

Please cite this paper as:

Okamoto, Y. (2009-01-12), "The Influence of Market Developments and Policies on Telecommunication Investment", *OECD Digital Economy Papers*, No. 151, OECD Publishing, Paris.
<http://dx.doi.org/10.1787/222517643310>



OECD Digital Economy Papers No. 151

The Influence of Market Developments and Policies on Telecommunication Investment

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Unclassified

DSTI/ICCP/CISP(2007)6/FINAL



Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

English - Or. English

**DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY
COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY**

Cancels & replaces the same document of 12 January 2009

Working Party on Communication Infrastructures and Services Policy

**THE INFLUENCE OF MARKET DEVELOPMENTS AND POLICIES ON TELECOMMUNICATION
INVESTMENT**

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FOREWORD

This paper was presented to the Working Party on Communication Infrastructures and Services Policy in December 2007. The working Party agreed to recommend the declassification of the document to the ICCP Committee. The ICCP Committee agreed to declassify the document through a written procedure in March 2008.

The paper was prepared by Mr. Yoshikazu Okamoto.

MAIN POINTS

This paper assembles some evidence on developments in investment by incumbent and alternative telecommunications operators during the period 2000-2005. The quality of data on investment is not in general sufficient to clearly differentiate between investment by new entrants and investment by incumbents. Definitional problems also exist in that the players in communication markets are no longer the traditional alternative operators providing voice services, but a range of service providers including Internet Service Providers and cable television service providers who, through cable modems, provide VoIP services and broadband access. As such it is much harder to make judgements about how policy impacts on investment. Although the period 2000-2005 coincides with the development of broadband in most OECD countries and the implementation of LLU, the paper does not try to show a correlation between investment and unbundling policies.

Part of the period coincides with the so called “dot-com bubble” during which a large number of telecommunication operators speculated in Internet related activities over a period ranging roughly from 1998 to 2000. Any examination of the relationship between policies and investment needs to factor in the impact of the “dot-com bubble”, including companies’ acquisition of bankrupt carriers preceding it: although there is sufficient data since the “dot-com bubble” burst 7 years ago. Some studies which tried to correlate policies and investment have tended to ignore the impact of the “dot-com bubble” on investment.

Data on investment by new entrants is also important in order to determine to what extent service competition leads to facilities competition, and therefore results in further investment in networks. Arguments, mainly in Europe, about the ‘ladder of investment’ imply that new entrants will eventually shift their business models away from service competition, developed mainly on the basis of local loop unbundling policies, relying increasingly on self-provided networks. However, regulators in many cases do not obtain sufficient data in order, particularly from new entrants, to monitor sufficiently the extent that their policies may impact on investment.

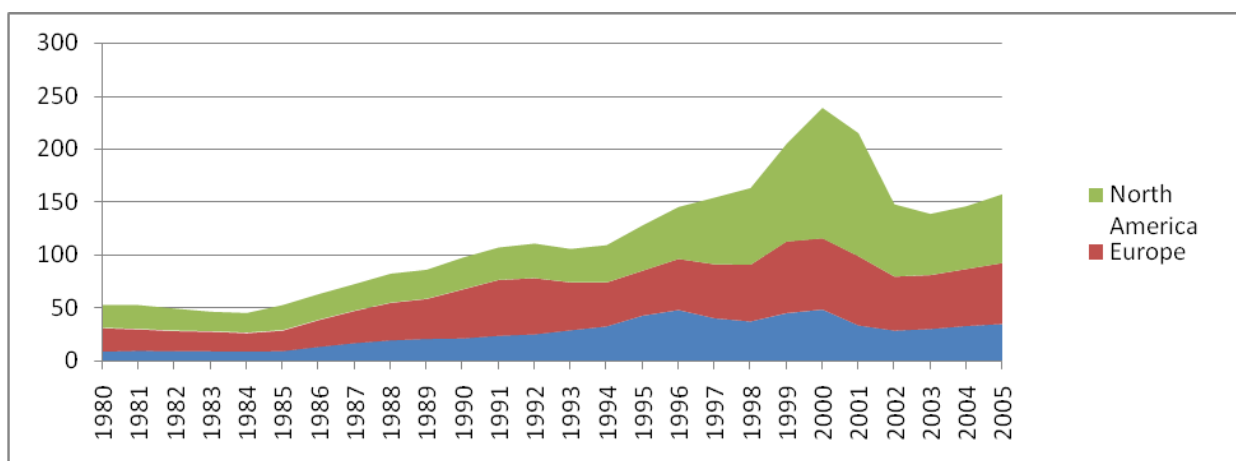
THE INFLUENCE OF MARKET DEVELOPMENTS AND POLICIES ON TELECOMMUNICATION INVESTMENT

