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Working Party on the Information Economy

THE IMPACT OF THE ECONOMIC CRISIS ON ICTs AND THEIR ROLE IN THE RECOVERY

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This paper is a contribution to analysis and discussion of the relations between ICTs and the economic crisis, requested at the December 2008 meeting of the Committee. It builds on document DSTI/ICCP/IE(2008)5 prepared to explore current and near-term outlook indicators to be used to map the impacts of the economic crisis on the ICT sector and vice-versa. The paper should be read in conjunction with DSTI/ICCP/CISP(2009)1, "The role of communication infrastructure investment in economic recovery". It will be finalised for the WPIE meeting in June 2009 and contribute to the 2010 Information Technology Outlook. Arthur Mickoleit and Christian Reimsbach Kounatze contributed to the paper.

Note that the cut-off date for statistical data and firm quarterly reports was 20 February 2009.

The Committee is invited to i) discuss and comment on the paper; and agree to: ii) declassify the most recent data for the IT Outlook web page; and iii) declassify the revised paper by a written procedure following the WPIE meeting in June 2009.

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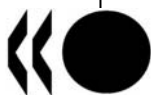


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THE IMPACT OF THE CRISIS ON THE ICT SUPPLY SIDE AND THEIR ROLE IN THE RECOVERY

Questions for discussion

The ICT sector

- *How will the crisis impact the ICT sector?*
- *What are major challenges faced by the sector, particularly in the longer term (see e.g. Table 1)?*
- *How can the ICT sector help the recovery and help the return to sustainable growth and employment?*

ICT diffusion and use

- *How will the crisis affect ICT diffusion and use ICT diffusion across the economy?*
- *Are there some particular areas where impacts are likely to be high?*

ICT policy pre- and post-crisis

- *How does the economic crisis change current ICT policy approaches and priorities? Is ICT policy rising to the challenge of the crisis? How does the OECD Seoul Ministerial Declaration on the Future Internet Economy help set the policy agenda?*
- *Are there ICT policy levers that are particularly important during the economic downturn?*
- *How are economic stimulus packages likely to affect ICT production, diffusion and use? What are priority areas and how should policies be coherently integrated with established ICT policies?*
- *What is the balance between the need for dealing rapidly with short-term problems (financial sector, rapidly rising unemployment) and longer-term approaches in complex areas such as healthcare and energy supply which have major components of ICT applications?*

Summary

1. The ICT industry is in for a tough year in 2009. It is, however, holding up somewhat better overall than in 2001-2002, and in relative terms is performing better than some other industries, notably automobiles in the goods sector. ICT services in general are performing moderately well, and maintaining moderate, albeit declining growth paths. Regional differences are clearly visible with Asian OECD countries (and China) being hit particularly hard by the down-turn, with slumping production and rising inventories, with Japan being hit hardest.

2. The semiconductor industry is a bell-weather for developments in the ICT industry. Semiconductor production fell particularly rapidly at the end of 2008, with capacity use dropping and semiconductor equipment manufacturers seeing very rapid falls in orders. However the crash has not yet reached the scale of 2001-2002 except in Asian OECD countries. The sector overall is generally in better shape than in 2001, with net cash positions of major firms generally higher than in the earlier period, suggesting that R&D and innovation activities could continue to be financed from internal sources of many large firms. Venture capital has also continued to flow into the sector, as well as into clean technologies which are very ICT dependent, albeit at lower rates.

3. ICT employment has trended downwards, but not as rapidly as in some other sectors. R&D has so far been maintained at a relatively high level despite the rapid declines in output, and it appears to be performing somewhat better than employment, and certainly better than production, as was the case for the ICT sector in the last cyclical downturn.

4. From the analysis of global ICT firms, it is clear that hardware sectors are more strongly affected by the economic crisis than services, software and Internet-related ones. Semiconductor and electronics companies have been particularly affected by slowing consumer demand and slowing IT investments. The communications equipment sector is feeling the pressure of the downturn too, despite continuing investments in broadband. Non-hardware sectors maintained positive growth, although Internet and software companies saw a steep fall of around 20 percentage points between the highest and lowest quarterly growth rate in 2008. Nevertheless, major Internet businesses show signs of holding up better than after 2001, especially industry leaders.

5. In general, large firms in the ICT sector are stronger at the end of 2008 than following the dot.com bust in 2001. This includes higher cash to debt ratios in companies' balance sheets, consolidated and stronger firms, increased importance of the Internet economy and thus dependence on ICTs and their applications in more fields than in 2001. However some large electronics and IT equipment manufacturers face difficulties as "growth pockets" in some business areas do not compensate for declines in others.

6. The Americas, Europe and Asia are all negatively affected by the current crisis. However, Asia is much worse than was expected at the outset of the downturn. There are several reasons for this: currency fluctuations, especially in disfavour of export-oriented ICT industries in Japan; plunging exports and domestic demand for Chinese producers, affecting manufacturers of IT equipment, components and suppliers all across the region, especially Chinese Taipei; low value-added activities, *e.g.* Apple growing rapidly, but original design manufacturers such as Quanta Computer having trouble; Korean companies also affected, but major IT companies Samsung and LG still growing, helped in part by a much weaker KRW.

7. Employment figures for the ICT sector are still patchy, although announcements of major lay-offs have been made. These announcements appear more pronounced in the semiconductor and electronics sectors where some firms say they will release over 10% of their workforce in the next few months. Insolvencies of companies add to the pressure on ICT labor markets. Lay-offs announced in IT services,

software, and Internet firms are lower. In general, these announcements must be treated with caution as they do not take into account new and continuing recruitments by firms.

8. ICT R&D activities are expected to stay flat, similar to developments after 2001, and if they decline it will be with a lag compared with turnover and employment (see *Information Technology Outlook 2008*, Chapter 1). During 2008 many firms remained flat in R&D expenditures. However, investments in innovation are also seen as a way of increasing future competitiveness, especially in future growth areas, and R&D tends to be maintained in the ICT industry through downturns.

9. OECD country ICT policies have increasingly been integrated into overall strategies for enhancing economic growth, employment and welfare in OECD countries (OECD *Information Technology Outlook 2008*, Chapter 7). They have shifted from dealing with sector-specific infrastructure issues towards the formulation of long-term strategies on how ICTs, the Internet and other types of networks can enable wider socio-economic objectives to be achieved. E-government activities are a part of strategies to boost public-sector efficiencies. ICTs are also increasingly used to address wider socio-economic issues at the national level (*e.g.* social cohesion, ageing societies, national security) and globally (*e.g.* climate change, energy-efficiency, global health issues).

10. Governments in OECD countries are introducing economic stimulus packages to address the economic crisis. These packages aim to stimulate demand in the short-term, by improving the flow of money and restoring the health of the banking sector, protecting existing jobs and creating new ones. Most governments also plan to foster growth through supply-side investments and demand-side measures to help restore favourable conditions for innovation and long term growth. In many cases these plans are directly relevant to the ICT sector and technology diffusion. The question is how current ICT policies should be maintained or rethought in the economic crisis and how to ensure worthwhile continuity in a time of crisis and radical change.

Introduction

11. The 2008 edition of the *Information Technology Outlook* (released in December 2008) showed that the downturn in the ICT sector was deepening rapidly but also that official short-term indicators, although issued with only a two month lag, had not yet started to show the depth and rapidity of the decline. Tracking the rapid slump in the economic performance of the ICT sector has been particularly difficult.¹ Unlike the 2001-2002 recession, which began with the Internet bubble, or other recent recessions, the current recession began in the financial services sector revealing deep-seated systemic weaknesses in financial services (banks, insurance companies) in OECD countries. The financial crisis has rapidly worsened and spilled over from the US to many other countries and the impacts felt in a growing crisis in the real economy. Despite very major government attempts to stabilise the financial system, it remains very fragile and threatens to collapse, undermining national and global economic activity.

12. The impacts of the unprecedented financial crisis and subsequent deepening economic crisis have been particularly difficult to foresee. For example, OECD macroeconomic estimates and projections were shifted down sharply in the 10 weeks from early September 2008 to mid-November 2008. Short and medium term projections in this period shifted from a rapid slowdown in growth and the onset of recession in *some* OECD countries in Q4 2008 (OECD, 2 September 2008),² to the *OECD area as a whole* entering recession and unemployment rising in many OECD countries in Q4 2008, with the ongoing financial crisis the prime driver of the deep economic downturn (OECD, 13 November 2008 and 25 November 2008).³ Against this background, the outlook for the ICT sector has been particularly difficult to position. The major challenge is to develop an indicator base to adequately describe recent performance and to better assess near-term trends.

13. There are three general drivers of change in ICT production and purchase. First, longer-term prospects and trends for the ICT sector remain good, with a continuation of the cyclical and structural growth across many segments witnessed over the last 15 years, despite the fall in 2001-2002. This growth is driven by product, process and organisational innovation and the ensuing increased share of ICTs in business and consumer expenditure as ICTs become increasingly embedded in all economic, social and cultural activities (see OECD 2008b).⁴ Second, ICT investment can be volatile. On the investment side this is due to the “acceleration principle”. Investment is approximately proportional to the rate of change of output. This magnifies changes in investment both upwards and downwards in both periods of growth and slump. Third, consumer spending also comes under increasing pressure and has dropped sharply. Consumer confidence has fallen very rapidly with the collapse of the house price bubble and stock market prices. People feel less rich despite unchanged income (the “wealth effect”), there is rapidly rising

¹ OECD (2008a), “Tough year ahead for IT industry, warns OECD”, Press release, 22 December, at www.oecd.org/sti/ito

² OECD (2008b), *What is the economic outlook for OECD countries? An interim assessment*, 2 September, OECD, Paris. In this assessment year-on-year growth for all of 2008 was projected to be: US 1.8%, Japan 1.2%, and the Euro area 1.3%. Ten weeks later (OECD, 2008c), due to the severity of the Q3/Q4 downturn, these projections were revised sharply down to year-on-year growth for 2008 to be: US 1.4%, Japan 0.5% and the Euro area 1.1%, with the November Q4 forecasts mostly on the down-side of the outer lower bounds forecast in September, such is the severity of the 2008 Q3/Q4 downturn. The continuing bad news has led to further sharp downward revisions of 2008 Q4 GDP, and 2009 Q1 and Q2 are being revised down further and the timing of the upturn pushed out to 2010.

³ OECD (2008c), *Economic projections for the US, Japan & Euro area*, 13 November, OECD Paris; OECD (2008c), *Economic Outlook, Number 84*, 25 November.

⁴ OECD (2008d), *The Seoul Declaration on the future of the Internet economy*, 17-18 June 2008.

unemployment (potentially reducing consumption expenditure) and increasing worries about job security (increasing household savings) and these factors slash consumer spending on ICTs. The results are that on both investment and consumption sides there are major downward pressures on ICT expenditures, particularly on goods, and to a certain extent on services.

14. The next section analyses the performance of the ICT sector with data drawn from official national statistical sources. The following section analyses recent developments on the basis of OECD estimates from quarterly reports of top ICT firms. The third section begins with a discussion of the likely supply and demand factors re-shaping the sector in the economic crisis and the impacts on ICT diffusion and use. The paper closes with a discussion of ICT policy, a brief survey of some of the programmes in current government economic crisis packages relevant to the ICT sector and applications of ICTs across the economy, and interactions between current ICT policy and the economic crisis packages.

- The data and arguments in this document are designed to address the following questions:
- What is the depth and extent of the current downturn in the ICT sector?
- How does it compare with the 2000-2001 downturn? Are some countries and sectors performing better (worse) than others in ICTs?
- What are the likely near-term effects of the recession and recovery in the sector?
- How do ICTs contribute to the recovery?
- What is the role of ICT policy? What impacts are the recent crisis packages likely to have on the ICT sector, and the use of ICTs more widely across the economy?

Part 1. Recent aggregate ICT production trends

Short-term ICT production⁵

By product area: ICT goods and services

15. Production of semiconductors has been leading the way down in this downturn, as it does habitually and as it does in upturns. Semiconductor production in current terms has been turning down in some countries since 2006, and the downturn has accelerated in some countries. On the other hand communications equipment has tended to trend slowly down towards zero, and measuring and controlling / instruments have overall remained on a slow, but positive growth path (see Annex 1 Figures).

16. ICT goods inventories have built up rapidly in countries for which detailed monthly data are available. In Japan the producer inventory ratio (inventory over shipments) has risen to unprecedented levels particularly in electronics and to a lesser extent in IT equipment as inventories have risen rapidly at the same time as shipments have dropped sharply. Similarly in Korea producer inventories for computers rose to unprecedented levels in the last half of 2008 and semiconductor inventories rose to close to record highs. However they also dropped sharply in the last quarter of 2008 as ICT manufacturers slashed production and as competitiveness improved with the declining currency. The very rapid inventory build-up in Japan and Korea is no doubt due to the precipitous decline in exports as consumer confidence dropped in importing countries. On the other hand ICT inventories have been rising in the US but are lower than in previous cycles.

17. Computer and IT services are slowing, but are retaining positive growth in most countries. In all countries for which data are presented, computer and IT services are currently performing somewhat better than telecommunications services (in monthly activity, output or turnover).

Comparisons with the cyclical downturn of 2001 - 2002

18. Comparisons of production in the current period compared with the last cyclical downturn vary considerably across countries. In general, production of ICT goods in the US and Europe is holding up so far better than in 2001-2002 across all ICT goods segments. On the other hand very sharp falls in goods production in Japan and Korea have already taken production indices to their 2001 cyclical lows, with no sign of an upturn at end-2008.

19. Other major ICT goods exporters have also registered historically very rapid falls in output (e.g. Chinese Taipei hit by a very sharp slump in flat-screen products and semiconductors) and Chinese data show falling ICT output towards the end of 2008, both considerably more than in the last downturn in 2001-2002. The producer inventory ratio for electronics and ICT equipment in Japan is considerably higher than in the previous cycle in 2001-2002, and in Korea the inventory buildup in the second half of 2008 was higher and sharper than the previous 2000-2001 cycle, although semiconductor inventories have not yet seen the prolonged two-year buildup beginning late-1999. For the US, inventory buildup has been lower than previously.

⁵ All data referred to is drawn from official national monthly statistics, most of which are released with an approximate 6 week lag. In this paper most national data are through December 2008, for the US they are through January 2009. In all cases 3-month moving averages on seasonally adjusted data have been used to iron out very short-term fluctuations, but to provide a better overview of recent movements than the usual 12-month moving averages used in the *Information Technology Outlook*. A sample of the set of figures used to prepare the analysis in this section is presented in Annex , Figures 17-32.

20. IT and computer-related services are generally performing better in most countries than during the last cyclical downturn in 2002. Telecommunications services are generally performing worse than IT and computer related services in the current slump, after having performed better in the last one.

Performance compared with other product groups

21. In the current slump, ICTs goods are generally performing better than aggregate manufacturing and in particular better than motor vehicles, which is the worst performing major sector across all countries surveyed. ICT goods are performing somewhat worse than chemicals across the majority of countries. In Japan and Korea ICT goods production is somewhat worse than total manufacturing and close to motor vehicles in its slump in production.

22. In Japan the producer inventory ratio in electronics and IT equipment is still rising much more rapidly than for total manufacturing, chemicals and motor vehicles, even though inventories in the chemicals sector have reached historic highs and the motor vehicles ratio is rising rapidly. Similarly in Korea, ICT manufacturing producer inventories rose to record highs in the second half of 2008. They peaked much more rapidly, and sooner, than chemicals and motor vehicles (which remain relatively low) and were well above total manufacturing. In the US ICT inventory movements are around the same as for total manufacturing, and as a further sign of relative resilience in US ICT goods production, the computer and professional equipment industries have had among the lowest year-on-year increases in their inventory to sales ratios amongst all US goods categories.⁶

23. In the previous slump in the 2001-2002 period, ICT goods production were worse than the manufacturing aggregate and worse than both motor vehicles and chemicals in all countries for which detailed monthly data have been retrieved.

24. IT and computer services performance remains positive in most countries and is performing much better than ICT goods. IT services performance is roughly in line with total services (or some sub-set of total services), with around one-half of countries having better performance than aggregate services. In most countries ICT services have performed worse than financial services until very recently, but better than communications services. In the previous slump in 2001-2002 IT services generally performed worse than total services, and considerably worse than both communications services and financial services.

Performance across countries

25. Overall, the current ICT production slump, while significant, is not yet as deep relatively as in 2001-2002 with the exception of Japan and Korea where the slump is particularly severe. This is probably due to the major and continuing restructuring of the ICT goods-producing industry from many OECD countries towards Asia, particularly China, and to Eastern Europe, following the last slump. In Korea and Japan the deep slump in ICT goods production approximately equals that in motor vehicles, and the rapid run-up in ICT inventories suggests that ICT goods production are likely to continue to decline.

26. Services performance has been trending downwards but has tended to remain positive in the sample set of countries, with no particularly major differences across them. This may be due to the domestic nature of most service transactions, so that they withstand changes in ICT goods trade and the rapid collapse of export markets seen for, particularly for Japan and Korea and for other Asian countries.

