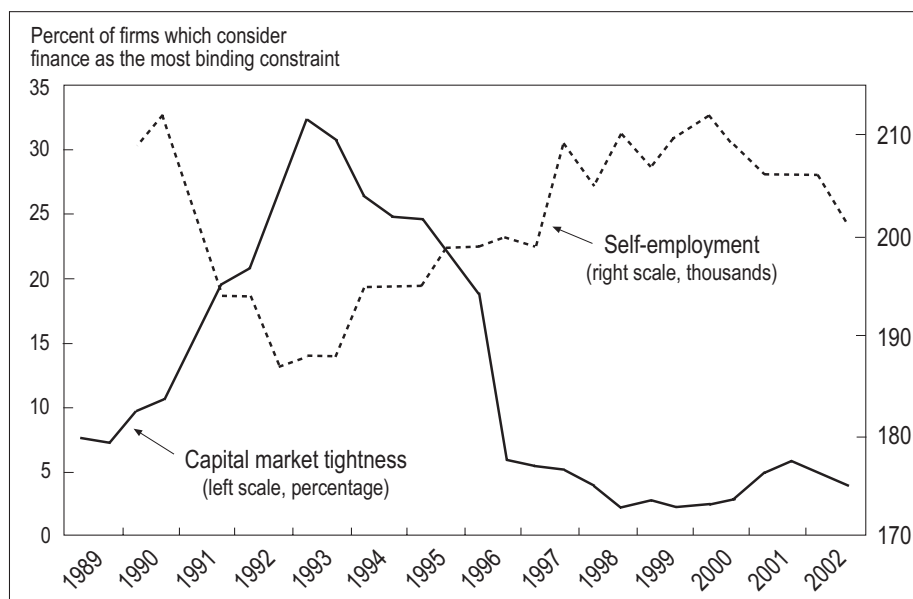
4. About half of business R&D in the United States in 2005 was performed by firms which did not exist (or were not of significant size) in 1980. Among small firms, start-ups play a crucial and distinctive role, *e.g.* in the commercialisation of public research and in fostering the mobility of high skilled workers.

5. The differentiated effect of unemployment on firm creation has been shown in a cross-regional study for Germany: Regions where unemployment was high, experienced greater higher creation of “low tech” firms, whereas regions with lower unemployment had a higher creation of “high tech” firms (Audretsch, 2008).

6. Many firms, notably in the retail trade and services sectors, are linked to “self-employment”. They are created in larger number in downturns, as unemployed labour finds self-employment to be a practical substitute to unemployment. However, the bulk of these firms are not innovative.

more efficient than firms created during expansion phases. This reflects higher entry barriers in downturns, which can be attributed to finance – new firms are generally riskier than established ones for banks and investors, which become more risk-averse in recessions, also as they anticipate that weaker demand will make life particularly difficult for new entrants. The binding role of finance in the development of small and medium-sized enterprises (SMEs), and its pro-cyclical character, is illustrated in the case of Finland, as shown in Figure 4 where the peak in the severity of the financial constraint coincided closely with the deep recession of the early 1990s.

Figure 4. Finland: Finance as the most significant obstacle to SME development and entrepreneurship

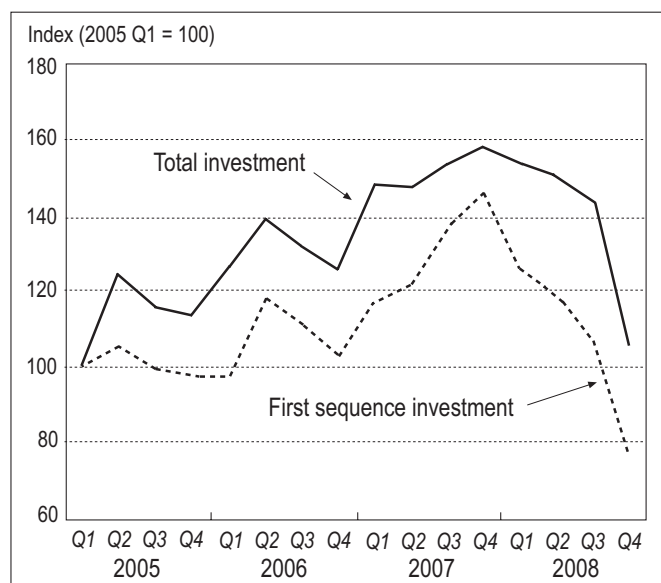


Source: Hyttinen and Pajarinen (2003).

