EUROPEAN COMMISSION

Brussels, 30.11.2011
SEC(2011) 1427 final

Volume 1 - part 9/14

COMMISSION STAFF WORKING PAPER

IMPACT ASSESSMENT

Accompanying the

Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation';

Proposal for a Regulation of the European Parliament and of the Council establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020);

Proposal for a Council Decision establishing the Specific Programme implementing Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020);

Proposal for a Council Regulation on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 – The Framework Programme for Research and Innovation

Annexes

Annex 4: The Economic Role of Science, Technology and Innovation

{COM(2011) 808 final}
{SEC(2011) 1428 final}

ANNEX 4: THE ECONOMIC ROLE OF SCIENCE, TECHNOLOGY AND INNOVATION

INTRODUCTION

Europe suffers from a weak recovery from the economic-financial crisis, from weak economic growth over the last decade, from a long-standing living standards gap with the US, and from dire future economic prospects.

A key reason is Europe's lack of investment in intangibles, in particular research and innovation, which are critical for promoting increases in labour productivity and structural economic growth.

MODERN 'GROWTH ACCOUNTING' LITERATURE

- The key role played by research and innovation in structural economic growth is highlighted by the modern 'growth accounting' literature, which integrates the concept of intangible assets.
- There are three kinds of intangible assets: (1) scientific R&D and non-scientific inventive and creative activities (scientific and creative property); (2) software, computer programs and computerised databases (computerised information); and (3) firm-specific human capital, organisational capital and brand names (economic competencies) (Innodrive, 2009).
- Intangible capital is an essential ingredient for economic growth (Jona-Lasinio et al., 2011). Labour productivity, which in the long term is commonly viewed as connected to the living standards of the workforce, is strongly promoted by the accumulation of intangible capital (Innodrive, 2009). An econometric analysis shows a positive and significant relation between business investment in intangible capital and overall economic labour productivity growth (Roth and Thum, 2010).
- The OECD estimates indicate that in Member Countries like Austria, Finland, Sweden, the United Kingdom and the United States, investment in intangible assets and MFP growth (linked to innovation and improvements in efficiency) together accounted for between two-thirds and three-quarters of labour productivity growth between 1995 and 2006, thereby making innovation the main driver of growth (OECD, 2010b).

MODERN ECONOMIC THEORY

- The modern 'growth accounting' literature confirms what modern economic theory has unanimously recognised for quite some time now: that research and innovation are prerequisites for the creation of more and better jobs, for productivity growth and competitiveness, and for the structural economic growth vital for social cohesion and required to sustain Europe's social model.

MACRO- AND MICRO-ECONOMIC LITERATURE

- This recognition has been based on an extensive body of macro- and micro-economic literature that has produced a number of clear conclusions:
- The economic returns to public and private research are high:
  - **Total R&D:**
    - Empirical work has established robust relationships at the macroeconomic level between investment in innovation and productivity, and firm-level studies have also found positive and significant effects of R&D on productivity growth (OECD, 2010b).
    - A 0.1 percentage point increase in R&D could boost output per capita growth by some 0.3-0.4 per cent (Bassanini and Scarpetta, 2001).
    - A stochastic frontier analysis by the European Commission's Directorate-General Economic and Financial Affairs found that an economy's R&D intensity has a significant positive effect on the number of patents per million inhabitants of that economy and that R&D investments are characterised by non-decreasing returns to scale (Mandl et al., 2008).

- Following a detailed analysis, a team of social scientists has concluded that factors connected with the concept of 'human capital' are responsible for around 70% of the difference in wealth between regions. Three dimensions of human capital are important, one of those relating to productivity and innovation. It is measured by looking at two things: the amount of public and private money being invested in research and technological development (R&D), and the number of patent applications being made in each region (Euractiv).