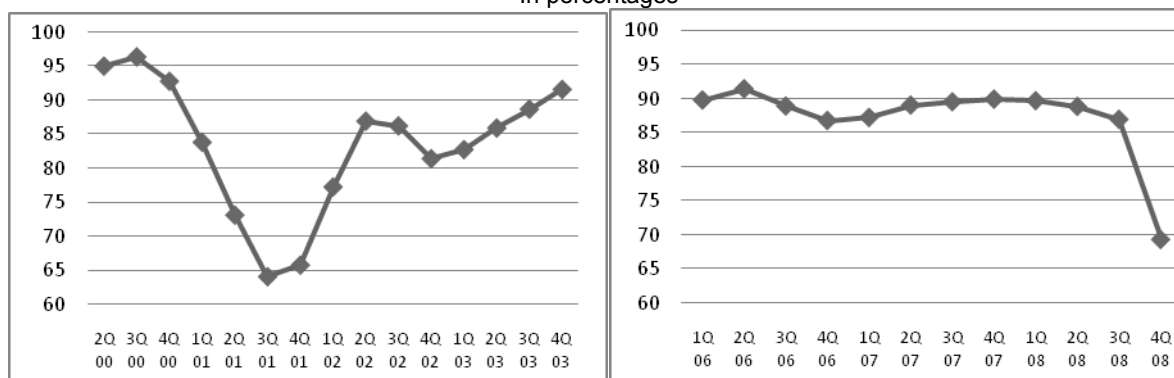
⁶ Data from *Economic Data*, 2009.

Semiconductors

27. Semiconductors are always seen as the bell-weather for the ICT goods industry. They are major intermediate inputs into production, leading the rest of the sector into slumps and pulling out first. Analysis of the performance of the semiconductor sector provides a good indication of what will happen across the wider ICT goods industries with a lag.

28. The world-wide semiconductor market remained flat overall in 2008, reflecting the combination of moderate growth during the first three quarters of the year and a sharp drop in the last quarter with the onset of the global recession. The Annex graph for semiconductor markets shows the compositional shift to Asia as an increasing share of production is undertaken there (Figure 14). However it is no doubt over-optimistic for 2009 taking into account the rapid decline in billings in the last quarter of the year. The shape of the accelerating slump in Q4 2008 resembles that of the sharp down-turn from Q1 2001 (Figure 15). Utilisation rates for semiconductor facilities have fallen below 70%, last seen at the end of 2001 (see Figure 1). These suggest a sharp downturn, possibly as deep, or deeper, as that in the 2001-2002 period, although so far this has not been the case.

Figure 1. Utilisation rate of semiconductor manufacturing facilities
In percentages



Note: the two graphs cannot be directly compared because emerging technologies led to a break in the series since Q1 2006.
Source: Semiconductor Industry Association, February 2009.

Venture capital

29. Venture capital gives a view of future potential as viewed by risk-taking investors. The volume of these funds is currently constrained by the availability of finance, and the potential for successful exit strategies through stock market listings or purchases, *e.g.* by private funds. These data are often collected and published very rapidly by VC industry associations, and may not be readily comparable across countries. Detailed quarterly US data is available with a lag of around 1 month and as the US is by far the largest VC market, these data are indicative of global trends in terms of the potential of ICT innovations.

30. The most recent data (through Q4, 2008, see Figure 16) show that ICT VC has held up moderately well, and the share of ICTs in total venture capital remains at 50% even if it has declined from over 75% at its peak during the Internet bubble. However venture capital has declined in current USD terms in the second half of 2008 from close to USD 4 billion per quarter to around USD 2.5 billion in Q4 2008 (see Annex Figure). Overall the VC data indicate the continuing importance of ICTs in venture capital investments despite the financial market crash starting in Q3 2008.

Part 2. Performance of top ICT firms in seven ICT sectors ⁷

31. This section analyses the performance of a set of top-250 ICT firms in seven different ICT sectors to compare recent performance and trends in more detail. The relative performance in 2008 (quarterly year-on-year growth) is compared with 2001. Quarterly results for large ICT firms are available with a few weeks lag in most cases. Year-on-year quarterly changes are calculated for each firm and then pooled to make up the Top-10 firm sector groupings.⁸ These give an overview of the recent evolution of ICT firms and the sector. Data on net cash positions of firms have been collected for the first time, with net cash calculated from balance sheet positions defined as: cash plus short-term investments/marketable securities minus debt. These net cash data, although very variable across firms, are presented to give a forward indicator of the likely survival of firms within the sector, and their potential to finance R&D and innovation from their own resources.

32. The “sectors” summarized below comprise the top-10 ICT firms in each sector, as identified in the *Information Technology Outlook 2008*. Overall the results suggest that there is considerable variation in results across sectors as would be expected in the recession, and geographical and firm-specific factors also account for a large deal of variability. Aggregate trends described in the first part are largely confirmed by firm-level developments in the ICT sub-sectors.

Semiconductors

33. Demand for semiconductors fell significantly throughout 2008 and severely during the final quarter. This is affecting the entire sector, including semiconductor equipment suppliers (*e.g.* ASML, Applied Materials, Kla-Tencor, Tokyo Electron) and subcontractors. Utilisation rates have dropped rapidly (see Figure 1 above). Positive headlines (*e.g.* Intel investing USD 7 billion in manufacturing facilities over the next two years) cannot balance the current downwards trend.

34. Memory semiconductors are particularly affected with rapidly falling demand and large overcapacities. Gartner reported that the total market for DRAM memories contracted by over one third in the final quarter, both on the previous quarter and year on year (Fabtech, 2009). This is not limited to Asian manufacturers as German Qimonda’s insolvency shows. “Growth pockets” for the semiconductor industry in 2009 can be expected from increasing demand for “netbooks” (or “sub-notebooks”), smartphones, GPS systems, photovoltaic technologies and investments in “green” semiconductor fabs.

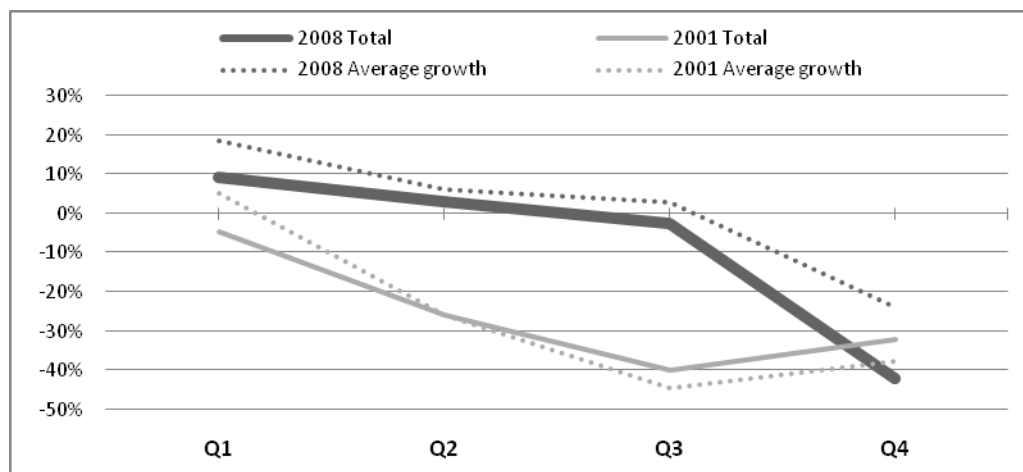
35. Major semiconductor firms are still performing better than in 2001 as a whole, but as usual the sector was earliest hit of all ICT sectors by the economic recession. Year on year revenue growth for the top 10 companies throughout 2008 was on average higher than in 2001.⁹ However, combined quarterly revenues dropped by 42% in the final quarter of 2008 compared to the final quarter in 2007. This drop was stronger than revenue declines witnessed for these companies in 2001 (see Figure 2). In combination with the plunge in utilisation rates, this shows a much more unexpected drop than during the dot.com bust.

⁷ These data are drawn from quarterly and annual data provided by Yahoo! Finance (based on EDGAR Online, SEC) or Google Finance and MSN Money (based on Thomson Reuters). Where audited Q4 data were not available from these sources, they are taken from current press releases on firms’ web sites.

⁸ To reduce the effect of exchange rate fluctuations, 2008 OECD exchange rates were applied to all of the quarterly results for 2008, 2007 and 2001, 2000.

⁹ Annual data are from annual reports (*i.e.* they are not the sum of four quarters). In only one case (FirstData) was annual data not available for the annual comparisons.

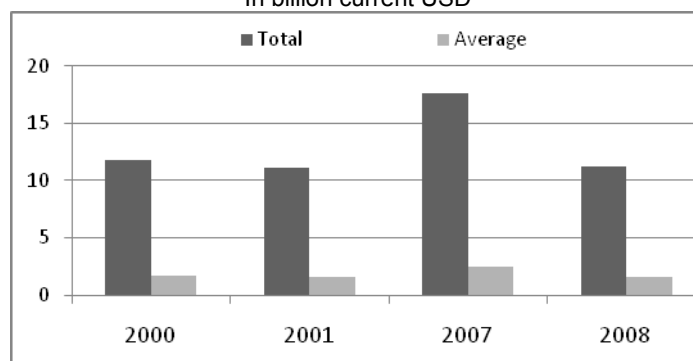
Figure 2. Quarterly revenue growth (year on year), Top-10 "Semiconductors"



Note: Average growth refers to non-weighted average of firms' annual growth rates.

36. Semiconductor companies had more net cash at the end of 2007 than in 2000, in sum and on average (Figure 3). Intel, Texas Instruments and Taiwan Semiconductor had several USD billions net cash in their balance sheets at the end of 2008. Overall, however, net cash dropped, to a large part due to rapidly falling revenues.

Figure 3. Net cash at end of year, Top-10 "Semiconductors"
In billion current USD



Note: Based on 2008 USD exchange rates. Average refers to non-weighted average of firms' net cash availability.

37. Where available, 2008 end-of-year data suggest stable employment, but some firms have announced lay-offs for 2009 (Intel – 6 000, 7% of total workforce; STM – 4 500, 8%; Texas Instruments – 3 600, 12%; Infineon; Qimonda). However, these announcements must be treated carefully as many companies are also investing and hiring (but possibly at a lower rate) in new areas to assure future competitiveness.

38. Where available, R&D figures for whole-year 2008 have not shown dramatic decreases compared to 2007. Spending cuts on R&D typically lag behind revenue declines and R&D expenditures were flat or declined slightly in the most recent quarters. Some major firms have, however, announced R&D spending cuts in 2009: Intel (-5%, from USD 5.7 to 5.4 billion), Texas Instruments (-20%, from USD 1.9 to 1.5 billion), NXP, although R&D cuts are generally less than employment cuts and much less than declines in revenues. This cyclical lag in R&D cuts was also the case in the previous business cycle in the early 2000s (see *Information Technology Outlook 2008*).

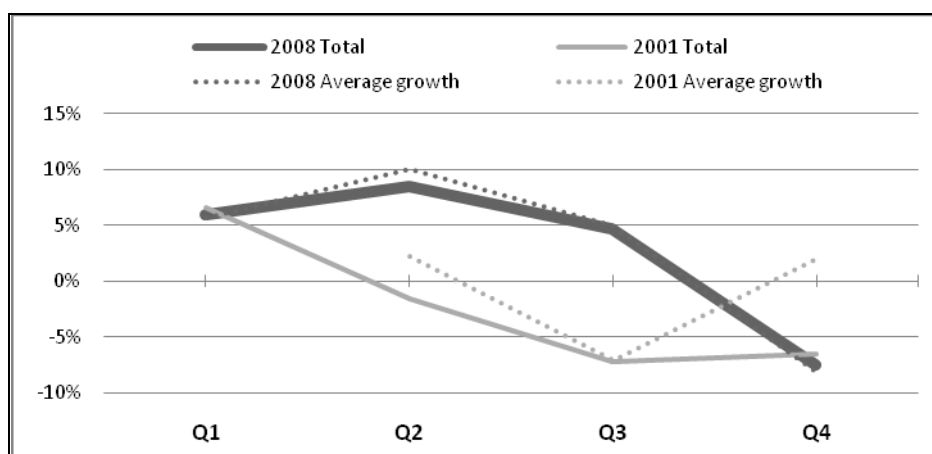
IT equipment

39. Slow demand for computers, consumer electronics devices and semiconductors but also decreased spending on enterprise servers hit IT equipment manufacturers, especially towards the end of 2008 (global PC shipments declined during the final quarter for the first time since 2002; IDC, 2009a). New growth areas exist, e.g. “netbooks”, but they have not yet compensated for the overall weakening market.

40. Major US companies (HP, IBM, Dell) were in total not as strongly hit by the downturn as Asian firms for two reasons: stronger growth rates in first half of 2008 and software/services divisions with growth or at least much slower declines. Manufacturers from Chinese Taipei (ASUSTeK, Quanta Computer) and Japan were severely affected, the latter also due to an appreciating JPY slowing exports. Apple was the only top-10 company to post positive Q4 revenue growth, with more than USD 10 billion quarterly revenues for the first time.

41. During 2008, major IT equipment companies followed a similar trajectory to that of semiconductors manufacturers. Whereas revenues grew strongly most of the year, the decline in the final quarter was much stronger than revenue declines witnessed in 2001 for the same companies (Figure 4).

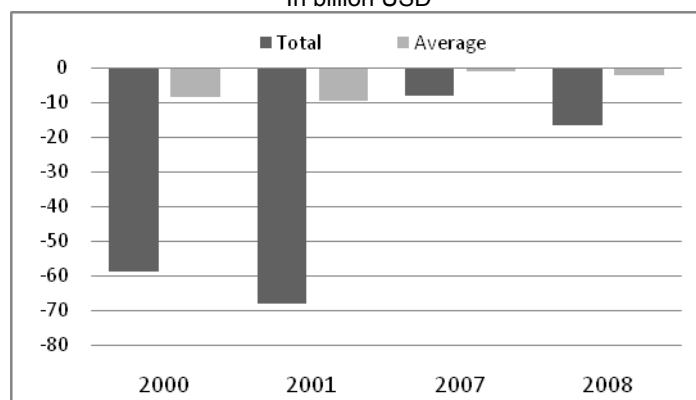
Figure 4. Quarterly revenue growth (year on year), Top-10 "IT Equipment"



Note: Average growth refers to non-weighted average of firms' annual growth rates. The figure does not include three top-10 companies from Chinese Taipei because of data availability issues.

42. Major IT equipment firms were more liquid at the outset of the recent economic downturn than before the dot.com bust (Figure 5 below). Firms in the sector on average still have negative net cash positions but cash levels are higher than in 2000/2001. However, at the end of 2008, only Apple and Dell had positive net cash in their balance sheets (USD 26 billion and USD 7 billion, respectively). IBM, Toshiba and HP had net cash positions of USD -21 billion, USD -16 billion and USD -8 billion respectively (in the case of HP, debts “inherited” through the acquisition of EDS).

Figure 5. Net cash at end of year (billions fixed USD), Top-10 "IT Equipment"
In billion USD



Note: Based on 2008 USD exchange rates. Average refers to non-weighted average of firms' net cash positions.

43. Employment figures are very patchy, but some companies have announced major lay-offs (NEC – 20 000, 12%; Toshiba – 4 500, 2%). Other companies report cutting jobs but have made no public statements on the expected magnitude (HP, IBM, Hon Hai). At the same time, however, some companies point out that recruitments will continue.

44. R&D expenditures of US and Japanese firms were flat or increased slightly during 2008. HP and IBM reported year-on-year decreases during the final quarters, but with *e.g.* IBM cutting R&D less than revenue declines. Apple reported a strong increase of 28% in R&D expenditures during the final quarter and expects further growth during 2009.

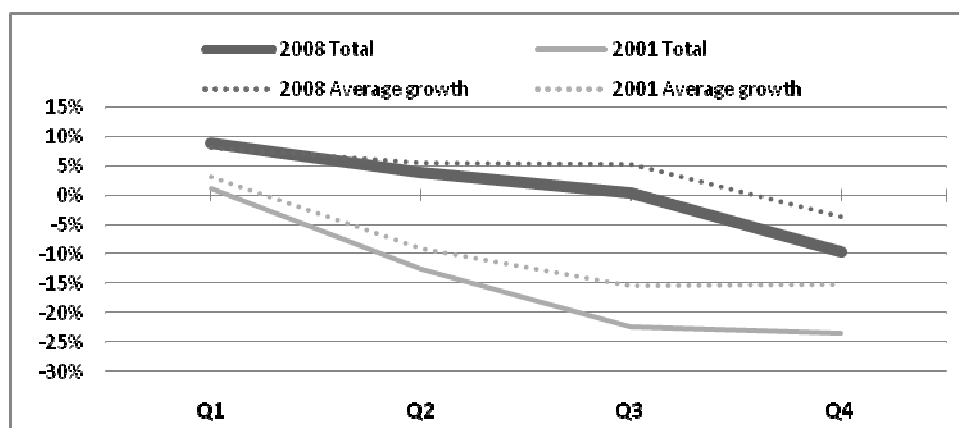
Communications equipment

45. Different developments in markets for handsets and ICT infrastructures have led to heterogenous trends in the sector's top 10 companies. In 2008, global growth of handset sales slowed down to 3.5% and was especially weak during the holiday season (-13% in the final quarter, compared to one year earlier; IDC, 2009b). Smartphones, however, are a major area of growth globally. Samsung, LG, Apple, RIM and to some degree Nokia were able to benefit from these developments. Motorola and SonyEricsson lost significant market shares, partly due to weaker positions in the smartphones and touch-screen mobile phone segments.