17. In contrast, studies also show that there are as many firm exits from the market in expansions as in recessions, with no difference in terms of the relative efficiency of the exiting firms as compared with the surviving ones. This provides added insight into the cleansing role of recessions: less efficient firms are those which exit first, but not more in downturns than in upturns. The decline in the demand faced by incumbent firms is partly compensated by the decline in competition from new entrants. This has implications for the design of policies supporting particular industries, which risk, by supporting the less efficient firms in the downturn, hampering the entry of more efficient and innovative firms.

18. Fading support by the financial system for firms, but in particular for new entrants, is thus a major concern in the current context. The growing aversion to risk combined with other factors (such as the lack of exit opportunities for investors) are already drying up many sources of seed and venture capital. The total amount of venture capital investment in the United States (Figure 5) declined markedly in the 4th quarter of 2008 (by 33% as compared with the 4th quarter of 2007), but the fall was even stronger for “first sequence investment” (by 47%), reflecting the fact that venture capital funds are concentrating their efforts on companies with whom they are already involved at the expense of new ventures.⁷

7. Venture Capital investment was down more than 30% in the 4th quarter of 2008 as compared to the 4th quarter of 2007, with IT and health care (including biotech) being particularly hit (Source: Dow Jones Venture Source, January 2009). The global number of initial public offerings (IPOs) was 20 in the 3rd quarter of 2008 (112 and 70 in the same period of 2007 and 2006, respectively). The slump had therefore already started by the beginning of the year with IPOs totalling 115 in the first three quarters of 2008,

Figure 5. Recent trends in VC investment in the United States

Source: PricewaterhouseCoopers and National Venture Capital Association.

Depreciation of human capital

19. The crisis is already increasing unemployment in many OECD countries and experience from previous recessions shows that many skilled human resources will also become unemployed (see the example of Korea in Box 1 above). Lay-offs in high tech industries (like IT, aeronautics or pharmaceuticals) and knowledge-intensive services (like financial services) are being announced almost daily. This human capital will quickly depreciate if suitable new work opportunities are not created soon.

20. In times of recession, education and the formation of human capital are subject to contradictory forces: on the one hand, budget constraints (in government, households and businesses) tend to reduce expenditure; on the other hand, due to rising unemployment, demand for training increases. Enrolment in higher education, for example, tends to increase, as some individuals prefer to spend their time at university, rather than being unemployed (or employed at a lower wage). Support for education and training during the current crisis can help find displaced workers find new job opportunities and can thus support the restructuring process.

Weakening of incentives to develop a greener economy

21. Efforts to promote a greener economy can also be compromised by the current crisis. The declining price of oil has already reduced incentives to switch to alternative energy sources - and the declining prices of raw materials are reducing pressures to use these resources more efficiently. Moreover,

compared with 381 in the same period of 2007. The situation is even worse for venture capital-backed IPOs. Regarding the flotation of the most innovative start up companies, there was only one in the United States in the third quarter, and six in the first three quarters of 2008 – the lowest number since 1977 (even lower than during the dot.com bubble burst in 2000-2002). “Companies that are ready to exit are very strong, with positive earnings as well as innovative technologies and business models, so they will remain in the venture capital portfolio until conditions improve. Should the current situation be prolonged into 2009, we can expect fewer new investments by the venture industry as they will need to spend their time with these later stage companies that are waiting to go public or be acquired” (NVCA).

pressures from special interest groups in the name of competitiveness and employment protection may further reduce incentives to move towards a greener economy. On the other hand, the prospect of industrial restructuring and the depreciation of currently installed equipment offer new opportunities to promote environment friendly investments and behaviour.