1. Trends in telecommunication investment

This paper aims to gather evidence on developments in investment in the telecommunication sector by incumbent operators and new entrants in order to clarify developments in investment during the period 2000-2005. OECD data on telecommunication investment (provided for example in the *Communications Outlooks* and in the *Telecommunication Database*) has not differentiated investment according to whether companies were incumbents or new entrants. Indeed, few regulators (or statistical agencies) differentiate between sources of investment. The OECD investment data includes all investment by fixed and mobile operators and is obtained from member countries through an annual questionnaire.

One of the most interesting features of the latest OECD data collection on telecommunications was the return of growth in telecommunication investment. Indeed 2004 showed an increase in total OECD investment in telecommunications since the “dot-com bubble” burst in 2000. Since 1980 when the OECD began collecting data on telecommunication investment, growth (in current USD) has shown, for the OECD as a whole, a steady trend from USD 52 billion in 1980, reaching a peak of USD 238.8 billion in 2000 during the height of the “dot-com bubble”. The latest data (for 2005) indicate overall OECD telecommunication investment at USD 157 billions (Figure 1), an increase from the trough of 2003-2004 following the bursting of the “dot-com bubble”.

Figure 1. Trend in telecommunication investment (current USD billions)

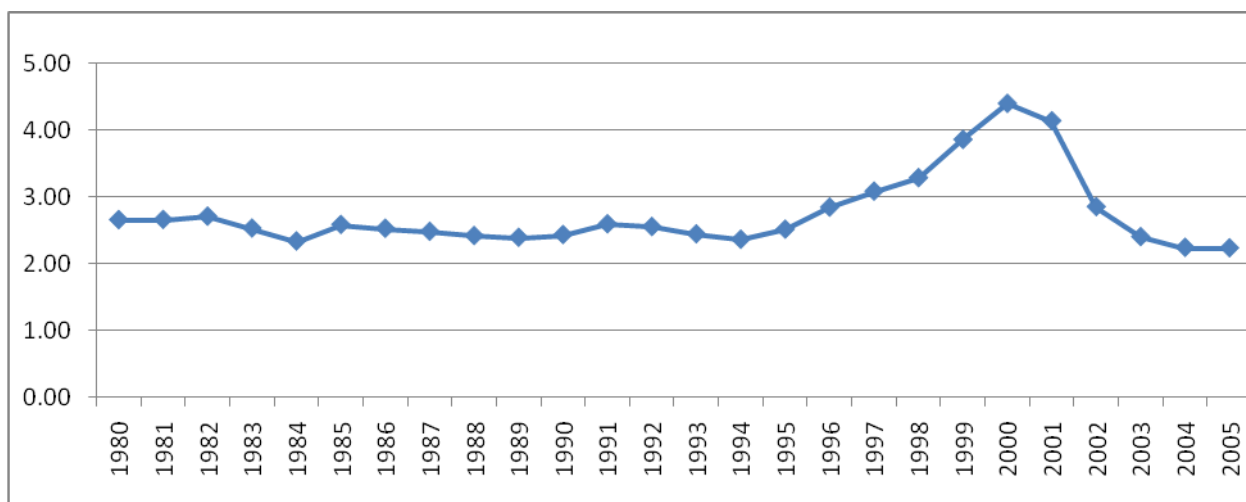


Note: Czech Republic, Poland and Slovak Republic are not included.