46. Investments in infrastructure networks are expected to slow in 2009, but demand for advanced wireless broadband networks persists. Economic stimulus packages in OECD countries include expanding broadband networks (see part 3 of this paper). China's government has also announced it will invest over USD 40 billion in 3G infrastructures over the next two years. Companies such as Cisco Systems, Ericsson, Nokia Siemens Networks and Huawei are likely to benefit most from these public initiatives in response to the crisis when implemented.

47. Overall, communications equipment companies fared better in 2008 than they did in 2001. Reporting companies saw slight revenue growth over 2008, compared to a double-digit fall in 2001. But revenues grew more slowly during the course of 2008 and declined strongly in the final quarter, both in total and as an unweighted average (Figure 6).

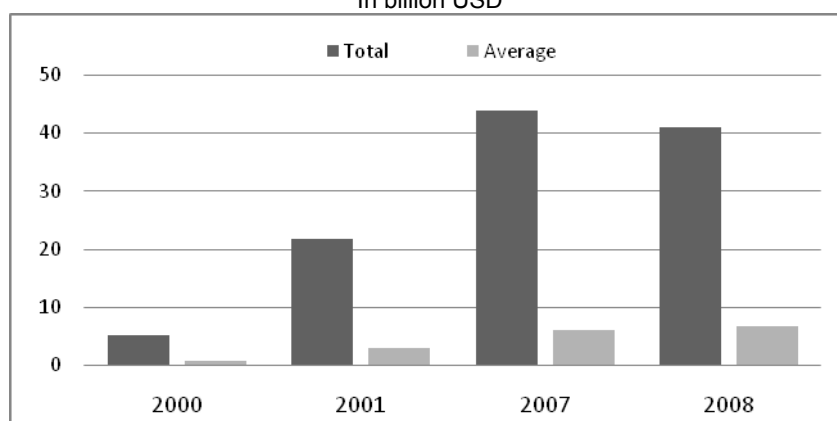
Figure 6. Quarterly revenue growth (year on year), Top-10 "Communications Equipment"



Note: Average growth refers to non-weighted average of firms' annual growth rates.

48. Another indicator of the better state of communications equipment companies is higher net cash than in 2000/2001 (Figure 7 below). At the end of 2007, major firms had on average USD 6 billion in net cash on their balance sheets. Whereas Nokia's net cash declined during 2008, companies such as Cisco Systems, Ericsson, Qualcomm were all able to increase their net cash. Nortel Networks' bankruptcy filing, however, points to more severe competition in the current downturn.

Figure 7. Net cash at end of year (billions USD), Top-10 "Communications Equipment"
In billion USD



Note: Based on 2008 USD exchange rates. Average refers to non-weighted average of firms' net cash availability.

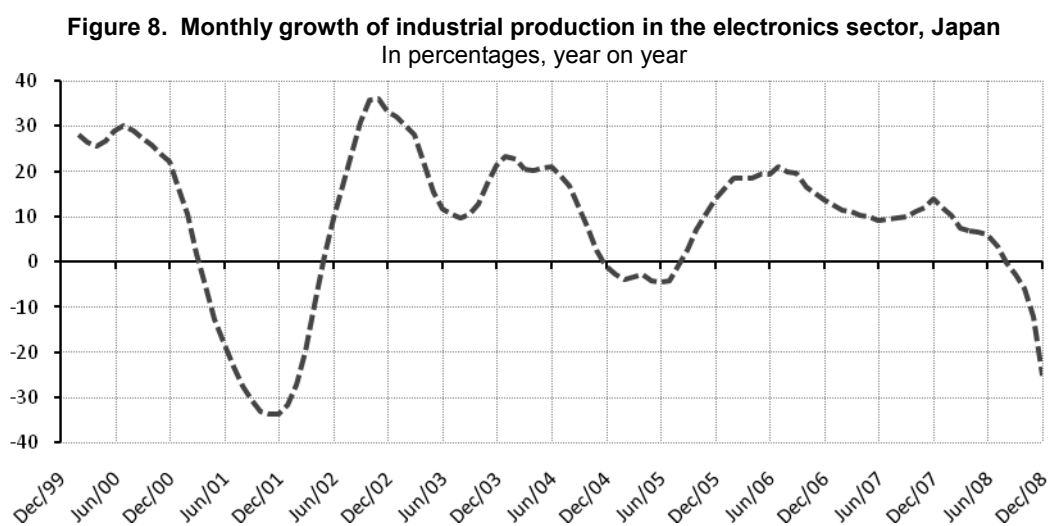
49. Where available, employment figures at the end of 2008 showed growth or stagnation in most cases. However, companies have announced job cuts for 2009 (Motorola – 4 000, 6% of total workforce; Ericsson – 5 000, 6%; Nokia; Nortel). At the same time, growing demand for some communications and Internet infrastructures leads companies such as Qualcomm to announce at least 2 600 engineering recruitments during 2009. Negative effects on R&D in the sector are limited with firms often maintaining expenditure levels during 2008 or slightly increasing them.

Electronics

50. The electronics sector was hit by declining global sales, just as IT equipment. Demand plunged for a wide range of consumer electronics and related products, *e.g.* TFT-LCD panel displays for notebooks, screens, etc. Japanese companies in the top-10 list as well as Dutch Philips posted revenue declines in the final quarter; German Siemens and Korean firms Samsung and LG maintained positive revenue growth.

51. New impetus is expected from emerging clean technologies and related electronics. One example is efficient battery technologies, which are essential to support the growing diffusion of mobile devices, electronic/hybrid vehicles, “smart” electricity grids and energy generated from renewable resources. While Japanese Sharp, for instance, saw overall revenues decline by 20% in the final quarter of 2008, its solar cells division increased revenues by 18%. But the example of Sharp also points to a challenge that many major electronics companies face: “over-diversification” (*cf.* The Economist, 2009). Korean Samsung, for example, posted revenue declines in its LCD panels and semiconductors divisions, but solid growth for mobile phones, also showing the up-side of diversification.

52. Japanese manufacturers were severely hit, partly due to an appreciating JPY and consequently slowing exports. More than half of top-10 electronics companies come from Japan. Q4 2008 data for Japanese firms was not readily available at the cut-off date but official statistics indicate the steep decline of electronics production, down to levels comparable to those at the end of 2001 (Figure 8 below and data summarised in Part 1).



Source: Japanese Ministry of Economy, Trade and Industry (METI), February 2009. See comparisons in Figure 21.

IT services

53. IT services providers were able to maintain growth throughout most of 2008, slowing during the final quarter. Demand for IT and Business Process Outsourcing (ITO/BPO) persists as IT executives continue to focus on reducing costs via (offshore) outsourcing (see Box 1). However, revenue growth through outsourcing is expected to decline in 2009 with small and short-term IT projects (with short amortization periods) being favoured over high-value and long-term IT investments.

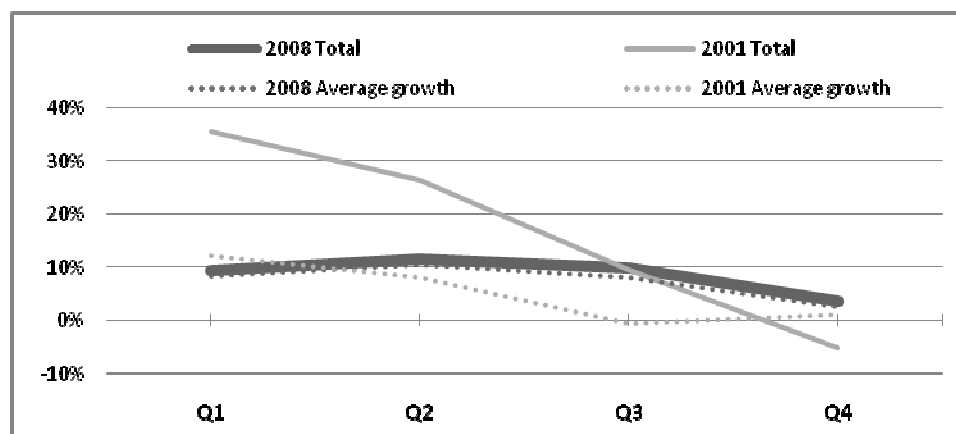
54. Banking and financial services firms account for around one fifth of global outsourcing deals (Everest Research, 2009) and the severe crisis in these sectors will have a pronounced effect on demand for ITO/BPO services. In 2008, the total value of deals in the sector dropped by 28% to USD 18 billion, the lowest value since 2001 (TPI, 2009).

55. Although IT services firms are not facing the same severe downturn as they did during 2001 (see Figure 9), combined annual revenue growth in 2008 was lower than in 2001 (8.4% compared to 12.8%).¹⁰ The top 10 services firms had almost constant revenue growth rates of around 9% during the first three

¹⁰ Excluding First Data from the sample of top 10 IT services firms gives total annual revenue growth of 8.4% in 2008 and 12.9% in 2001 (see below).

quarters of 2008, but growth slipped to 3.5% in the final quarter.¹¹ Affiliated Computer Services, Accenture and CSC had growth rates between 5% and 7%; Unisys and Cap Gemini had the lowest revenue growth (-17% and 1%). Some IT service providers from other sectors also saw flat or slightly declining revenues in their IT services divisions, e.g. -4% at IBM's services division.

Figure 9. Quarterly revenue growth (year on year), Top-10 "IT services"



Note: Average growth refers to non-weighted average of firms' annual growth rates.

Box 1. Trends in IT outsourcing for 2009

IT executives still plan to increase their IT budget in 2009 according to most recent surveys, but with some declines. A survey conducted by the *Society for Information Management* (SIM) of 230 firms in the United States, for instance, reveals that "44% of IT leaders plan to increase their IT budgets in 2009, 37% plan to leave their budgets at the same level as in 2008 and only 19% of respondents admitted planning to cut their IT budgets". For comparison: in 2008, IT spending significantly increased in 46% IT companies over 2007, 28% kept their budget at 2007 level, and 28% reduced their IT budgets (TEAM International, 2008).

Other surveys conducted in the United States reveals that IT (offshore) outsourcing is seen by IT executives as a mean to reduce costs and to improve liquidity. *Info-Tech Research*, for instance, in their current survey targeting more than 150 IT companies in the United States, shows that more than 60% of the IT departments are "focusing on reducing costs via offshore outsourcing". According to the current survey of *Robert Half Technology*, 43% of 1 400 CIOs are planning to increase offshore transactions in 2009 (TEAM International, 2008).

The European Information Technology Observatory (EITO) has also projected an increase in revenues for IT and BO outsourcing in 2009 in Europe. In Germany, for instance, annual revenues generated by IT and BO outsourcing is expected to increase by 7.2% in 2009 compared to 7.4% in 2008 (BITKOM, 2009).

Recent quarterly data of the outsourcing market indicates that revenue growth through IT and BP outsourcing will probably decline in 2009, due to current high uncertainty. This is reflected by an increasing number of contracts, but with a decreasing Total Contract Value (TCV). According to Technology Partners International (TPI), the TCV of outsourcing deals in H2 2008 was the lowest in 10 years. The number of large outsourcing contracts (over USD 25 million) dropped by 20% in Q3 2008, to a total of just over USD 14 billion. Nevertheless, the industry-wide annual contract value (the potential annual revenue associated with the outsourcing transaction) in 2008 was the highest ever, driven by the shortest ever average contract duration (5.2 years) (TPI, 2009), and Indian firms providing outsourcing services have remained relatively optimistic as they change their service product mix to adapt to market demands during the crisis.

¹¹ Total quarterly revenue growth in Q4 2008 does not include current quarterly revenue of First Data, which had not published its annual report by the cut-off date for this paper. Q3 2008 revenue has been taken as a proxy for Q4 2008 and the sum of quarterly revenues used as a proxy for annual revenue.

56. The better overall performance of IT services firms in 2008 is also reflected by improved net cash compared to 2001. At the end of 2008, the top IT services firms had positive net cash (USD 387 million, or USD 10 million on average), compared to negative net cash positions at the end of 2001 (USD -2 billion, USD -221 million on average). Accenture had almost USD 2.8 billion in net cash, and Cap Gemini and Automatic Data Processing more than USD 1 billion.

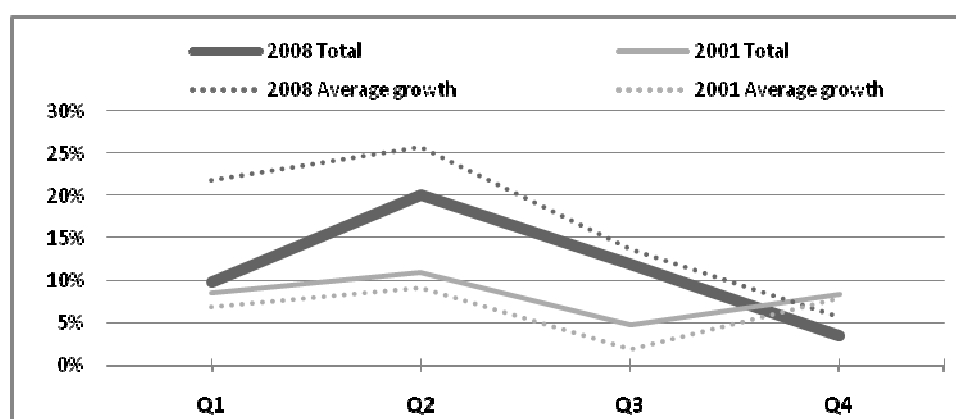
57. Few top IT services firms have so far drastically reduced the number of employees. Unisys announced cuts of 1 300 jobs (4.3% of the total workforce); Accenture is to cut about 500 jobs (less than 0.5%). While not laying off employees, IT services firms such as Cap Gemini announced slower hiring for 2009. This also includes leading Indian IT services firms (*e.g.* TCS, Infosys, HCL, Cognizant), where hiring dropped by 22% in the first quarter of 2008 and by almost half in the second quarter (compared to the same period one year earlier). These hiring drops are also reflected in the decreasing number of new outsourcing centres opened by IT services firms (Everest Research, 2009).

Software

58. Major software firms maintained positive growth throughout 2008, but with a steep fall in growth rates from the second quarter. Declining business confidence in the current economic downturn is likely to continue to slow investments in long-term and high-valued software projects. The European Information Technology Observatory, for instance, expects the European software market to grow by 2.8% in 2009, compared to 5.4% in 2008, a downwards correction of its April 2008 forecast of 4.8% (EITO, 2008).

59. The top 10 software firms had a total annual revenue growth of 18% in 2008, much better than the total annual revenue of 6% achieved in 2001. During the first two quarters of 2008, they had high revenue growth rates with a peak in Q2 of 20%. However, in Q3 and Q4 there was a dramatic drop in their revenue growth to 12% and 3% year-on-year (*e.g.* Oracle: 24% in Q2, 18% in Q3, and 6% in Q4; SAP: 18% in Q2, 14% in Q3, and 8% in Q4). Some major software producers, however, were able to maintain high growth rates during the final quarter of 2008, *e.g.* Autodesk (18%) and Electronic Arts (10%).

Figure 10. Quarterly revenue growth (year on year), Top-10 “Software”



Note: Average growth refers to non-weighted average of firms' annual growth rates.

60. In terms of net cash, the top 10 software firms were in a better financial situation in 2008 than following the dot.com bust. In 2008, they had an aggregated net cash of USD 29 billion compared to USD 8 billion in 2001, with Microsoft alone adding USD 21 billion in 2008 and USD 5 billion in 2001. The uncertainty in the software market has however had an effect on employment in the top 10 software firms, where until now announcements of 10 000 job cuts (over 3% of their workforce) have been made. The number of announced job cuts is still increasing. For instance Microsoft announced cuts of 5 000 jobs (5.5% of total employees) over the next 18 months; SAP announced 3 000 job cuts for 2009 (almost 6%).

61. The top 10 software firms increased their R&D spending in FY 2008 by 14% to USD 18 billion compared to 2007, with Microsoft having the highest R&D budget (USD 8 billion) and Oracle the highest increase in R&D spending (25%). Quarterly year-on-year comparisons, however, reveals a decreasing growth rate in R&D expenditures, falling below zero for most of the top 10 firms in the final quarter. During the first two quarters of 2008, total R&D spending increased 19% year-on-year, but then fell dramatically to 3% in Q3 2008. In the final quarter of 2008, total R&D expenditure increased again to 7%, but mainly because Microsoft increasing its quarterly R&D spending to USD 2.3 billion in Q4 2008 compared to USD 1.9 billion in Q4 2007.