3. From the pre-crisis to the post-crisis economy: towards an innovation-led, green recovery

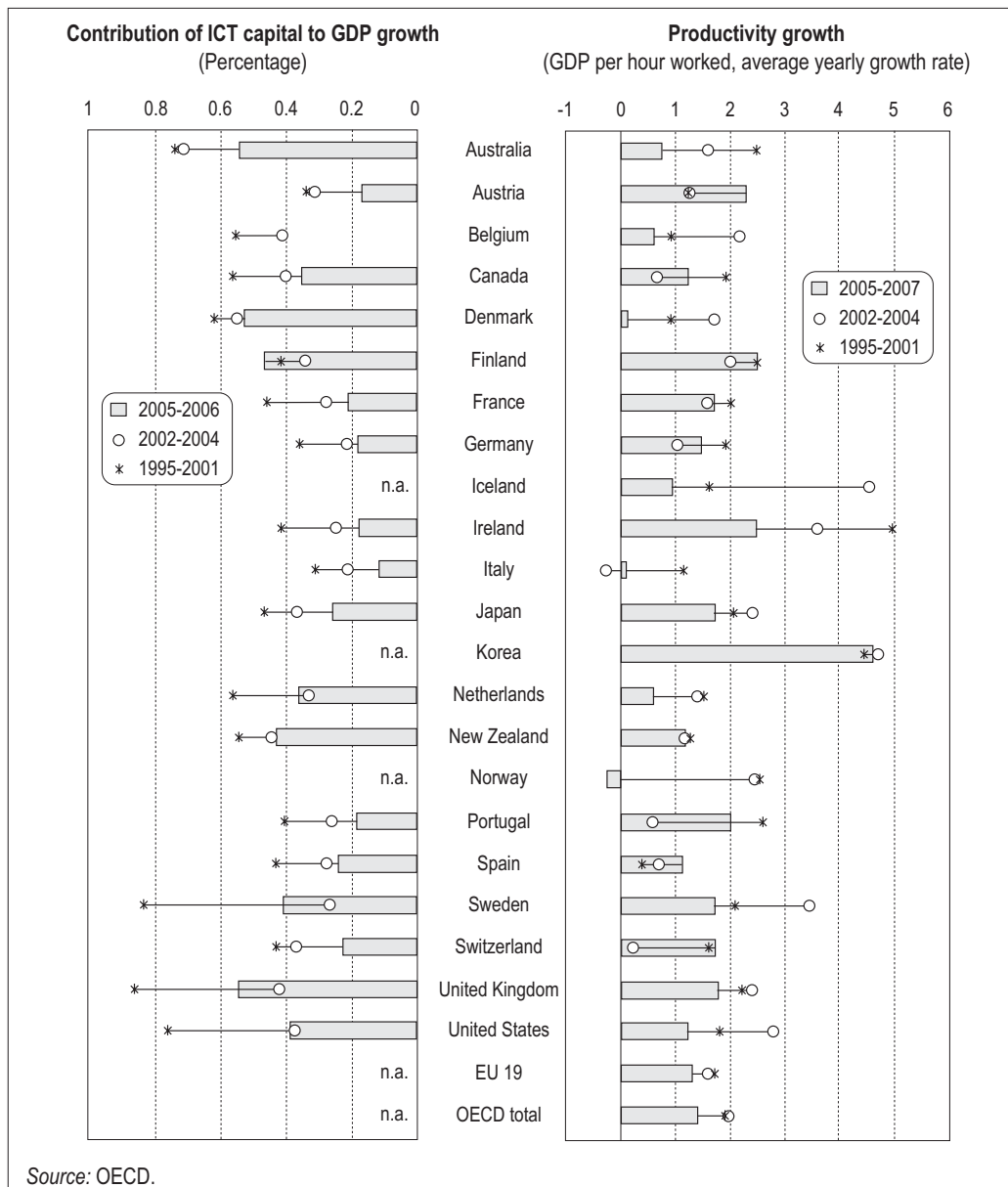
If economic growth following the crisis is to be sustainable, it will require a stronger role of innovation and a much greater focus on “green” growth. Reinvigorating growth through productivity-enhancing and environment-friendly innovation may also put governments in a better position to repay the debt they are accumulating.

A durable recovery should be driven by productivity growth

22. Productivity growth is usually pro-cyclical, it is therefore to be expected that will continue to decline in 2008-2009. In many countries, the productivity slowdown started some time ago (Figure 6). Overall, the average growth rate of labour productivity (measured as GDP per hour worked) dropped from 2% in 2002-2004 to 1.4% in 2005-2006 in the OECD area. The slowdown was most marked in the US (from 2.8% to 1.2%), in the UK, in the Nordic countries (except Finland), in Australia and in Japan, whereas productivity growth was stable, or even accelerated slightly, in most continental European countries and in Korea. The slowdown has been more pronounced, overall, in countries which had the highest productivity growth in the period prior to 2004, reflecting the capital deepening and the diffusion of ICT equipment that occurred in these countries in the second half of the 1990s but that has slowed down markedly since 2002.