The ratio of telecommunication investment to overall OECD gross fixed capital formation (GFCF) has been remarkably stable from 1980 to 1995 at 2.5% (Figure 2) so that, in general, telecommunication investment in the OECD countries grew at the same pace as total investment. The period 1995 to 2000 saw a significant rise in investment as a result of liberalisation, the fact that many incumbents began to digitalise their networks, and the significant investment in mobile cellular networks as these were

developed to replace analogue mobile networks and were extended to provide close to 100% of geographic coverage. The rapid increase in telecommunication investment led to the ratio of telecommunication investment to GFCF reaching a peak of 4.4% in 2000. As Figure 2 shows the recent recuperation of telecommunication investment is resulting in telecommunication investment attaining its historical trend rate of around 2.5% as a ratio of GFCF. The development of the “dot-com bubble” during this period also accounted for the rapid increase in investment.

Figure 2. Ratio of telecommunication investment on GFCF (percentage)



Note: Czech Republic, Poland and Slovak Republic are not included.

On a geographical basis, North America has been leading the OECD in telecommunication investment since 1995 in terms of total volume (current prices) (Figure 1), reaching a 54% share in 2001. But, North America (mainly the United States) also saw the most drastic reduction in investment in this sector with total investment declining from USD 123 billion in 2000 to USD 58 billion in 2003. In comparison in the OECD European countries, the reduction went from USD 67 billion in 1999 to USD 50.6 billion in 2003. On a *per capita* basis (Table 1) country performance varied considerably.

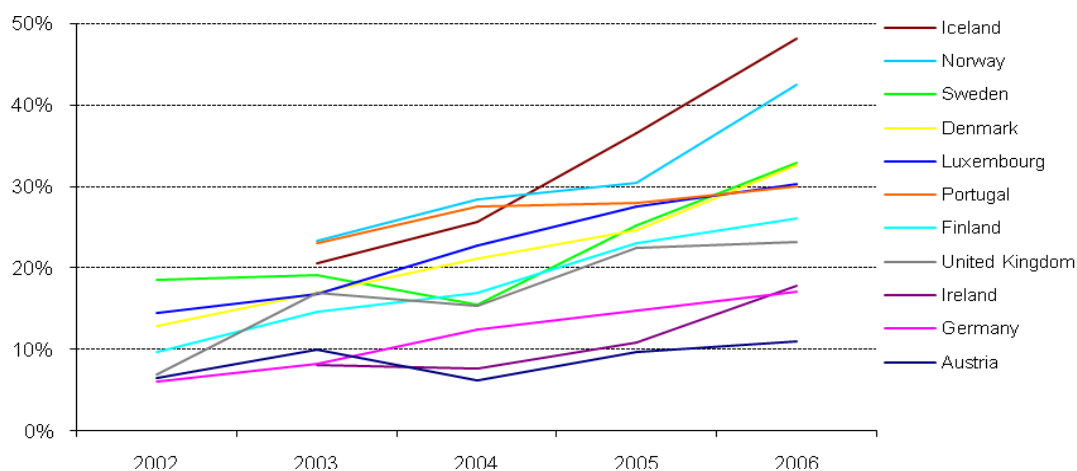
Table 1. Public Telecommunication per capita (USD)