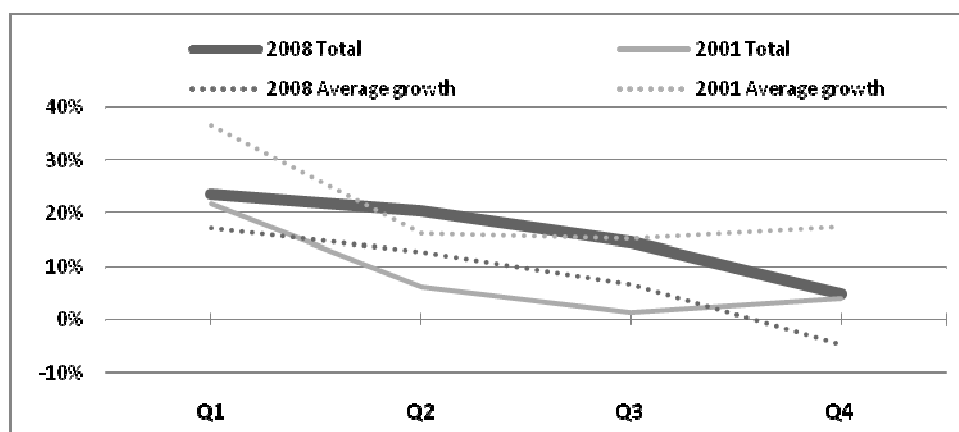
Internet

62. The current economic downturn has also had considerable impacts on major Internet firms as they witnessed a continuous decline in revenue growth rates throughout 2008. In total, however, companies were able to maintain positive growth rates and total annual revenue growth in 2008 was higher than in 2001 (19% compared with 8%).

63. The fate of top-10 Internet companies depends on factors different from other sectors: a mix of developments in consumer demand as online purchases continue to grow as share of total consumer purchases (Amazon, eBay, Expedia), online advertising spending (Google, AOL, Yahoo!, IAC), financial markets (E*Trade, TD Ameritrade), as well as growth in broadband subscriber numbers. Slower overall growth in some of these can benefit major Internet companies as consumers look for better deals online and advertisers focus on online advertising (see ZenithOptimedia, 2008). This is likely to benefit the most successful firms and encourage further consolidation, e.g. Amazon and/or eBay for online retail and merchandising, Google for online advertising, Apple for digital content. The iTunes Store, for example makes up 10% of Apple's revenues and revenues grew by 25% during the final quarter of 2008 (year on year), driven by downloads of music, films and iPhone applications.

64. Quarterly revenues in 2008 did not fall as rapidly as in 2001, but growth rates were similar at the start and end of both years (see Figure 11). In the first half of 2008, combined revenues of major Internet firms grew by over 20%, the highest growth rate in the ICT sector. However, quarterly revenue growth fell to 15% and 5% in the third and fourth quarter, respectively. Some of the firms experienced the steepest fall in the third quarter (e.g. E*Trade: -35%, Yahoo Japan: -1%), others in the final quarter of 2008 (e.g. TD Ameritrade Holding: -17%, Expedia: -7%). The combined growth of revenues during 2008 is considerably higher than the average growth because double-digit revenue growth at Google and Amazon, combined with their much higher total revenues, strongly influences the sector's total growth rate.

Figure 11. Quarterly revenue growth (year on year), Top-10 "Internet"



Note: Average growth refers to non-weighted average of firms' annual growth rates.

65. The Top-10 Internet firms are better placed financially than in 2001. In 2008, they had an aggregated net cash of over USD 3.5 billion compared to just over USD 2 billion in 2001. The 2008 data does not include Google, which was not yet public in 2001 – the company has almost USD 16 billion in net cash and is one of the cash-richest ICT firms in 2008.

66. The current economic downturn appears to have a greater impact on employment in Internet firms than, for instance, IT services. Top-10 Internet firms have already announced around 3 500 job cuts (*i.e.* over 2% of their total workforce). Yahoo! announced to cut around 1 500 jobs (over 8% of its employees), eBay announced 1 000 job cuts (over 6%).

67. Where available, annual R&D expenditures have shown to increase in 2008 compared to 2007 (*e.g.* Google: 32%, e-bay: 17%, and Expedia: 15%). However, quarterly R&D figures reveal that expenditures had falling growth rates. For example, in the first quarter of 2008, Google increased its R&D spending by 65% compared with 2007, in Q2 and Q3 R&D expenditures increased to 28%, and finally by 16% in the last quarter (also see eBay: 28%, 26%, 16% and 1%).

Part 3. ICT challenges and opportunities

68. Information and communication technologies (ICTs) have been a major source of innovation, growth, and employment. The ICT sector itself contributes a considerable share of business sector value-added (around 8% in 2006 for the OECD) and employment (5.5% of business sector employment in the OECD). The ICT sector is also highly R&D-intensive and a source of innovation. Furthermore, ICTs and the Internet are a fundamental economic infrastructure, driving productivity and innovation.

69. Given the central nature of ICTs in the economy the impact of the economic crisis on ICTs is two-fold, *i.e.* direct and more indirect impacts on the ICT sector itself but also, on the productive and innovative use of ICTs throughout the economy and society. The two impacts are related and mutually reinforcing. A slowing ICT sector will generate lower productivity increases and a lesser degree of innovation. A slower uptake in ICTs slows the productivity- and innovation-enhancing features of ICTs from diffusing throughout the economy. Network effects induced by a broadly installed ICT infrastructure do not materialise.

70. When assessing the economic crisis and its interactions with ICT production, diffusion and use, the special nature of ICTs has to be considered. Keeping these above interactions in mind the next sections will first deal with the direct and indirect impact on the ICT sector before shifting to impacts on the side of diffusion and the above-mentioned broader repercussions.

Impacts on the ICT sector

Short- to medium-term impacts

71. The economic crisis is having a direct impact on the ICT sector itself. Table 1 shows potential opportunities and challenges over the short and longer terms.

72. The first block looks at short- to medium-term impacts on the ICT sector. On the side of opportunities, it shows the factors that may benefit the ICT sector relative to other industries. In a period of economic contraction, the greater centrality of ICTs in business, government and society may make it harder to radically compress IT budgets, or at least any faster than the declines in economic activity. Moreover, ICTs are essential in times of restructuring, value chain reconfigurations and new regulations, potentially leading to increased demand for certain types of ICT services (*e.g.* software).

Table 1. ICT sector challenges and opportunities

	Opportunities	Challenges
Short- to medium-term	<p>Downturn leads to ICT sector restructuring and greater efficiencies</p> <p>Despite pressures to reduce capital investments, ICT budgets are harder to compress with greater reliance on ICTs and the Internet</p> <p>Restructuring and cost-cutting in other sectors leads to more use of ICTs (information management and productivity tools, CRM)</p> <p>ICT cost cutting measures could lead to more outsourcing of services (hosting etc.), software-as-a service, open source software, more sustainable energy efficient ICTs</p> <p>Public sector continues to invest in ICTs</p> <p>Emerging economies continue to invest in ICT infrastructure, albeit at slower speed</p> <p>Stimulus on ICT infrastructure and use from the OECD country economic stimulus packages</p>	<p>Declines in R&D and innovation activities</p> <p>ICT sector run-down in (currently) good net cash positions and employment shedding</p> <p>Decreasing access to capital (including venture capital) for the ICT sector, financial difficulties of ICT suppliers and SMEs / falling investments in the ICT sector</p> <p>Potential reduction in outsourced services</p> <p>Pressures on IT budgets in all sectors / regions leading firms to operate with current ICT infrastructure</p> <p>Fall in consumer ICT spending as confidence drops and unemployment rises</p> <p>Countries specialised in ICT manufacturing see operations rapidly reduced (China, E.Europe) with declines in ICT trade</p> <p>Fall in demand from emerging economies</p>
Longer-term	<p>ICT sector continues as a leading source of value-added, employment and innovations.</p> <p>New ICT R&D and innovation priorities as growth driver (IT, nano- and bio-tech)</p> <p>Continuing growth in digital content applications</p> <p>Low-carbon economy and green IT as growth drivers: remote working, sensors, smart grid / socio-economic challenges using ICTs as driver: climate change, energy efficiency, health & aging</p> <p>More interdependent value chains and enterprise network models will rely on ICTs.</p> <p>Consolidation and globalization of back-office and greater use of information management, e.g. to improve transparency of financial markets and public sector</p> <p>Greater spending on ICT security</p> <p>Longer-term stimulus on ICT infrastructure and use from economic stimulus packages</p>	<p>Dropping ICT R&D priorities and pre-recession innovation opportunities lowering future growth / weakening ICT innovation and value chain networks</p> <p>Prolonged ICT sector financing problems</p> <p>Slow or no development of ICT and digital content business models and products (e.g. advanced broadband services) to drive industry growth</p> <p>Resistance to change slows ICT innovation. Notably organisational change to benefit from ICTs.</p> <p>Slowdown in supply of ICT professionals and ICT skills</p> <p>Continued fall in ICT business / consumer spending</p> <p>Prolonged underinvestment in ICT infrastructure (supply and demand) lowering future growth</p> <p>Backlash to globalisation putting pressure on efficient globalised ICT value chains / permanent effects on production ability of low-cost production locations</p> <p>Slower ICT uptake and diffusion through economy and society slows growth of ICT sector</p>

73. On the side of challenges, the ICT sector is not isolated from the economic crisis. As shown in Parts 2 and 3, despite potential resilience ICT production and sales are falling under the twin impacts of pressures on business IT budgets and significant falls in business and consumer confidence and demand. The impacts are being felt most immediately by suppliers to the top ICT firms and low-cost production locations which have seen their activity plummet, for example in semiconductors. Although the ICT sector maintained R&D and innovation expenditures in the last cyclical down-turn and these only showed a lagged decline, decreased revenues, faltering growth and a lack of capital may influence longer-term capacities to invest in R&D, innovation and ICT-related human capital in this economic downturn.

Longer term impacts on the ICT sector

74. The second block looks at longer-term impacts on the ICT sector. On the side of opportunities, a range of factors will foster the central role of ICTs in our economy and society. In the business sector, it can be argued that enterprise models will continue to evolve around ICT-enabled networks and the rationalisation of production. Different forms of business and social innovations will add to the growth potential of the ICT sector. New trends such as the further dematerialisation of production, and the shift to a low carbon-economy will provide further boosts. Finally, solutions to ever-central socio-economic challenges in fields such as climate change, health and aging, and mobility will be ICT-based.

Figure 12. ICTs in the economy

	ICT industry and supply side	Non-ICT industry and demand-side
Measures fostering demand for ICTs	Supporting infrastructure investment, either in unserved or underserved areas or fostering next-generation networks	Upgrading ICT infrastructure in schools, public sector, healthcare, research, education, etc. Introducing “smart” and “green” ICT-related infrastructure (e.g. health IT, smart grid)
First-order effects	Immediate positive revenue impact for communication companies and equipment vendors and others involved in the deployment of infrastructure Preservation and creation of jobs for infrastructure deployment. Workers continue to spend money in other sectors	Creates demand for ICT industry products and services feeding into ICT sector revenues and employment Rise of new specialised hardware, service and consultancy providers (smart grid, health IT, etc.) Preservation & creation of ICT technical and related jobs in other sectors
Second- and third-order effects	Increase of business and consumer spending (including from newly connected areas and ICT sector wages) Preservation of revenues and jobs related to infrastructure Stimulus for ICT hardware demand Multifactor productivity growth in the ICT-producing sector Demand for broadband content & applications and creation/preservation of related jobs	Investment in ICT contributes to overall capital deepening and raises labour productivity Reorganisation of these sectors and productivity impacts (efficiency and MFP) New products and services (distance education, telework, online medicine, etc.) Demand for more infrastructure or servicing that infrastructure New skills
	New business opportunities and generation of new revenue flows through new products and services (e-commerce, healthcare, online education, knowledge-intensive professional services, digital content, entertainment,) ICTs enable other innovation at firm, sector and country levels ICT as productivity and growth driver	

75. The economic stimulus packages which OECD countries are launching may provide further growth and diffusion of ICTs. Most governments plan to foster growth through smart investments which have repercussions on the supply-side, helping to restore favourable conditions for innovation and long

term growth. In many cases these plans will be directly relevant to the ICT sector and technology diffusion. The way these ICT investments could feed into the economy and society also illustrates the broader interactions between the ICT supply and the use side. Figure 12 sketches out some of these interactions.

76. Potential longer-term down-side risks to the ICT sector are shown in Table 1. Some of these are a direct prolongation or outcome of short-term challenges. Depending on the overall business cycle and the evolution of the crisis, a continued fall in ICT spending and uptake and a prolonged period of underinvestment in the ICT infrastructure is a possibility. The inability of ICT sector to generate finance in the longer-term and potential underinvestments in R&D and innovation might also be felt or become more chronic. A neglect of key R&D priorities would also mean that the ICT sector will be less able to deliver solutions to societal challenges. A slowdown in the supply of ICT professionals and ICT skills could also have important long-term effects. Given the international nature of ICT production and sales, a backlash to globalisation and protectionism will also have a direct impact on ICT sector production.

Impacts on ICT diffusion and use

77. ICTs and the Internet are a fundamental economic infrastructure (OECD, 2008d). The benefits of ICTs are amplified by their use throughout the economy and society, and the innovations that they drive. ICT investments spur competitiveness and productivity at the firm and aggregate level, in particular when combined with investment in skills, organisational change (and industry restructuring), innovation and new firm creation (OECD, 2003, OECD *IT Outlooks*). Investment in ICT contributes to overall capital deepening helping to raise labour productivity. Technological progress in the production of ICTs may contribute to more rapid multifactor productivity growth in the ICT-producing sector. Finally and most importantly, greater use of ICT outside the ICT sector throughout the economy helps firms, public and social institutions to increase efficiency and enhance innovation, develop new products and services and raise multifactor productivity growth. The Internet is an increasingly important platform for much of this creativity and innovation.¹²

78. Figure 12 provides a snapshot of the interactions between the ICT supply and demand side, by highlighting how certain policy measures promoting the ICT infrastructure or the ICT demand side 'ripple' through the economy and foster growth, employment and innovation.

79. As partly laid out in Table 1 a fall in sales and shipments from the ICT sector is the mirror of falling demand and declining ICT uptake by businesses, the public sector and households. At a minimum new investments and upgrades of the existing ICT infrastructure are delayed. The result could be a slowdown in ICT diffusion and uptake (potentially to firms and sectors which had been special policy targets) and slowdowns in the development of ICT skills, potentially leading to longer-term skill mismatches and shortages. ICT uptake and use still have an important role to play if countries are to return to the productivity growth path of the late 1990s and early 2000s and the crisis will probably slow this return. In this case expected productivity-enhancing impacts and ICT-enabled innovations will be less frequent and overall ICT-induced job and growth will remain below potential.

80. Finally, lack of ICT infrastructure and broader ICT uptake throughout the economy in areas of smart applications in e.g. transport, development of energy-efficient buildings, and the health sector will have long-term negative consequences and slow the ability to address key social challenges.

¹² Chairman's summary, Ministerial on the Future of the Internet Economy, Seoul, June 2008, www.oecd.org/dataoecd/53/49/40989438.pdf.

ICT policy and the economic crisis

81. This section focuses on potential implications for ICT policy. The questions are whether and how ICT policies might need to be adjusted or reinforced in the economic crisis and whether current economic stimulus packages designed to foster short-term demand and provide foundations for long-term sustainable growth coherently address ICT policy goals. The section first sets out OECD ICT policy themes and approaches in practice before the crisis and asks questions about their new directions. Then it discusses how economic stimulus packages and associated policies are directly or indirectly relevant to ICT policies.