23. As investment in ICT often has a lagged effect on productivity growth, as it takes time to train workers, reorganise the firm or develop new activities, the recent slowdown in productivity could be related to the slowdown in ICT investment.

Figure 6. The pre-crisis productivity slowdown



A durable recovery should be green

24. In the first half of 2008, due notably to extremely strong demand confronted with limited supply, the price of oil and raw materials surged to unprecedented levels. They fell sharply at the end of 2008 due to the recession, which triggered a drop in demand. A recovery could lead to renewed increases in the prices of oil and raw materials, which could retard the recovery. Hence, in order to ensure a sustainable recovery and facilitate a restructuring towards a low-carbon economy, progress has to be made in developing alternative sources of energy, promoting energy saving and the efficient use of raw materials.

A broad strategy to promote innovation in the long term

25. For sustaining growth in the longer term, a broader innovation strategy is therefore required, which recognises the changing economic landscape, notably the central role of innovation in the economy and for social well-being. Identifying principles that support the formulation of such strategy is the objective of OECD Innovation Strategy project⁸. This strategy will require the various parts of governments to work in a coordinated manner with a common objective, and the various national governments to strengthen their international co-operation. Elements that needs to be considered in such a strategy and that are pertinent to the current context, include:

- **Fostering collaboration and knowledge exchange:** Innovators today increasingly collaborate with external partners, including suppliers, customers and universities, to tap into new knowledge, expand their reach or share risks and costs.
- **Strengthening platforms for innovative activity:** The Internet and related information and communications technologies are arguably the most important platform for innovation today, in enabling innovation and linking innovators internationally. Moreover, while business accounts for the bulk of investment in innovation, government support for longer-term fundamental research remains essential in creating the seeds for future innovation.
- **Tapping into the global system and building on local strengths:** Innovation today is a global undertaking, in particular for multinational enterprises, but is built on local strengths.
- **Preparing citizens to participate in the innovation economy:** The skills and competencies that are needed for innovation today include skills such as management, leadership, marketing and business skills, as well collaborative and team-working skills.
- **Fostering entrepreneurship:** Innovation often occurs through entrepreneurs exploring new markets, ideas and opportunities. Entrepreneurs are also the key in generating competitive pressures on incumbents, forcing them to innovate.
- **Facilitating international cooperation and technology transfer:** More effective mechanisms to diffuse innovations as widely as possible, cooperation in research and the development of effective solutions are among the key actions that can help to address global challenges such as climate change.
- **Enhancing the efficiency of policy:** Improving the design of government policies, e.g. in using competitive processes or public-private partnerships, can help enhance their effectiveness and increase the value for money. Evaluation is essential to improve policy making.
- **Fostering innovation in the public sector:** New approaches and new technologies, such as e-government, can help solve problems and improve how public services are delivered by increasing responsiveness and improving efficiency and transparency.
- **Creating enabling framework conditions:** The development of innovation policies needs to be supported by excellent “framework conditions” – sound macro-economic policy, competitive markets, smart regulations, openness to international trade and foreign direct investment, a good tax climate and a healthy financial system.

8. See www.oecd.org/innovation/strategy.

- **Good governance and strong political leadership:** The broad range of policies that needs to be combined and integrated to foster innovation and the importance of innovation for core policy objectives shows that innovation has become a central pillar of government policy. Political leadership in advancing the policy agenda and good governance in developing comprehensive policies to foster innovation are therefore of key importance.

26. These long to medium term actions have to be translated into immediate policies, and the current crisis should be seen as an opportunity to move in this direction. It is not expected that such measures would immediately bring countries out of the downturn, but they would certainly make the recovery more sustainable and durable.

4. Long term factors in the short term policy responses

In addition to ensuring that basic framework conditions remain conducive to innovation (especially by avoiding that protectionism can impair the expansion of trade, foreign direct investment, and global networks), a number of more specific measures to strengthen the basis for innovation-led, green growth should also be considered by governments in the context of their individual and collective responses to the current crisis.