	1999	2000	2001	2002	2003	2004	2005	Average 2003-2005
Australia	217.74	199.38	170.69	134.11	208.52	205.80	216.85	210.39
Austria	250.48	326.91	201.44	111.91	50.66	53.28	61.82	55.25
Belgium	72.93	92.93	57.52	72.98	85.83	96.58	113.34	98.58
Canada	128.41	161.07	165.63	132.41	97.47	132.52	140.65	123.55
Czech Republic	83.08	45.89	58.62	44.63	124.16	50.15	52.61	75.64
Denmark	185.22	209.01	247.16	180.40	157.85	176.80	209.88	181.51
Finland	110.76	121.48	126.73	91.24	94.51	97.80	144.57	112.30
France	104.19	118.48	134.13	87.38	98.64	108.85	125.04	110.84
Germany	101.09	110.51	124.70	81.21	74.89	85.30	98.98	86.39
Greece	128.51	123.27	140.08	117.46	114.57	122.77	73.17	103.50
Hungary	79.29	80.34	73.66	70.16	61.66	64.61	76.13	67.47
Iceland	201.23	246.97	130.72	84.42	151.61	273.24	305.33	243.39
Ireland	122.55	185.18	114.53	146.57	144.14	157.34	164.91	155.46
Italy	126.28	114.60	126.51	156.34	153.84	150.34	147.09	150.42
Japan	265.00	287.91	188.10	151.10	159.90	181.52	191.35	177.59
Korea	150.98	165.21	126.50	134.32	108.79	110.00	113.13	110.64
Luxembourg	126.98	34.63	68.56	109.94	97.38	160.12	122.23	126.58
Mexico	41.44	52.98	57.48	30.87	25.16	34.76	32.59	30.84
Netherlands	658.98	199.37	166.51	96.87	112.27	118.57	82.13	104.32
New Zealand	91.86	98.21	74.37	104.52	93.65	102.81	125.47	107.31
Norway	121.17	128.59	132.31	155.82	114.76	223.09	247.11	194.99
Poland	48.16	63.62	51.38	60.84	35.70	39.07	40.32	38.36
Portugal	121.25	112.04	119.36	91.29	61.82	79.77	86.38	75.99
Slovak Republic	194.63	251.70	260.14	119.22	64.19	78.90	85.49	76.19
Spain	164.61	232.11	179.60	126.87	121.50	134.92	133.58	130.00
Sweden	114.42	184.49	192.66	159.43	162.08	175.35	130.93	156.12
Switzerland	283.80	311.39	225.49	225.18	213.33	222.88	213.84	216.68
Turkey	58.70	52.48	42.98	31.00	31.17	..	19.28	16.81
United Kingdom	218.11	239.81	239.53	171.69	183.58	199.94	219.29	200.93
United States	302.27	401.17	370.07	211.62	179.18	175.34	192.73	182.42
OECD	186.06	215.08	192.26	131.69	122.51	127.37	136.35	128.74

Source: OECD Communications Outlook 2007, Table 4.17

The strong demand for a growing variety of broadband enabled Internet services such as IPTV and radio (Figure 3) has provided an important incentive to service providers to upgrade their facilities and invest in new technologies which is stimulating further investment growth in the sector. Recent indications from many telecommunication operators planning in investing in fibre in the local loop, and in wireless broadband technologies lead to expectations that investment growth will continue in the future.

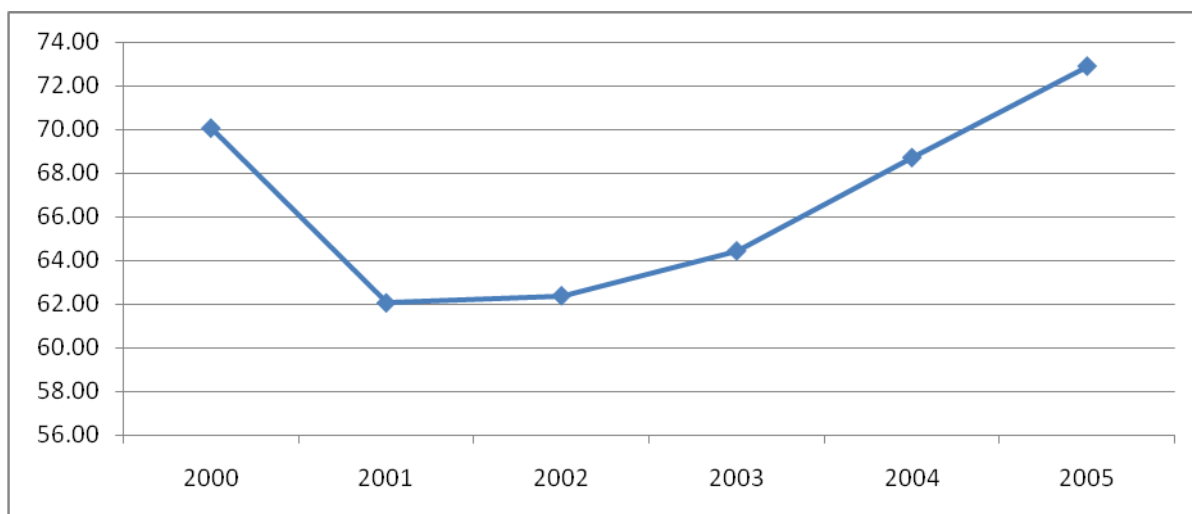
Figure 3. Internet users listening to web radios/watching TV, selected OECD countries, 2002-2006