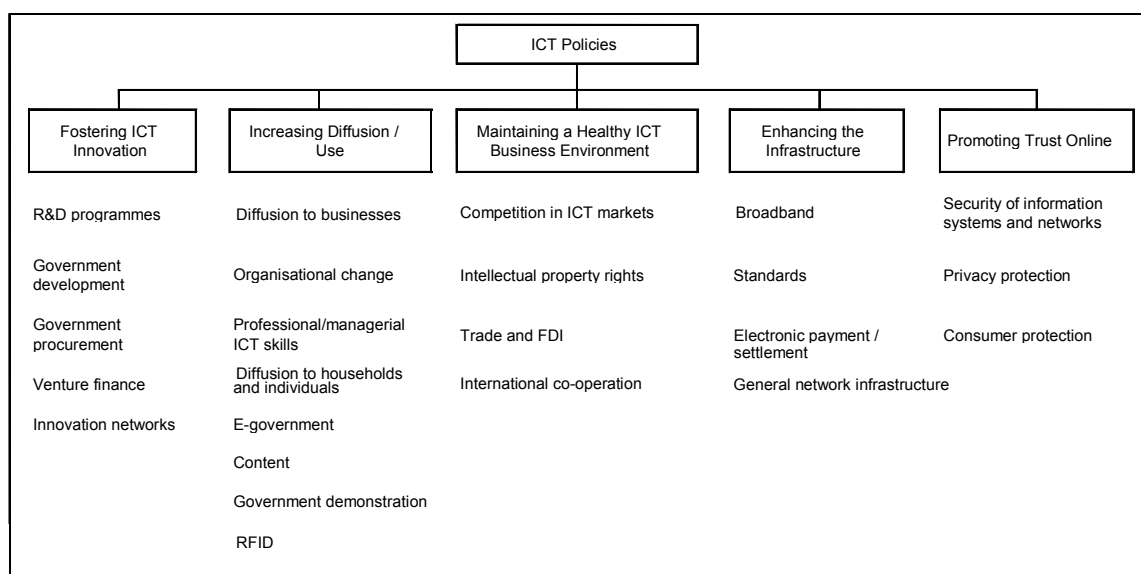
The 'pre-crisis OECD ICT policy framework

82. ICT policies have been increasingly integrated into overall strategies for enhancing economic growth, employment and welfare in OECD countries (OECD *Information Technology Outlook 2008*, Chapter 7). They have shifted in the last decade from dealing with sector-specific infrastructure issues towards long-term strategies on how ICTs, the Internet and other types of networks can enable information societies to achieve wider socio-economic objectives. E-government activities are a part of strategies to boost public-sector efficiencies, and ICTs are increasingly used to address wider socio-economic issues at national level (e.g. social cohesion, ageing societies, national security) and globally (e.g. climate change, energy efficiency, global health issues).

83. Figure 13 shows ICT policies that OECD countries are pursuing, ranging from "Fostering ICT innovation" to "Promoting trust online". Table 2 lists the top ten ICT policy priorities in OECD countries summarised in the *OECD Information Technology Outlook 2008*. At the top of the ranking are government online activities and policies to promote broadband uptake and use. Specific policies to foster innovation in the top ten are ICT R&D programmes and ICT innovation support. Policies to promote IT education and to encourage industry-based/on-the-job IT training also feature prominently.

84. Most of these policy measures can be looked at in the context of the economic crisis and their current relevance or the need for adjustment/reinforcement. An economic downturn will, for example, create pressures for government-supported build-out of the infrastructure (due to lack of finance or hesitance of telecommunication companies to invest), for ICT innovation (e.g. R&D expenditures, venture finance, support for small firms), for the diffusion of ICTs to businesses, etc. In times of a crisis, trust online or the security of ICT networks might decrease. Taking a more macro-economic view, trade and foreign direct investments flows are down and protectionism may increase.

85. ICT policy can be affected in two ways. With pressures on government budgets attention might shift away from current ICT policy approaches. On the other hand, expansionary fiscal policies and the desire to craft new 'anti-crisis' stimulus packages may provide additional resources and political will may potentially lead governments to reinforce or modify existing ICT policies.

Figure 13. ICT policy framework

Source: OECD Information Technology Outlook, various issues.

Table 2. Top ten ICT policy priorities, 2008

1	Government online, government as model users
2	Broadband
3	ICT R&D programmes
4	Promoting IT education
5	Technology diffusion to businesses
6	Technology diffusion to individuals and households
7	Industry-based and on-the-job training
8	General digital content development
9	Public sector information and content
10	ICT innovation support

Source: Information Technology Outlook 2008.

86. OECD governments have been continually updating their ICT policies, for example with the announcement of new self-standing broadband strategies (*e.g.* Australian Broadband Plan, Ireland national broadband scheme, Korean broadband plan¹³) or new ICT policies (France numérique 2012, Spain Avanza, United Kingdom Digital Britain). Beyond broadband, themes include the improved use of wireless spectrum, new UMTS licenses, mobile and digital TV, developing digital content services and advanced broadband uses (*e.g.* telework, distance education, e-government and health applications). The United Kingdom's Digital Britain plan aims to upgrade and modernise digital networks, create an investment climate for digital content, applications and services, foster universal availability coupled with the skills and digital literacy, and enable the widespread online delivery of public services and business interface with Government. Spain's Plan Avanza 2 is designed to contribute to the economic recovery through the widespread and intensive use of ICTs (with a focus on the future Internet and digital content). Korea has re-launched its New Growth Engines Initiative focused on new ICT goods, ICT services and software.

¹³ Korea has initiated plans to bring 1 GB/s broadband connections to homes by 2012.

87. Some OECD governments have identified ICTs as an important direct or indirect component of economic stimulus plans. This is based on the rationale that ICTs are a fundamental economic infrastructure and a precondition for competitiveness. The idea is that the availability of ICT infrastructure and applications throughout the economy and society induce large benefits through their productivity- and innovation-enhancing features (see above). Figure 12 sets out some of the direct and indirect impacts of ICT-specific and ICT-related economic stimulus measures including potentially more far-reaching impacts of adoption and use throughout the economy.

ICTs in economic stimulus packages

88. Governments in OECD and major non-OECD countries are setting up economic stimulus packages to address the economic crisis.¹⁴ The aim of these packages is to stimulate demand in the short-term, i.e. re-financing banks, injecting cash into the economy and protecting existing jobs. However, most governments also plan to foster growth through smart investments which have repercussions on the supply-side, helping to restore favourable conditions for innovation and long term growth. In most cases these plans are directly relevant to the ICT sector and technology diffusion, and many include ICT-related elements which should prove a positive stimulus to the ICT sector.

Measures aimed at the ICT infrastructure

89. Many of the stimulus packages recognise the importance of modern fixed and wireless communication infrastructure as necessary to support innovative products and services and the need to devote some public resources to improve or accelerate deployment.

90. References to communications infrastructure in stimulus plans cover two key areas: extending broadband to areas without connectivity and upgrading existing networks to support very-high speed communications (OECD, 2009a). Many plans focus on closing the broadband gap by providing universal broadband coverage throughout the country. These investments will be largely devoted to rural and remote areas. Depending on the country concerned, plans also devote resources to building out new, very-high-speed networks (next-generation networks). In most cases, the exact meaning of ‘broadband’ and ‘unserved or underserved’ are not yet defined in terms of geography, speeds or technology. Some plans make explicit reference to the fostering of wireless services or fibre deployment.

91. In all cases, the deployment of broadband is to ensure more widespread connectivity and lay the foundation for broadband content and applications. Details of some of these initiatives are in OECD, 2009a, and a separate paper examines the justification of investment in communication infrastructures and argues for principles which should guide any government investment (OECD, 2009b). Most plans do or will entail non-budgetary, regulatory measures to sustain policy targets (e.g. facilitating the roll-out of fibre) largely pursuing policy targets and regulation analysed in previous work on broadband development (see OECD, 2008a and OECD Council Recommendation on Broadband Development). Governments are also planning to foster convergence and drive demand for the ICT infrastructure and services. As part of their stimulus packages, the US, Korea and Japan for example, are using regulatory measures to foster the transition to digital broadcasting.

¹⁴ The OECD Secretariat is collecting information on current and planned policy packages, looking at the packages’ broader objectives, specific measures, and their design. To date, 20 OECD member countries have provided information (see OECD, 2009a). Within “Measures relating to innovation and long term growth”, OECD countries are focusing on: (i) Improving the infrastructure, (ii) Support for R&D and innovation, (iii) Investment in human capital, education/training, (iv) Green technologies and innovation to foster energy-efficiency and sustainable economic growth, and (v) Support for innovation and entrepreneurship.

Other targets involving ICTs

92. Besides direct investment in broadband, stimulus packages often have a more indirect but larger impact on ICT deployment and use, for example investment in "intelligent" transport systems, greener cars with more electronics and embedded software, smart buildings and grids, health, the environment, and modernizing public services (OECD, 2009a). Planned investments in these areas are much bigger in monetary terms than those for broadband (*e.g.* in the US, USD 19 billion for health care ICTs and USD 100 billion for modern infrastructure, compared with USD 7 billion for broadband).

93. The fostering of ICT infrastructure and services in for example health care or research networks will also provide the technological basis for ICT innovation, new infrastructure and services in other fields, and there are for example synergies between broadband deployment and smart electrical grids and transport systems. Most new infrastructure investments in areas such as modernising schools, health care, and transport systems will have an impact on deployment of ICTs and fostering ICT applications, and projects in the fields of education, R&D and green technologies also feature ICT components.

94. A list of areas with specific ICT examples includes:

- Modernising research institutions and facilities (including advanced ICT research networks). Some of the proposed public R&D expenditures will positively impact ICT research where this critically depends on public research. This also particularly applies to R&D support aimed at green technologies.
- Modernising educational and training institutions (including ICT infrastructure and hardware, software and digital content applications).
- Modernising public services (including e-government).
- Modernising the healthcare sector..
- Modernising the transport infrastructure (intelligent transport systems)
- Modernising and developing the energy infrastructure (*e.g.* smart electrical grids, Box 2).

95. For example, in the healthcare sector the United States has a major computerisation initiative aimed at reducing healthcare costs (*e.g.*, digitisation of health records of every American over the next 5 years) and foster health IT systems. Canada plans to invest CAD 500 million to develop greater use of electronic health records.

Box 2. Developing energy-efficient smart grids

The United States stimulus package gives priority to the development of a “smart grid”. The stimulus bill is allocating funds for “smart” technologies, including smart meters and a total of about USD 11 billion for the smart electricity grid. The central idea behind modernizing the power grid’s infrastructure is to use two-way communication, sensors, and advanced IT to create an intelligent and connected power grid, optimizing and reducing electrical energy consumption. The smart grid will enable the use of new technologies including plug-in hybrid electric vehicles, distributed generation, and energy storage applications.

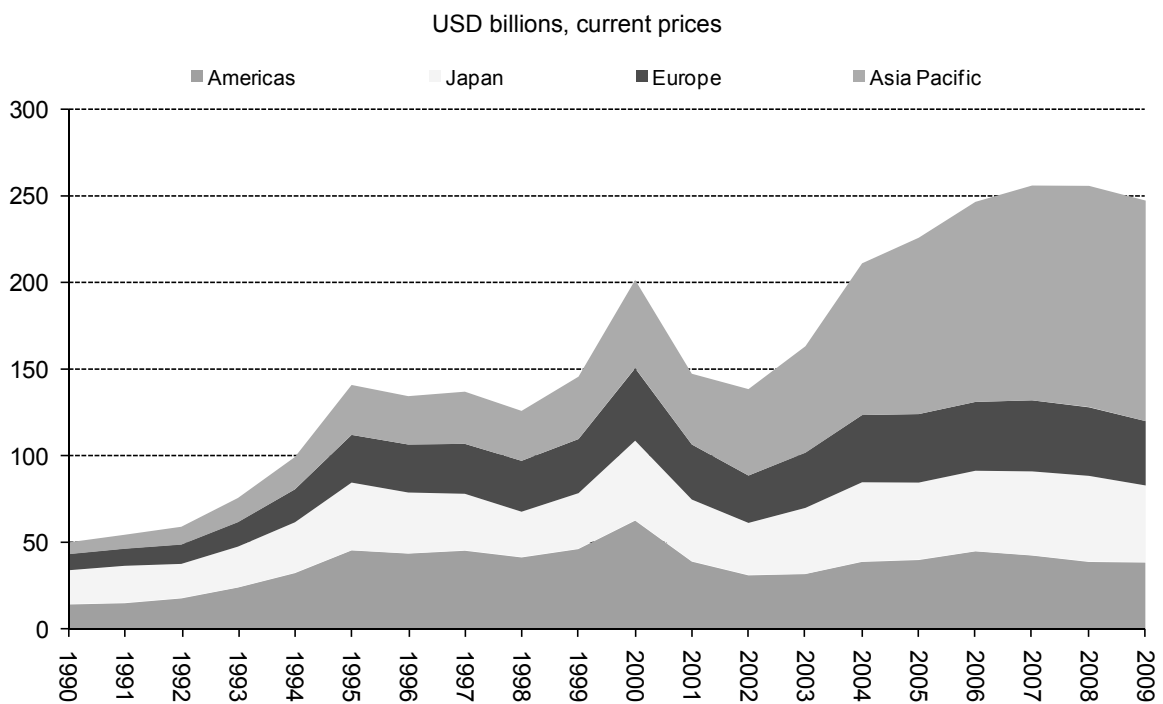
96. The major objective to develop energy-efficient and green infrastructure investments will also have major ICT dimensions, *e.g.* more energy-efficient smart homes, smart transport systems and the smart grid. Korea, for instance, has “Green IT” as specific component of its stimulus plan. Spain will also foster the widespread intensive use of ICTs, in particular for projects leading to sustainability and energy-saving. Hungary and Japan will promote the use of teleworking. Second order effects include the developments enabled by that same infrastructure, *i.e.* new products, services, business opportunities and productivity-enhancing features resulting from the availability of ICT infrastructure.

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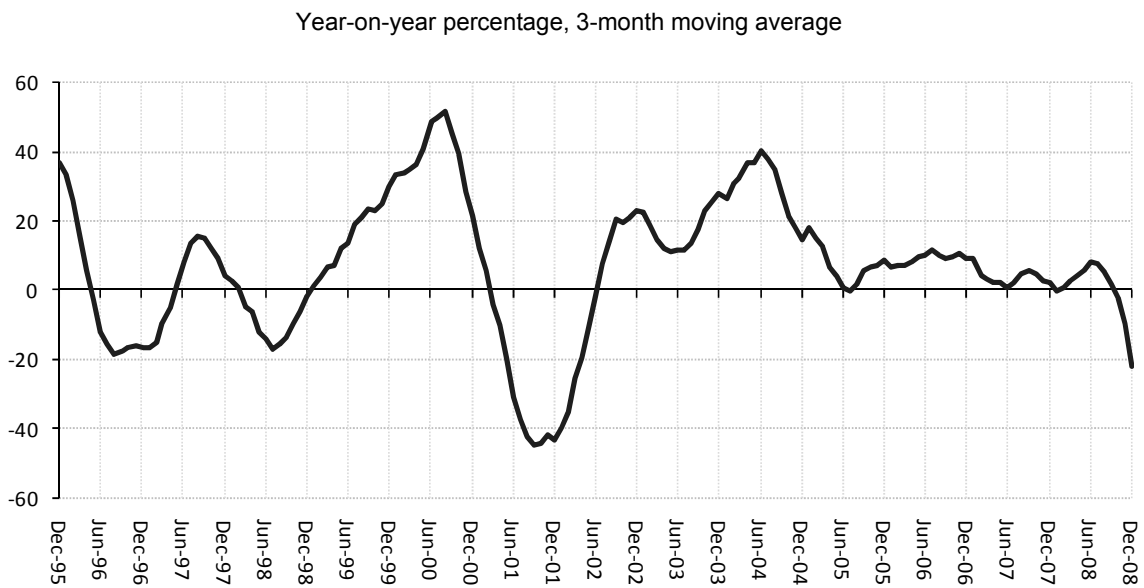
ANNEX FIGURES

Figure 14. Worldwide semiconductor market by region, 1990-2009



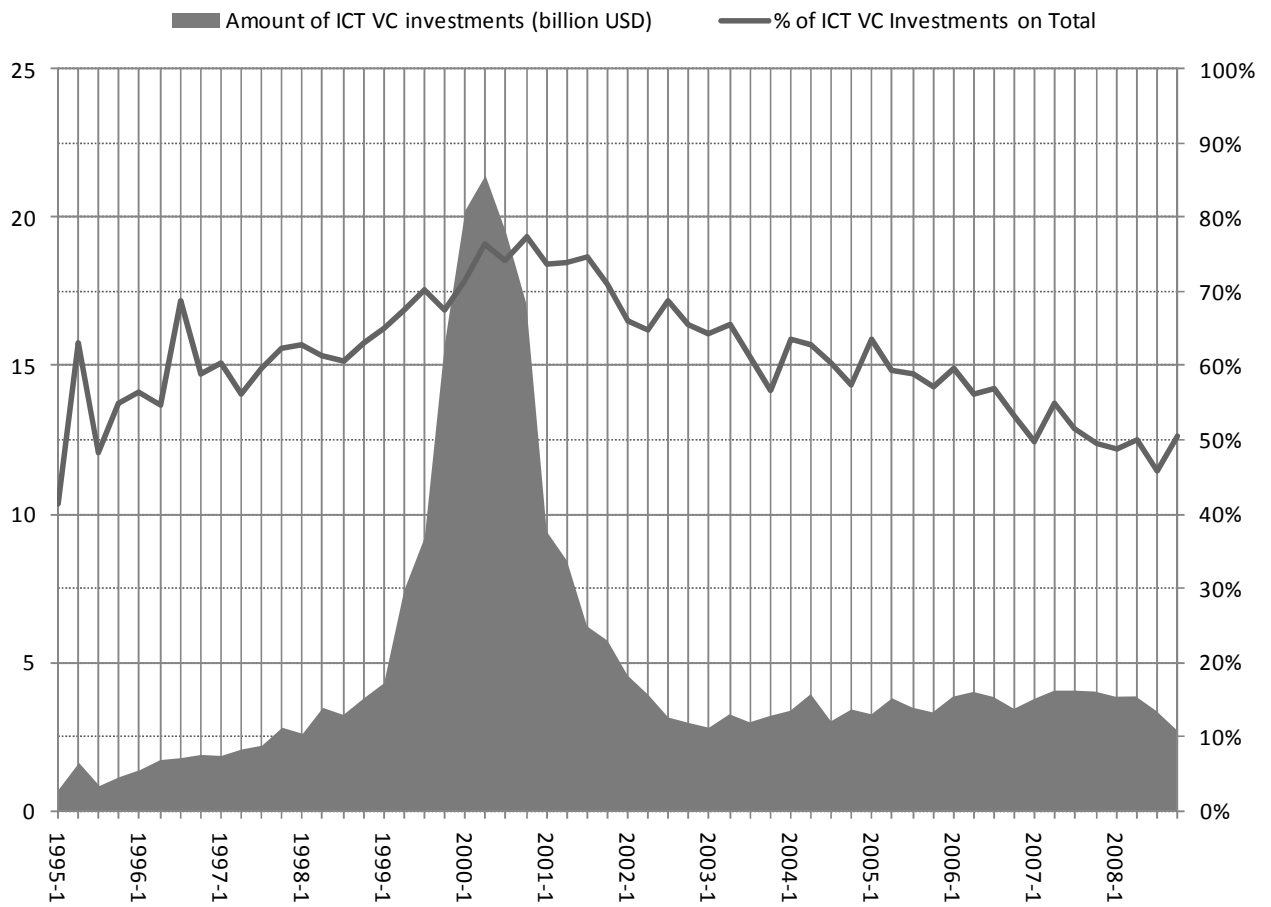
Source: Semiconductor Industry Association, February 2009; OECD estimates.