27. In addition to ensuring that basic framework conditions remain conducive to innovation (especially by avoiding that protectionism impairs the expansion of trade, foreign direct investment, and global networks), a number of more specific measures should also be considered by governments in the context of their individual and collective responses to the current crisis. Some of these measures could be integrated into the stimulus packages that governments are assembling in order to boost demand, but many should be taken separately as they require more time to be prepared. Expenditures aimed at stimulating demand are targeting the immediate effects of the economic crisis and their effectiveness depends on their rapid execution. On the other hand, not all supply-side measures involve spending, and they can take some time to be set up and to affect demand, *e.g.* in designing the projects, identifying the actors, going through administrative processes, establishing complementary regulations or institutions, *etc.*

28. Long term concerns can be integrated in stimulus packages in two ways: as special areas for spending (on innovative activities *etc.*); and as horizontal guidelines for short term spending in order to maximise the long term benefit. Some possible principles for stimulus packages include:

- Include suitable projects that will increase the efficiency, sustainability and green character of the economy in the long term.
- In order to maximise the short term impact on demand, but also to minimise the risk of wasting public money, focus on projects which are “shovel ready”, aimed at the right goals and mature enough to be implemented immediately in an efficient manner. More complex investment projects should be carefully planned and undertaken only when efficient implementation procedures can be secured.
- Target expenses to idle resources, notably unemployed workers, so as to minimise crowding out effects and combat the depreciation of skills that often comes with unemployment.
- Use existing programs and agencies to distribute the spending, as they are equipped for the task, as new programs or agencies take time to become effective. Regional agencies can be used as a vehicle to reach actors that cannot be reached by national agencies and programmes.
- Avoid bailing out firms that were performing poorly before the crisis, who have ailing business models or who exert considerable market power through their incumbent status – these firms will yield little to taxpayers when governments seek to exit and will hinder the cathartic restructuring that needs to occur. In general, public spending should encourage the move of resources from less to more efficient firms.
- Strive to coordinate internationally: stimulus packages will be more effective if they are coordinated across countries, so as to minimise collective “leakages” and maximise efficiency. *A fortiori* no protectionist clauses should be included in recovery packages.

Support to R&D and innovation

29. Recovery packages need to include policy measures that will explicitly mitigate the negative impact of the financial crisis on the level and orientation of innovation activities. The rationale for this kind of policy intervention is clear. First, the crisis magnifies widely acknowledged market failures in innovation financing. Second, only public policy can address the “systemic need” for infrastructures and institutional frameworks that underpin innovation. Third, many economists now consider that R&D should be counter-cyclical: as resources which are left idle during recessions should be put to good use, *e.g.* through investment in long term growth-enhancing activities, such as R&D or training (Aghion *et al.* 2005).

30. The overriding objectives, guiding principles, and instruments, of government interventions to support R&D and innovation should consider the following:

- Innovation in both young, small, firms and “innovation-oriented” entrepreneurship is important for future growth. Removing barriers to the creation and growth of these firms is essential and available tool kits (loans, guarantees, project-based subsidies, equity financing, etc should be mobilised to strengthen their creation and growth.
- Tangible but also intangible infrastructures for knowledge creation, diffusion and use should be considered in the context of expansionary public investment, as these provide the seeds for future innovation.
- More broadly, including a high-tech (often ICT) component in physical infrastructure investments (including transportation systems and buildings) will allow their “smart use” in the future (smart roads, electricity grids, *etc.*).
- Given the costs involved in fibre deployment it is fairly certain that outside the dense urban areas it is unlikely that the market will be able to support more than one fibre based network. The exception may be in markets which already have well developed and ubiquitous, cable TV infrastructures which may provide an alternative and competing platform. Governments, both central and municipal, can play an important role through public-private partnerships in stimulating the development of nationwide high speed broadband networks. Investment in this area must be accompanied by regulatory frameworks which support open access and competition in the market. These networks which can be viewed as a general purpose technology that can underpin new economic activities, have widespread economic productivity benefits and facilitate many social goals.
- Additional, horizontal support to business innovation may be warranted but has to be delivered through measures that are counter-cyclical. Existing policy mixes need to be reconsidered in many countries, at least during a transitory period, with for example greater reliance on grants which can be counter-cyclical, as opposed to tax incentives, which are pro-cyclical.
- Financing for public-private partnerships for research and innovation, which are key in ensuring fruitful interactions between the public and private parts of the innovation system, are of great importance, in particular for high socio-economic priority areas, such as green innovation and health. Public-private partnerships increase the resilience of R&D as the balance of their financing can be varied over the business cycle, when the stringency of the financial constraint on businesses changes.