- **Public R&D:**
  - The rate of return for publicly funded R&D usually exceeds 30 percent (Muldur et al., 2006).
  - Each extra 1 percent in public R&D generates an extra 0.17 percent in productivity growth (Guellec and van Pottelsberghe de la Potterie, 2001/2004).
  - Estimates of the impact of UK Research Council spending on the UK's national output suggest that a cut of £1 billion in annual spending would lead to a fall in GDP of £10 billion (Haskel and Wallis, 2010).
  - The US$3.8 billion spent by the US government to map the human genome spurred the creation of tens of thousands of jobs and gave rise to an industry that – while slow to deliver medical breakthroughs- now generates about US$67 billion in annual economic activity. The genome-sequencing project triggered many novel types of economic activity, from the manufacture of sequencing machines and other instruments to the devising of genetic test kits and diagnostic materials used for lab experiments. The investment also produced significant economic returns in the form of tax revenues and personal income. The US$3.8 billion, along with subsequent capital provided by the government and the private sector, generated a total return of roughly US$49 billion in direct and indirect federal tax revenues over the last two decades or so. Over the same period, those initial investments also helped to drive US$796 billion in direct and indirect economic output and generate US$244 billion in total personal income. In 2003, for example, the NIH and DOE together invested US$437 million in the Human Genome Project. That directly led to US$552.9 million in economic activity, the creation of 5,025 jobs and US$51 million in federal tax revenue. When the ripple effect is included, the impact was greater: US$1.65 billion of economic output, 12,422 jobs created, and US$125.5 million in federal tax revenue (WSJ).
  - Spending by the National Institute of Health directly and indirectly supported nearly 488,000 jobs and produced US$68 billion in new economic activity in 2010 (WSJ).
  - According to UK research, a £1.00 investment in public/charitable CVD research produced a stream of benefits thereafter that is equivalent in value to earning £0.39 per year in perpetuity. The total rate of return for mental health research is 37% (HERG Brunel University et al., 2008).

- **Private R&D:**
  - Firms' returns to their own investment in research usually range from 20 to 30 percent (Muldur et al., 2006).
  - Societal returns to firm investment in research usually range from 30 to 40 percent (Muldur et al., 2006).
  - Each extra 1 percent in business R&D generates an extra 0.13 percent in productivity growth (Guellec and van Pottelsberghe de la Potterie, 2001/2004).

- Research and innovation are vital for industrial competitiveness:
  - Research and innovation allow European firms to deal with the competitive threat posed by the low-cost and increasingly high-tech BRIC (Brazil, Russia, India and China) and small East Asian economies.
  - The ability to innovate (in addition to size, productivity, the skill intensity of the workforce) is positively related to firms' export performance. It also supports more complex internationalisation

strategies, such as exporting to a larger number of markets, to more distant countries and producing abroad through FDI or international outsourcing (Navaretti et al., 2010).

- On the other hand, firms' export status induces product innovations (learning by exporting). This may be due to the interaction between exporters and foreign customers and in particular the need of a domestic firm to modify its products when entering and staying in a foreign market (Bratti and Felice, 2010).

- Domestic research is necessary to be in a position to absorb the results of foreign research (international spillovers):
  - Each extra 1 percent in foreign R&D generates an extra 0.44 percent in productivity growth. This means that R&D not only benefits highly R&D-intensive countries but also R&D followers, but they must carry out a minimum of R&D to be able to absorb the results of others (Guellec and van Pottelsberghe de la Potterie, 2001/2004).
- Technological change boosts employment:
  - The often accepted view that innovation destroys jobs is wrong. Innovations have a positive and significant effect on employment, which persists over several years (Van Reenen, 1997).
  - For instance, an increase in business R&D by 1 percent is associated with an increase in business employment of 0.15 percent (Bogliacino and Vivarelli, 2010).
- Research-intensive sectors create more and better jobs:
  - Long-term, high-quality jobs stay in industries where there is a high degree of innovative content and where innovation, manufacturing, and end-user demand are tightly integrated.
- R&I can significantly help economies re-emerge from deep crises. Finland and Korea responded to their economic crises in the 1990s by investing heavily in R&D while severely constraining public spending; these investments helped their strong re-emergence in knowledge-based economies (CaSE, 2010).