Figure 15. Growth in the monthly semiconductors worldwide market billings, December 1995 – December 2008



Source: World Semiconductor Trade Statistics (WSTS), February 2009.

Figure 16. Quarterly venture capital investments in the ICT sector in the United States, Q1 1995 - Q4 2008



Source: MoneyTree survey report, PricewaterhouseCoopers, January 2009.

CANADA

Figure 17. Growth in the real output (GDP), Q1 2003 – Q3 2008

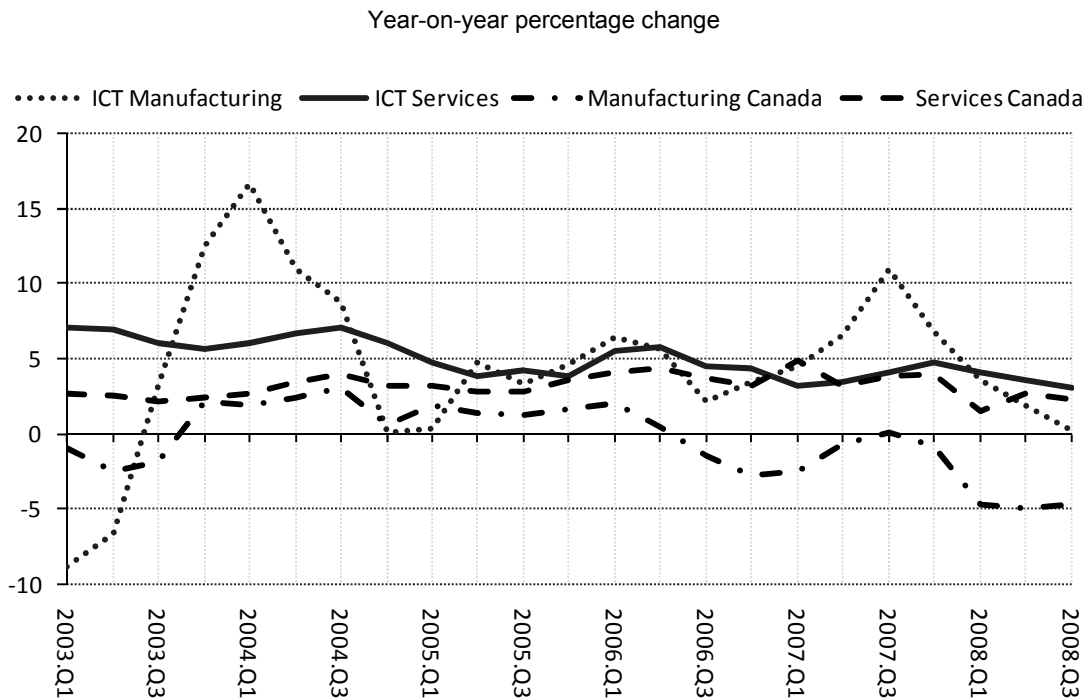
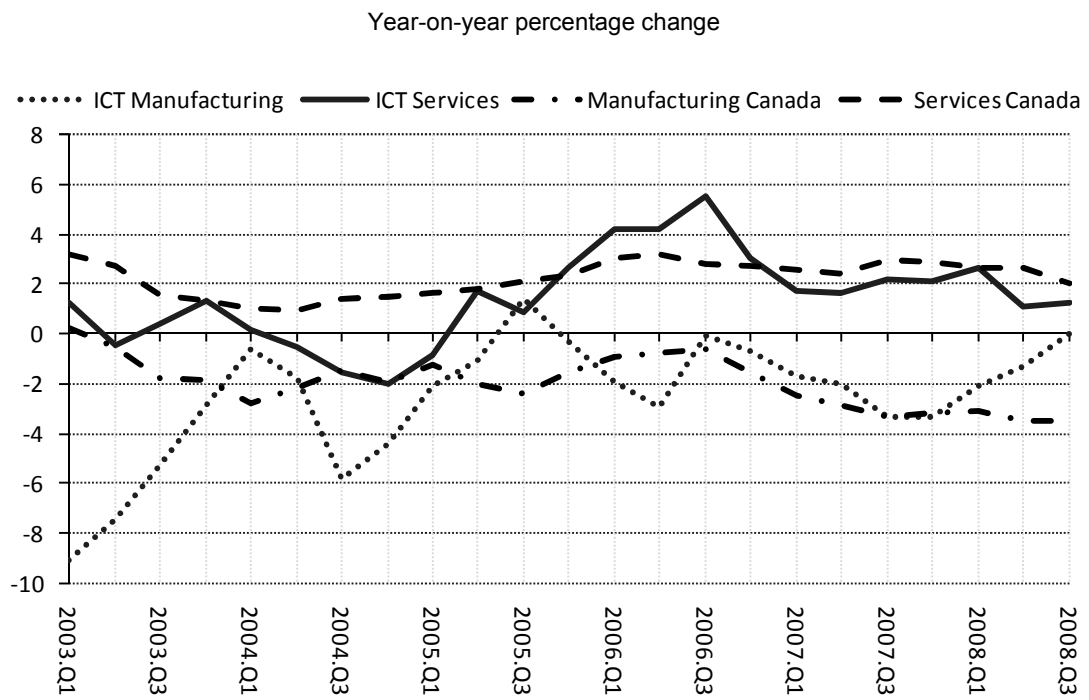


Figure 18. Growth in employment, Q1 2003 – Q3 2008

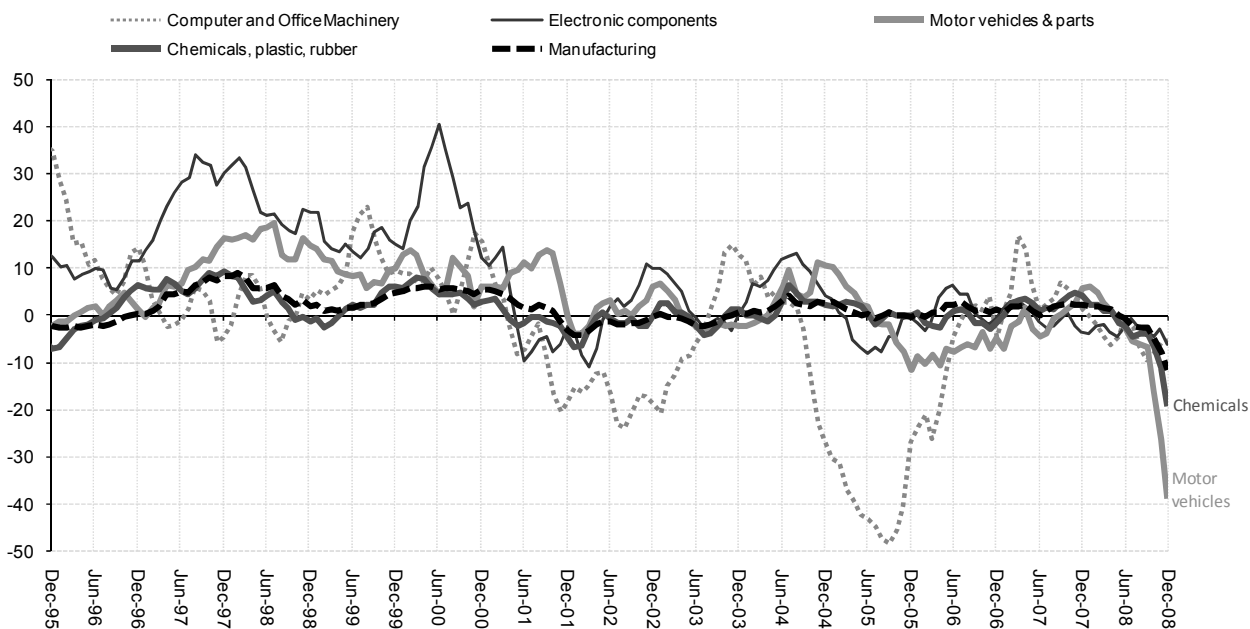
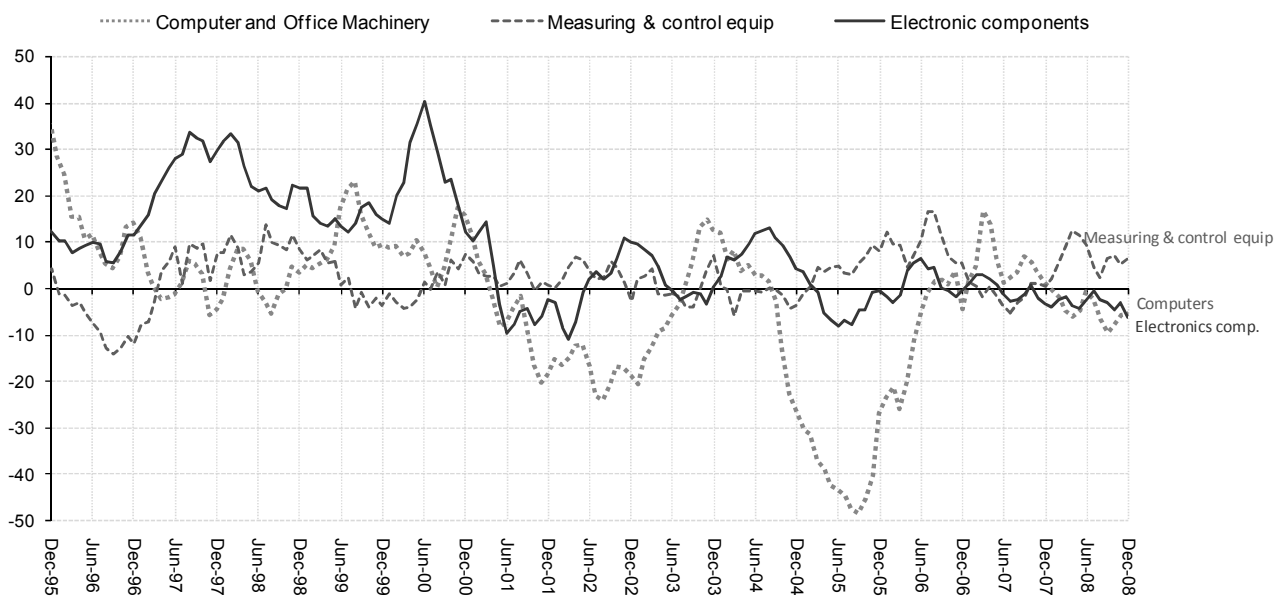


Source: Industry Canada, Quarterly Monitor of the Canadian ICT Sector, Third Quarter 2008, January 2009.

FRANCE

Figure 19. Growth in monthly production in ICT and selected sectors, December 1995 – December 2008

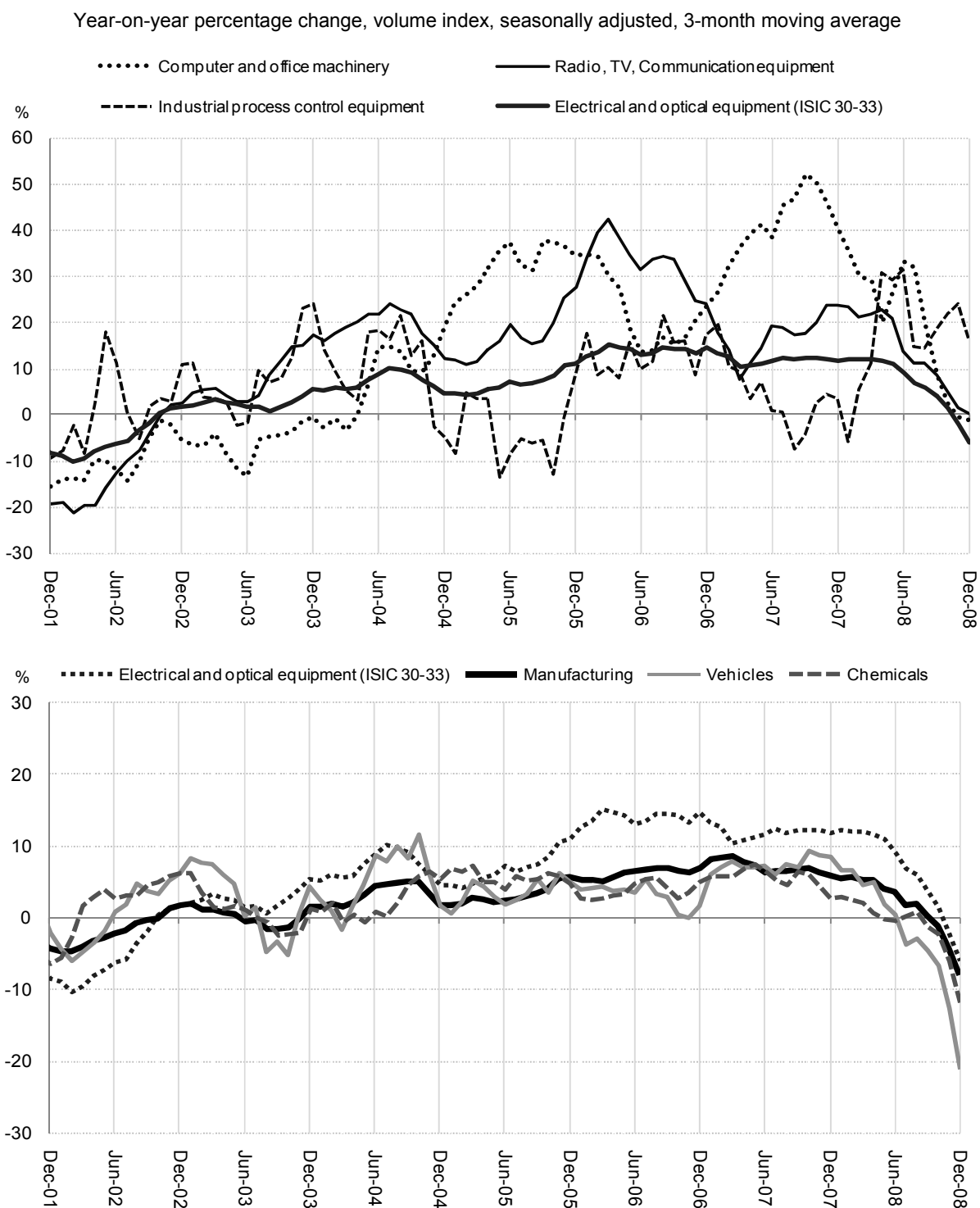
Year on year percentage change, monthly volume index, seasonally adjusted, 3-month moving average



Source: INSEE, Indice et séries statistiques, February 2009.