- Innovative clusters usually involve such public-private partnerships and have been promoted for years in most countries. They are usually a major platform for organising complementarities and exchanges between new firms, established firms and universities. They can be used in the current context to minimise the risk of capture by “strong players”, by ensuring that government funds reach directly new and small players and co-operative projects which are already under way or “shovel ready”.
- Public procurement should be considered more systematically as a demand-side instrument to support R&D and lead markets for innovative goods and services, especially where it can contribute to solving sustainability issues in areas such as mobility and energy (see Box 4).
- New regulations of financial markets that will likely be enacted to prevent recurrent waves of mis-pricing of assets should not sacrifice financial innovations that have supported the innovation process. This includes venture capital and the securitisation of innovation-related assets (*e.g.* IP).

Box 4. Fostering demand for innovation via lead markets

There are several ways governments can influence the demand for innovation. Tax policy, subsidies, regulations, such as in the environmental or health sectors, and standard-setting are among the most common ways to stimulate demand for innovation. Although not without difficulty, public procurement can and has been used to stimulate demand for innovative products and services. A key characteristic of a “lead market” is that the uptake results not by the sole technological superiority of an innovation but by the ability of market players including competitors, consumers, and government regulations, to influence its adoption (*e.g.* via the price mechanism, co-operation or regulations) and the adoption in other markets, including those outside a country’s borders. The relative importance of demand-side policies such as regulations, standards-setting/certification and public procurement, or public support to business R&D, in fostering lead markets is highly sector and technology dependent

In networked industries, such as automobile, LCDs or telecommunications, standards/quality certification and consumer safety rules will play a very important role. In others such as the environment and energy, the obstacles to stimulating demand for innovation will require a greater reliance on regulations, tax subsidies (*e.g.* in the case of wind and solar energy) as well as public procurement (*e.g.* municipalities purchasing electric cars) and infrastructure. The development of lead markets can help innovating firms achieve the critical mass and competitiveness to bring prices down and encourage further diffusion and adoption of the innovation (Jakob *et. al* 2009). Policy makers should not underestimate the complexities and challenges to fostering the development of lead markets. There are important transactions costs of co-ordination between stakeholders at national level as well ensuring compliance with competition law and state aid rules. In addition, public procurement rules may limit the amount of risk taken on by governments as a purchaser of new producers and services. Lead markets are perhaps the most horizontal of policy areas and therefore require highly specialised knowledge and competencies and ensuring the incentives of the different stakeholders are well aligned.

Fostering creative destruction

31. The creation of new business opportunities and the reallocation of resources from declining activities towards emerging ones should underlie a sustainable recovery. Government plans should not hamper this reallocation process and facilitate structural change. Several policy avenues can be considered in this regard:

- Entrepreneurship policies: reducing the administrative cost of creating a new company; reducing the barriers to growth of small companies, for example by providing access to public procurement (like the US Small Business Act); or developing micro-credit for the myriads of “necessity-driven” entrepreneurs (*e.g.* through certain forms of loan guarantees to banks).

- Combating risk aversion by reducing the cost of failure: bankruptcy laws can be made less punitive to entrepreneurs in certain countries; more favourable conditions for the survival and restructuring of ailing businesses (instead of quasi-automatic bankruptcy) should be considered.
- Conditioning government support to businesses on the provision of clear business plans, ensuring its efficient use.
- Preserving market competition and avoiding protectionist measures that undermine efficiency and innovation.
- Address the social effects of industrial renewal, *e.g.* through activating social policies and support for training.

Sustained investment in human capital for innovation

32. Innovation requires a broad set of human skills which are nurtured within both the education and the firm-based training systems, and over the whole (life-long) learning cycle. Preserving these skills will require joint investment by government, the private sector, and individuals themselves. Sustaining these complementary flows of investment during the downturn, while continuing to adapt them to evolving demand, is vital for the future of the knowledge-based economy. More specifically:

- Policy can foster innovation in education. The restructuring brought about by the current crisis will accelerate changes: new sectors will appear, old ones will fade away; new work organisations will be introduced under new rules and regulations; new skills will be needed, while the demand for others will abate. Entrepreneurial skills and attitudes, risk-taking behaviour, creativity, etc. will be crucial competencies in the economy that need to be nurtured by more adaptive and innovative education and training systems.
- Educational infrastructure can be an important element of public investments in infrastructure that can support an economic recovery. In many countries, there are huge challenges regarding school buildings. It is therefore crucial that this opportunity be used to renovate the school infrastructure itself (*e.g.* ecologically-friendly schools). Investment in ICT (in schools and families) can also support education and training.
- Some support to individuals' investment in education could also be considered. In particular, the backing of student loans might be necessary to prevent a decrease in investment in education.⁹