Source: OECD (2007): Broadband and ICT Access and use by Households and Individuals, (DSTI/ICCP/IE (2007)4/FINAL)

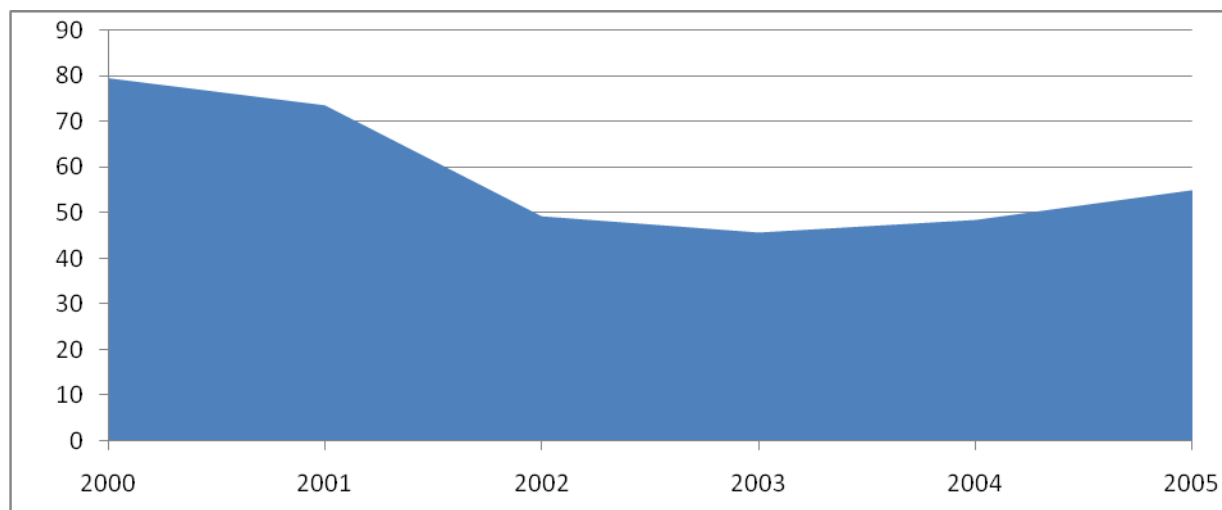
Although telecommunication markets began to open to new entrants in the mid-1990s (earlier for some countries), the incumbent operators were still the most significant investors in the telecommunications sector (Figure 4) accounting for 73% of the sector’s investment in 2005. After the “dot-com bubble” burst, investment from incumbents operators decreased relatively more than investment by new entrants and for a 3-year period accounted for 62% to 64% of the total telecommunication investment (Figure 4). The trend in incumbent operators’ investment, specifically on fixed networks (Figure 5), decreased as well after the “dot-com bubble” burst but is now recovering. Investment by incumbents in fixed networks seems to be relatively stable ranging from 48% to 56% of their total investment (Figure 6). The investment trend for the alternative operators is more difficult to evaluate as the data are not easily available, but reviewing data from 9 countries show a decreasing trend for the last 6 years following to some extent the same downward trend as for incumbents but without any significant upward trend visible for the time being (Figure 7).