GERMANY

Figure 20. Growth in monthly production in ICT and selected sectors, December 2001 – December 2008

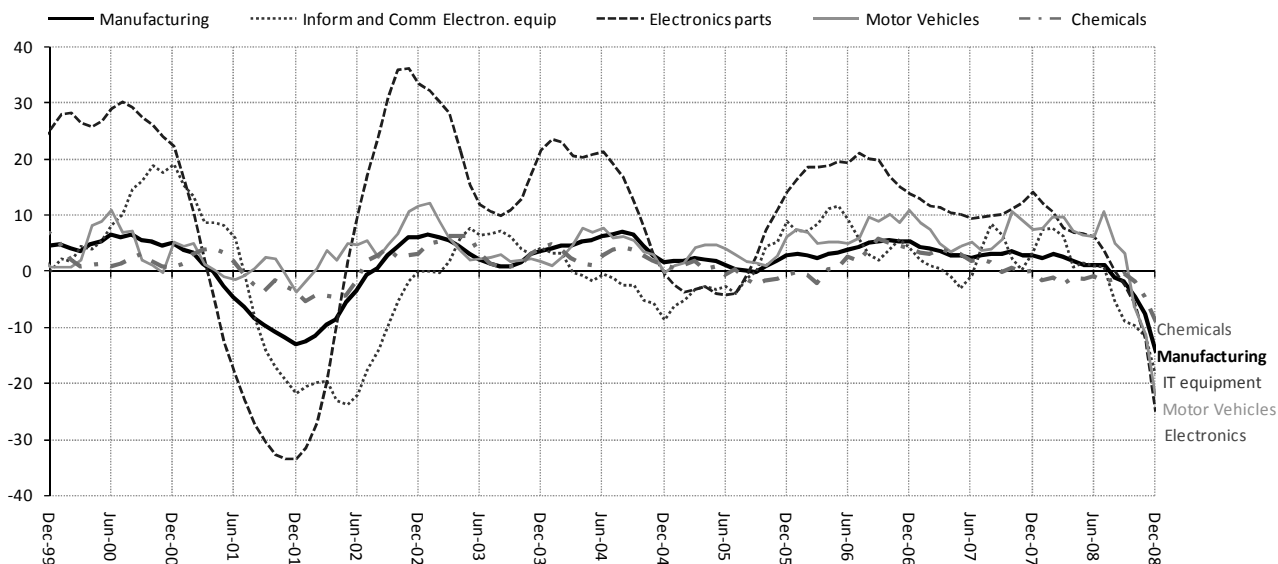


Source: Statistisches Bundesamt, Produktionsindex, February 2009.

JAPAN

Figure 21. Growth in monthly production in ICT and selected sectors, December 1999 – December 2008

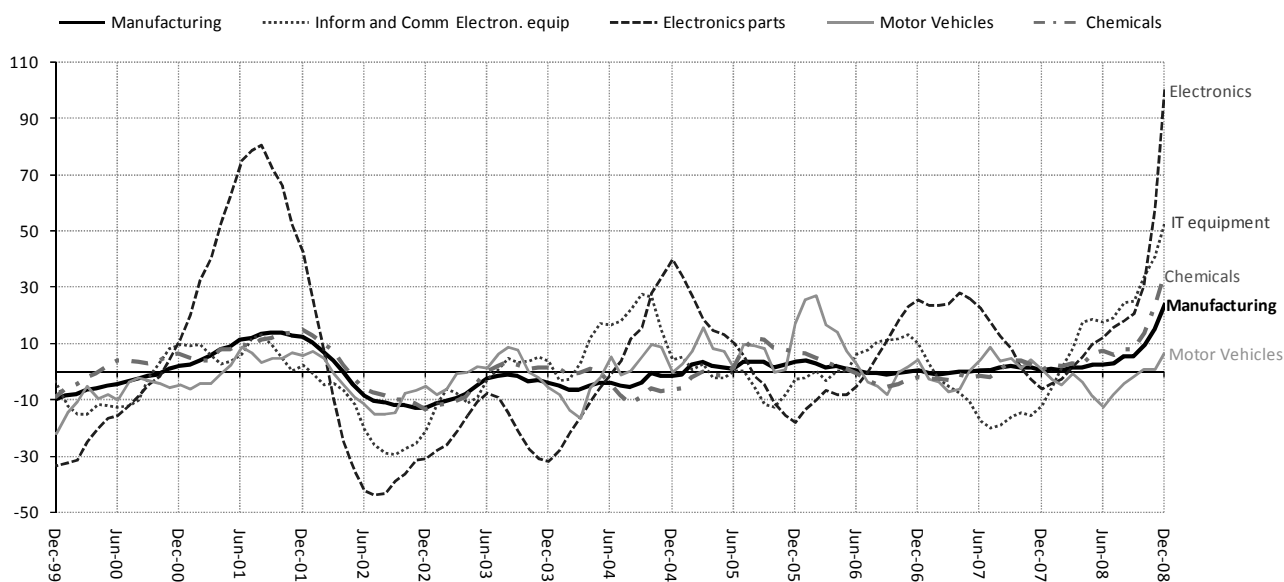
Year-on-year percentage change, volume index, seasonally adjusted, 3-month moving average



Source: Japanese Ministry of Economy, Trade and Industry, February 2009.

Figure 22. Growth in monthly inventories in ICT selected sectors, December 1999 – December 2008

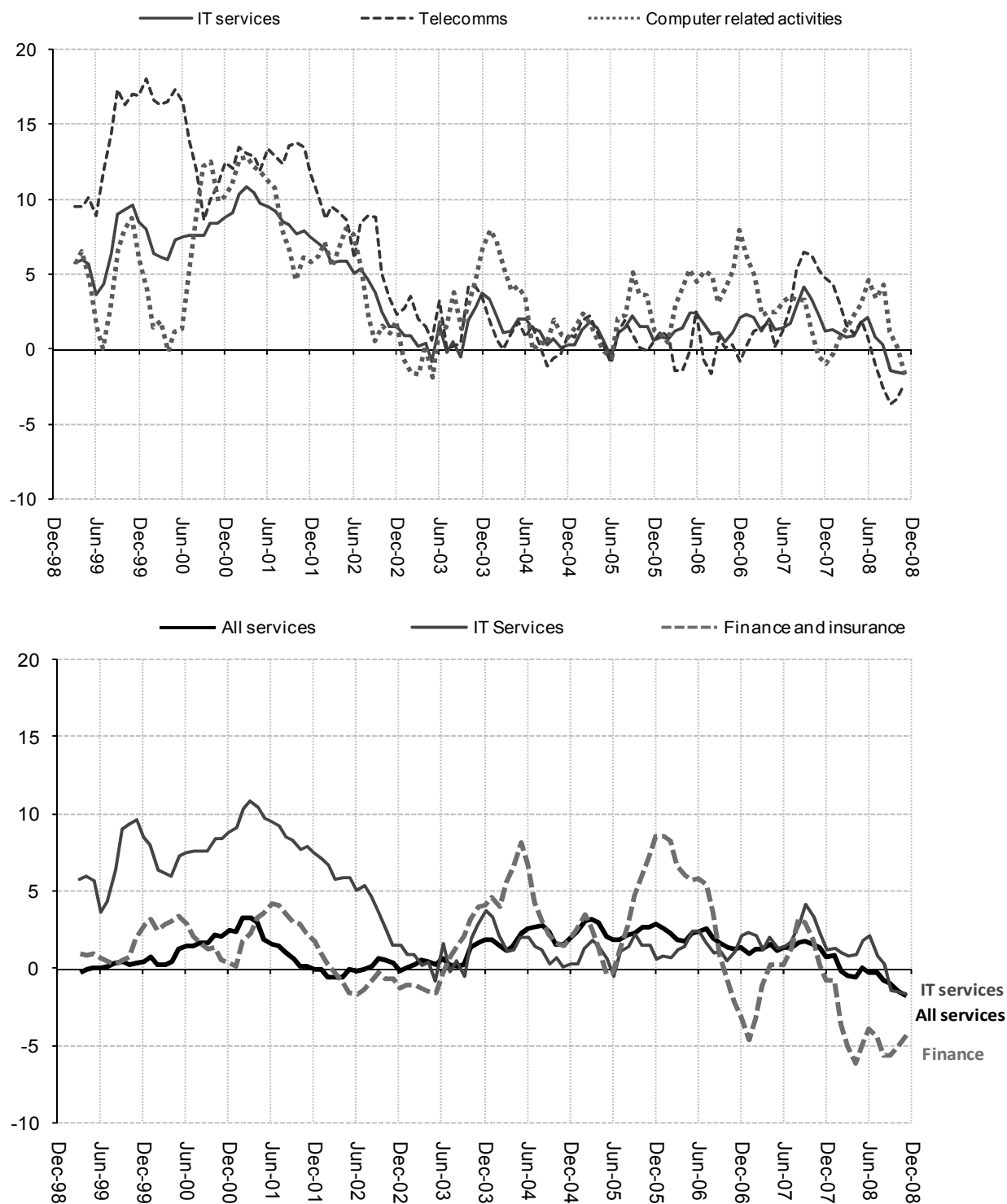
Year-on-year percentage change, producer inventory ratio index, seasonally adjusted, 3-month moving average



Source: Japanese Ministry of Economy, Trade and Industry, February 2009.

Figure 23. Growth in monthly industrial activity in ICT and selected service sectors, December 2001 – November 2008

Year-on-year percentage change, production indices, seasonally adjusted, 3-month moving average

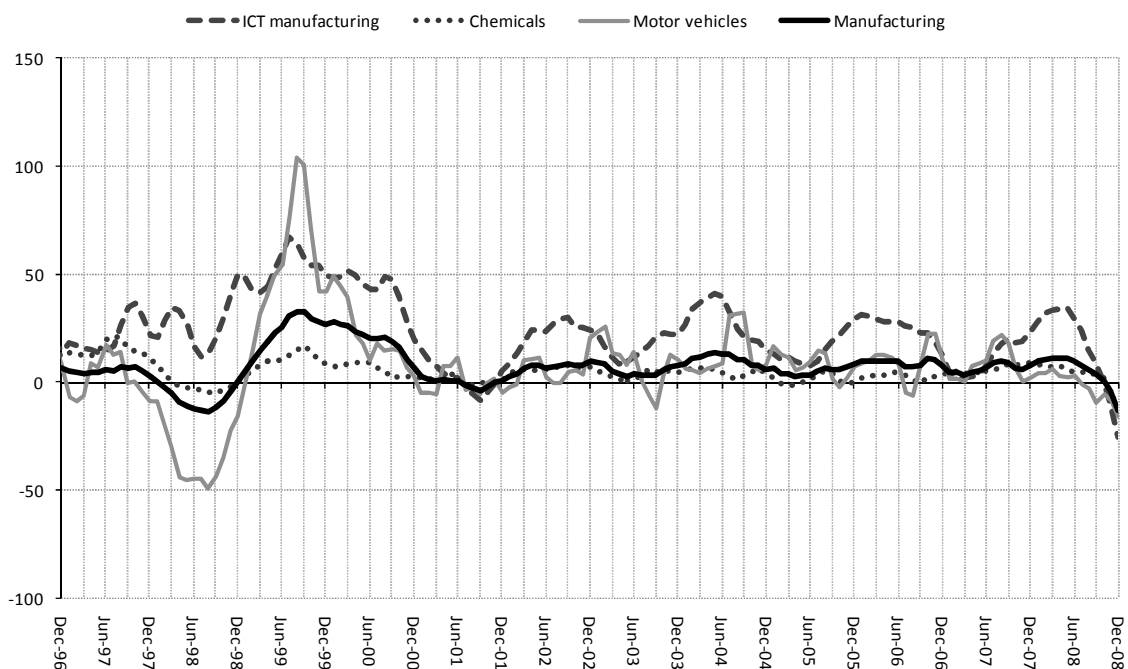


Note: See www.stat.go.jp/english/index/official/208.htm for details about the indices.
Source: Japanese Ministry of Economy, Trade and Industry, February 2009.

KOREA

Figure 24. Growth in monthly production in ICT and selected sectors, December 1996 - December 2008

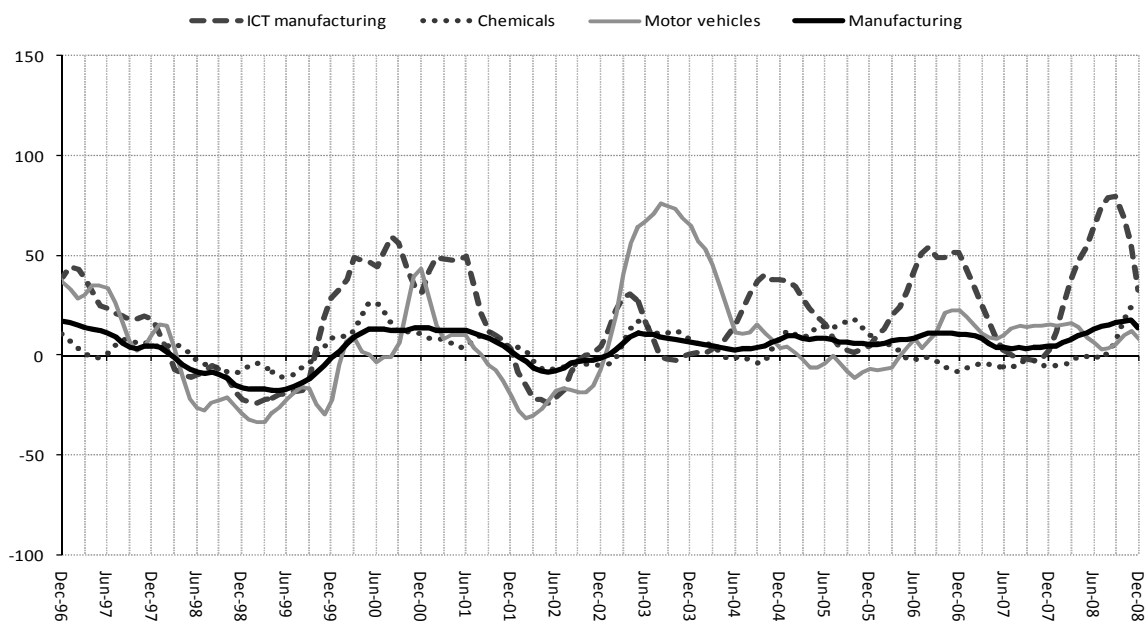
Year-on-year percentage change, monthly volume index, seasonally adjusted, 3-month moving average



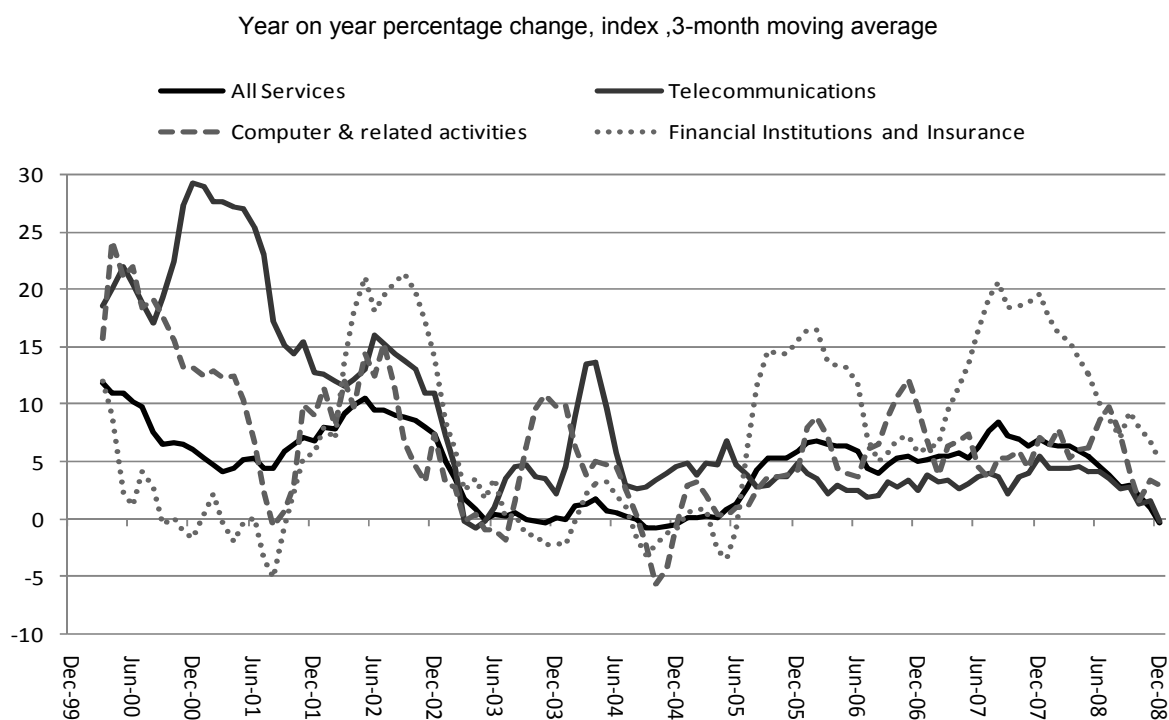
Source: Korea National Statistics Office, February 2009.