Greener innovation policy

33. Letting the economic downturn reduce pressures for a greener, low carbon economy would be detrimental for both overall welfare and for economic growth. The convergence of innovation and environmental policy should therefore continue to be encouraged, by emphasizing the following policy actions:

- Public infrastructure investment, likely to be an important part of recovery packages, can be made greener (*e.g.* public transport networks, ecology passive public buildings). As indicated above, governments could also take "lead market" initiatives in using public demand to leverage innovation in environmental-friendly technologies.

9. For example, the Federal Reserve Board of the United States decided on 25 November to support the issuance of asset-backed securities (ABS), collateralized by student loans (FRB, 2008).

- Pricing the bad (*e.g.* carbon emissions) should help in making private investment in physical assets (such as cars) and in R&D greener, so that the current fall in the price of oil and raw materials does not result in behavioural choices that reduce pressure to address climate change or harm the environment.
- Use the economic downturn as a window for the reform of environmentally-harmful subsidies (*e.g.* on fossil fuels). Some of these existing subsidies already operate as a drag on economic output, and are also contributing to environmental problems. Reforming or eliminating them would not only benefit the environment directly, but would also improve public budgets and improve long-term incentives for environmental-friendly innovation.
- International co-operation should be strengthened to address global problems, such as climate change, and can also help mitigate competitiveness concerns by levelling the playing field.
- Any policies aimed at compensating business for the loss of international competitiveness should seek to maintain an incentive at the margin for the polluters/sectors involved to reduce the environmental impact of their activities.
- To improve the diffusion of available eco-innovations and promote global economic growth, barriers to trade in climate-friendly technologies, goods and services should be removed.

REFERENCES

- Aghion P., Askenazy P., Bermùan N., Cette G. and Eymard L. (2008), “Credit Constraints and the Cyclicity of R&D Investment: Evidence from France. Banque de France. NER R-198. Paris.
- Aghion, P, Angeletos G., Abhijit B., and K. Manova. 2005. “Volatility and Growth: Credit Constraints and Productivity-Enhancing Investment.” National Bureau of Economic Research Working Paper 11 349.
- Barlevy, G. (2007), “On the Cyclicity of R&D”. *American Economic Review*, 97(4), pp. 1131-1164.
- FRB (2008), <http://www.federalreserve.gov/newsevents/press/monetary/monetary20081125a1.pdf>
- Hyytinen and Pajarinen, 2003 (eds.), *Financial Systems and Firm Performance: Theoretical and Empirical Perspectives*, ETLA B: 200.
- Edler J. and L. Georghiou. (2007), “Public procurement and innovation—Resurrecting the demand side” *Research Policy*, Volume 36, Issue 7, Pages 949-963
- Lee, Y. and T. Mukoyama (2007), “Entry, Exit, and Plant-level Dynamics over the Business Cycle,” Federal Reserve Bank of Cleveland, Working Paper 07-18).
- NVCA (2008), <http://www.nvca.org/pdf/Q308ExitpollFINAL.pdf>
- OECD (2005), *Innovation Policy and Performance: A Cross-Country Comparison*
- OECD (2008), *Open Innovation in Global Networks*.
- OECD (2009), *The OECD Innovation Strategy – Interim Report*, SG/INNOV(2009)1.
- Ogawa, K. (2003) *Debt, R&D Investment and Technological Progress: A Panel Study of Japanese Manufacturing Firms in the 90s*. Institute of Social and Economic Research, Osaka University
- Rafferty, M. and M. Funk (2008), “Asymmetric Effects of the Business Cycle on Firm-Financed R&D”. *Economics of Innovation and New Technology*. 17(5), pp. 497–510.
- Stenberg, L. (2004) “Government Research and Innovation Policy in Japan“, Report produced jointly by the Swedish Research Council and the Swedish Institute for Growth Policies. Ostersund. Sweden.
- Thurik A. R., Carree M. A., van Stel A., and D. B. Audretsch (2008), “Does Self-employment Reduce Unemployment?” *Journal of Business Venturing*, 23(6).