Figure 4. Ratio of incumbent operators’ investment (capital expenditures) on total investment



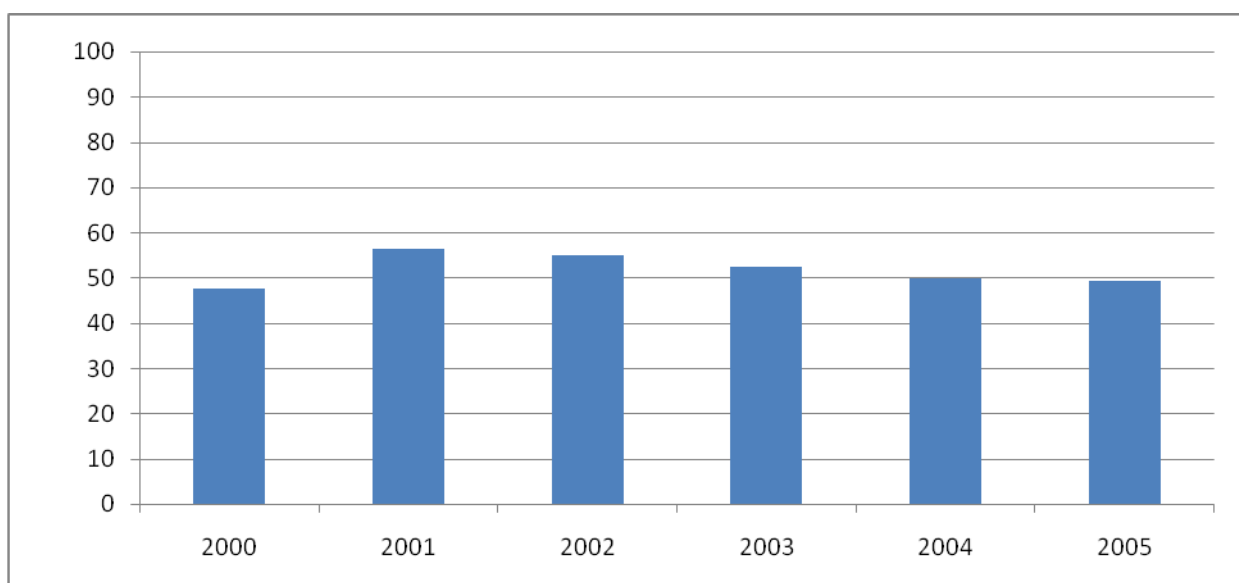
Note: Czech Republic, Poland and Slovak Republic are not included.

Figure 5. Capital expenditures for fixed network business by incumbent operators in OECD countries (USD billions)