Figure 25. Growth in monthly inventories in ICT and selected sectors, December 1996 - December 2008

Year-on-year percentage change, monthly volume index, seasonally adjusted, 3-month moving average

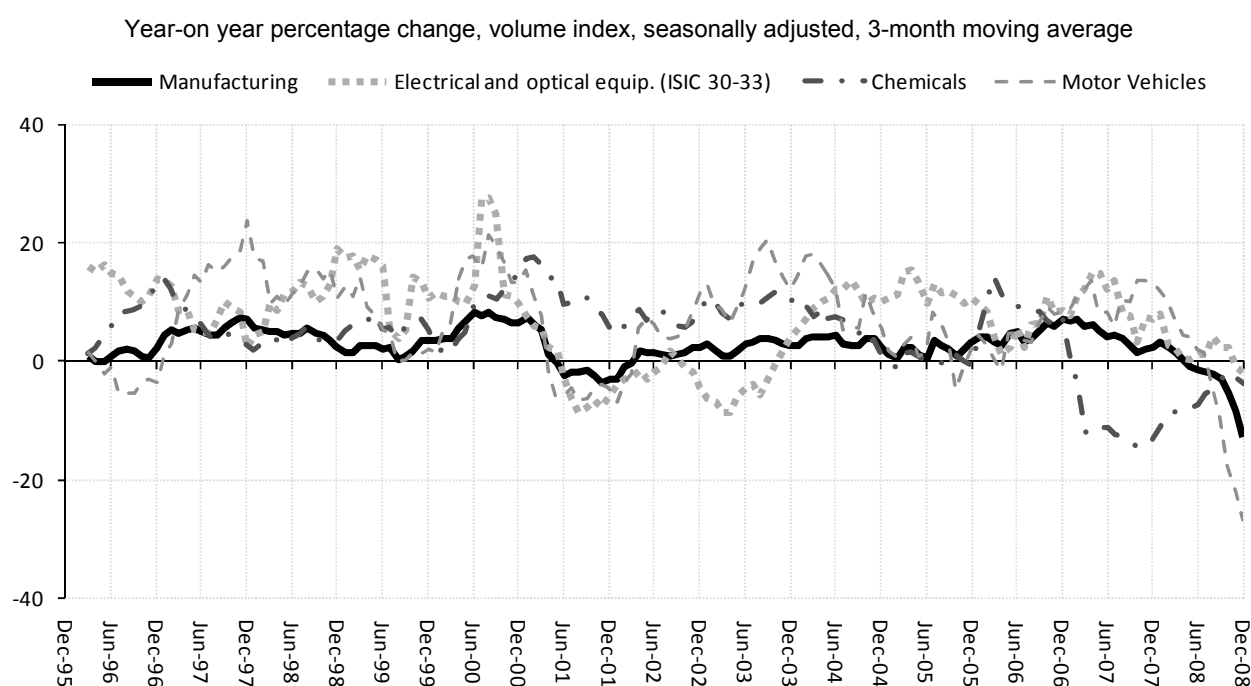


Source: Korea National Statistics Office, February 2009.

Figure 26. Growth in monthly activity of ICT services, December 1999 - December 2008

Source: Korea National Statistics Office, February 2009.

SWEDEN

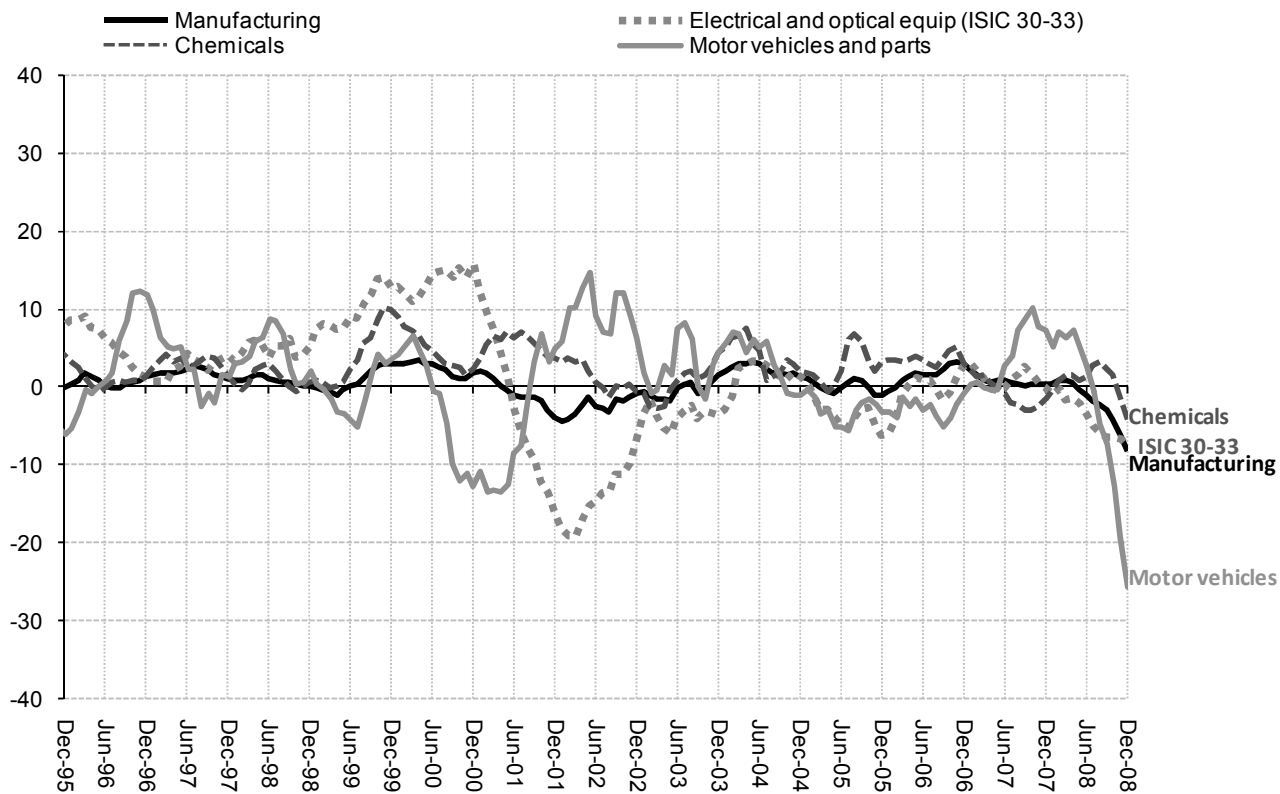
Figure 27. Growth in monthly production in selected ICT sectors, December 1995 – December 2008

Source: Statistics Sweden, February 2009.

UNITED KINGDOM

Figure 28. Growth in monthly production in ICT and selected sectors, December 1995 – December 2008

Year-on year percentage change, volume index, seasonally adjusted, 3-month moving average

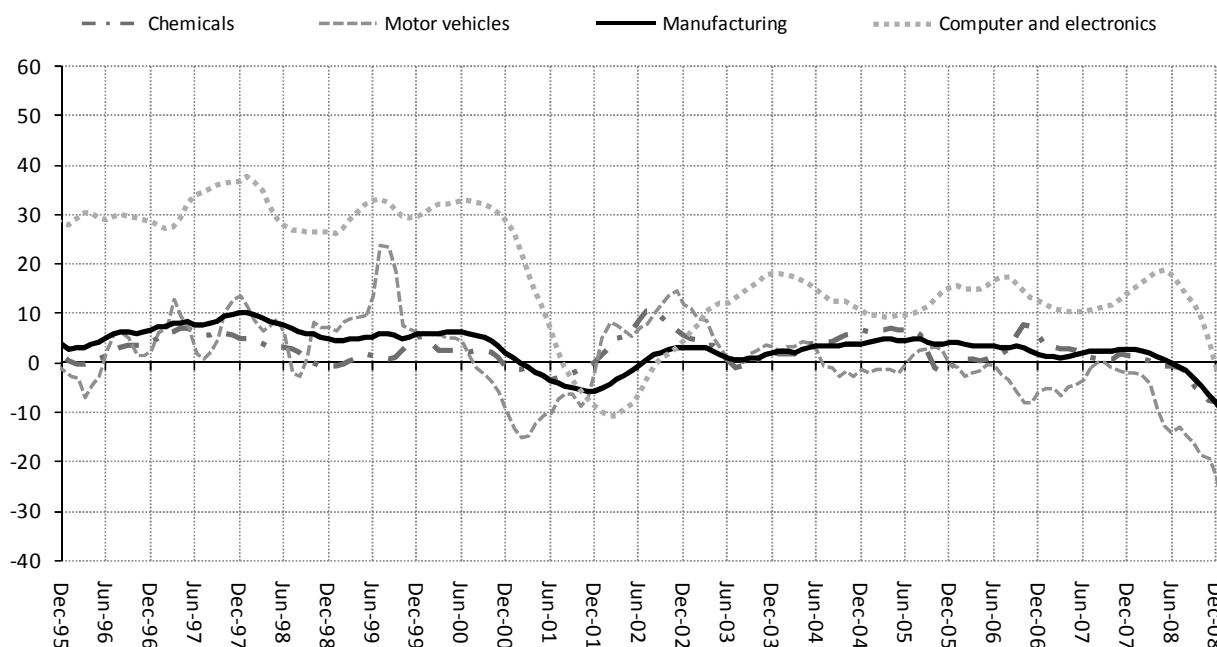


Source: National Statistics Office, February 2009.

UNITED STATES

Figure 29. Growth in monthly production in ICT and selected sectors, December 1995 – January 2009

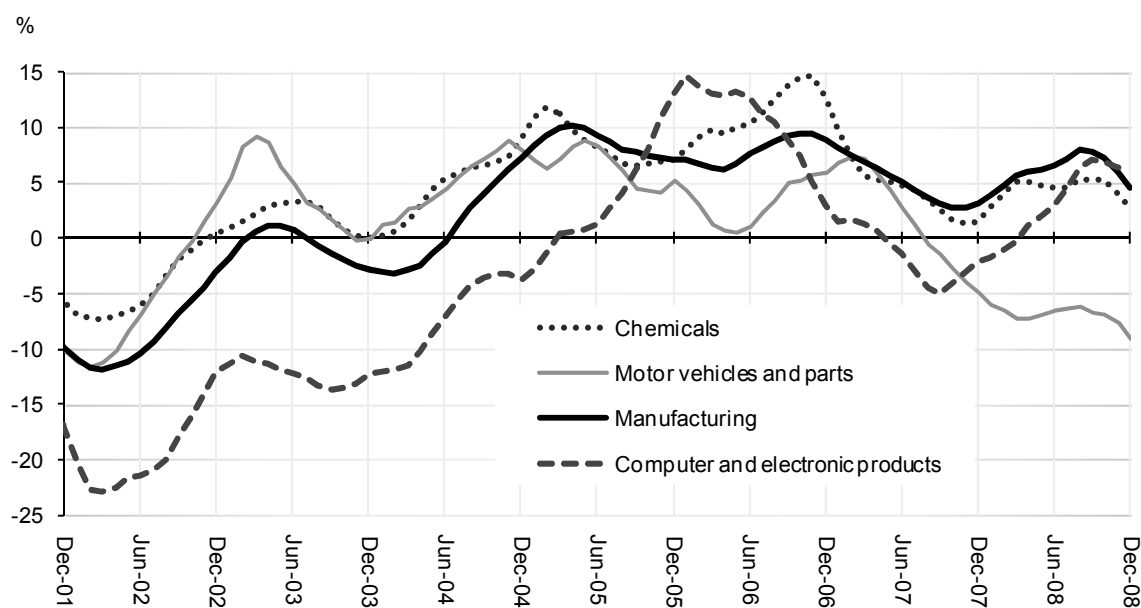
Year-on-year percentage change, index, seasonally adjusted, 3-month moving average



Source: The Federal Reserve Board, February 2009.

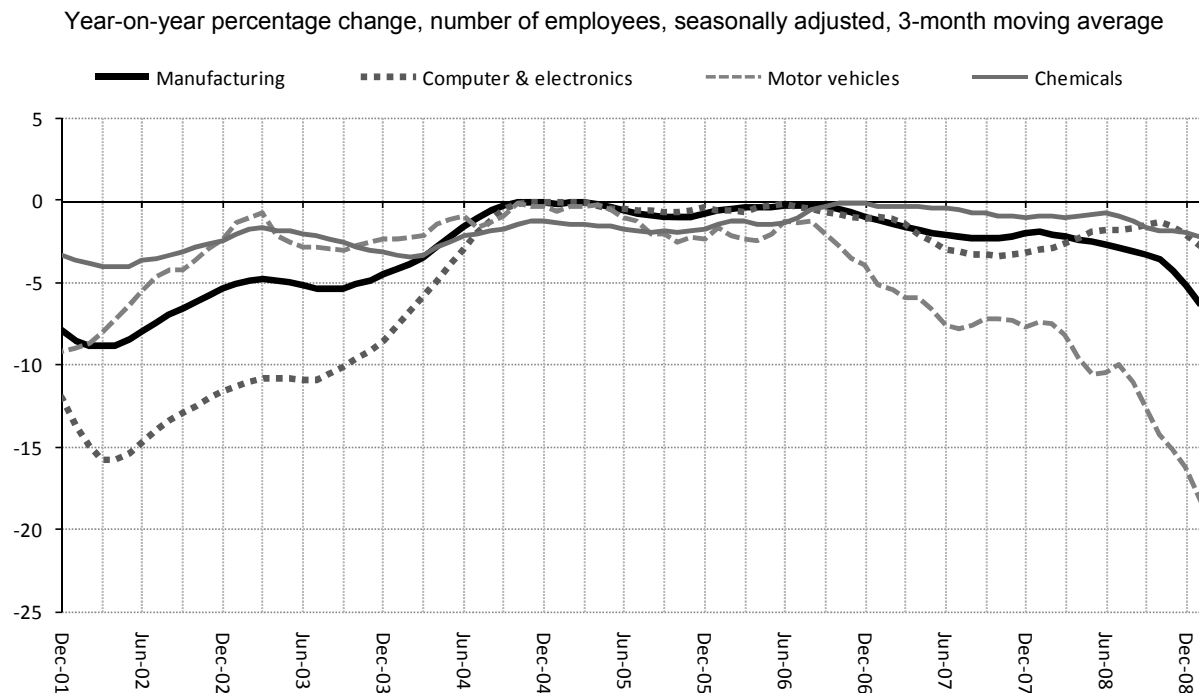
Figure 30. Growth in monthly inventories in ICT and selected sectors, December 2001 – December 2008

Year-on-year percentage change, current cost or pre-LIFO, seasonally adjusted, 3-month moving average



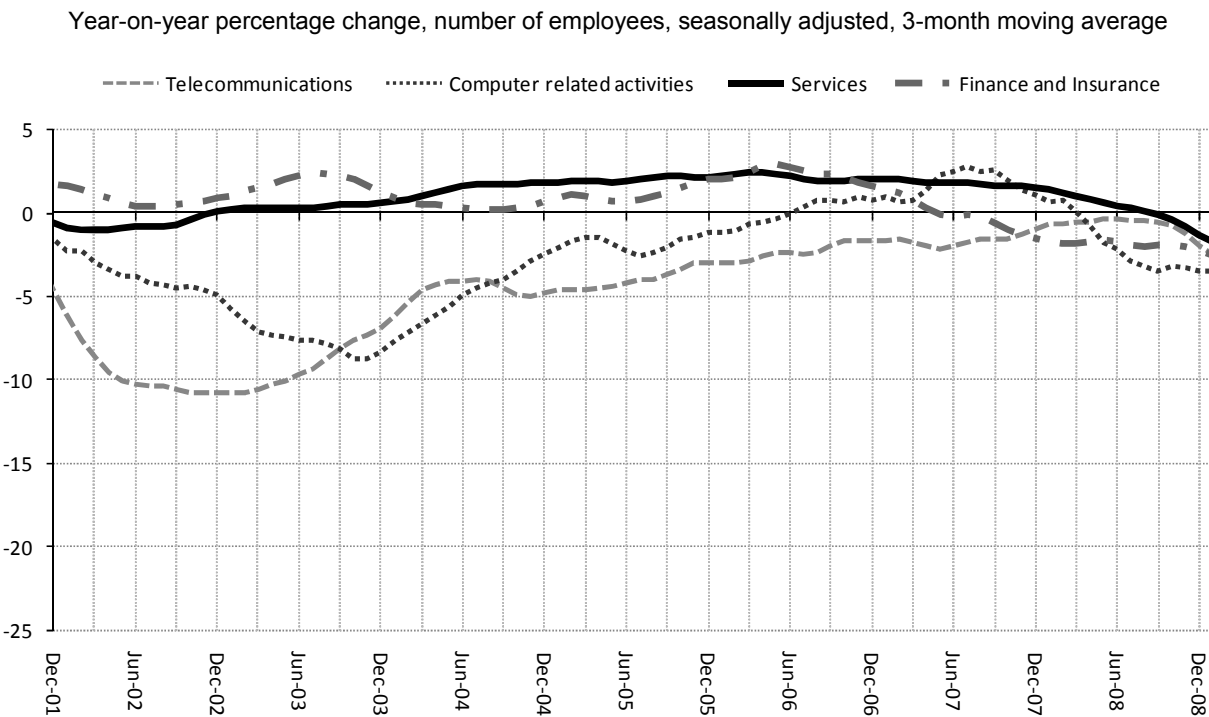
Source: OECD, based on US Bureau of the Census, Manufacturer's Shipments, Inventories and Orders (M3) survey, February 2009.

Figure 31. Growth in monthly employment in ICT and selected sectors, December 2001 – January 2009



Source: U.S. Labour Bureau Statistics, February 2009.

Figure 32. Growth in monthly employment in ICT and selected services, December 2001 – January 2009



Source: U.S. Labour Bureau Statistics, February 2009.