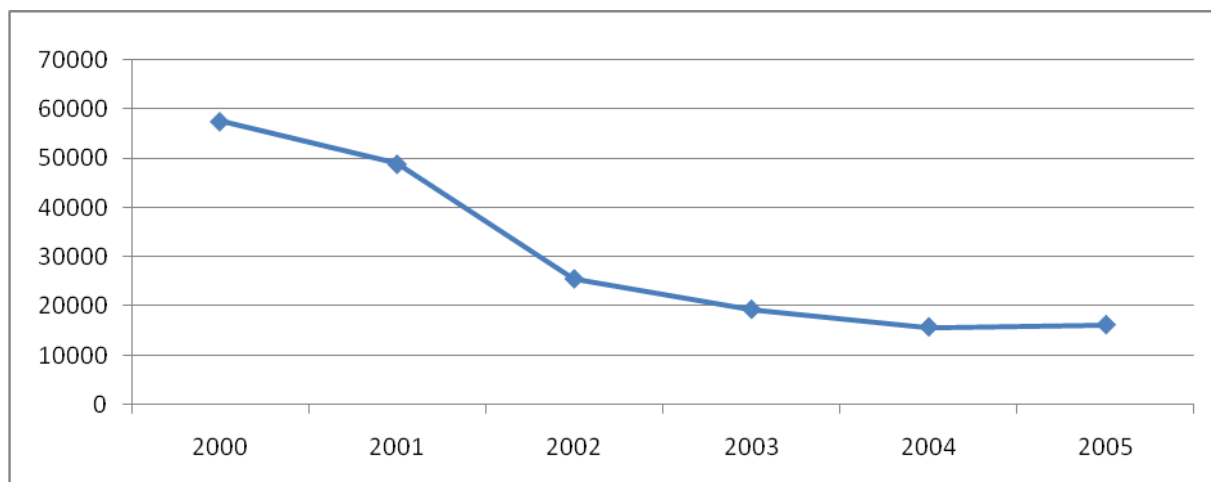


Note: Canada, Greece, Iceland, Luxembourg are not included.

Figure 6. Ratio of incumbent operators' investment on fixed networks over their total investment (percentage)



Note: Canada, Greece, Iceland, Luxembourg are not included.

Figure 7. Investment by all alternative fixed operators in OECD countries (USD Millions)

Note: Countries included: Denmark, Finland, Hungary, Italy, Japan, Portugal, Sweden, Switzerland and United States.

2. Investment and competition

By the late 1990s most OECD countries had opened up their telecommunication markets to full competition. Second generation mobile networks had also to a large part been deployed. The focus of policy in many countries changed from stimulating competition in voice markets to developing broadband services. With the shift from dial-up Internet to broadband and the fact that most countries viewed the development of broadband as having significant economic and social benefits, a number of countries began to adopt policies on broadband development either through facilities competition or through service competition based on local loop unbundling (LLU). Those countries using LLU viewed this as a stepping stone to facilities-based competition.¹ By the early 2000s most European OECD countries had in the context of EU Directives adopted local loop unbundling frameworks. The development of broadband and broadband competition has led to new services, such as those provided by multiple play, and further expansion in broadband markets, in particular the provision of higher speeds and the development of more infrastructure competition in a number of national markets. Broadband also led to a significant increase in market entry by Internet Service Providers, who initially provided only Internet access, but overtime diversified to provide voice and video services as well as broadband access. This new market entry is, however, not always captured in telecommunication investment data since in many cases ISPs are not considered as telecommunication service providers.

Infrastructure-based competition has, in general, developed much more rapidly, in the broadband era than in the early days of opening of PSTN markets, although in the 1980s and early 1990s regulators were expecting that service competition would develop into infrastructure-based competition.² In those countries with extensive cable television plant, cable-based broadband, for example, competes against DSL-based broadband, and increasingly both face competition from wireless providers as well. In addition to the promotion of competition, the promotion of innovation and investment has also been regarded as an important policy issue for some regulators. For example, in the United States, the FCC has followed a consistent policy of lesser regulation or unbundling for facilities supporting new services. Indeed in this context many incumbents and some regulators have taken the position that LLU obligations are a disincentive to investment and innovation given that new investment in the local loop may have to be shared with new entrants. These arguments have become more pronounced as incumbents and new entrants began considering whether to invest in fibre networks in the local loop.

A counter-argument, especially in Europe, has been based on the ‘ladder of investment’, whereby service competition and investment in new services facilitated by regulatory decisions such as LLU, are viewed as the initial rungs of a ladder which, by creating competition and allowing new entrants to create rapidly a customer base, generates immediate revenue. This early service competition, it has been argued, eventually stimulates further investment by new entrants allowing them to move up the investment ladder leading eventually to investment in their own facilities and, in particular, competition in the local loop.

2.1. *The ladder of investment*

The ‘ladder of investment’ debate has essentially argued that:³

- Access regulation can encourage entry by setting efficient access charges to stimulate entry by new entrants to wholesale products, who would otherwise have difficulties in replicating incumbent networks’ bottleneck facilities.
- New entrants making use of these access charges initially occupy the lowest ‘rung’ of the ladder such as reselling the incumbent’s services, before moving up the ladder to offer services closer to customer premises.
- New entrants can then consolidate their market position by increasing their customer and revenue bases and are able to provide ever more facilities-based services to retail customers. At this point regulatory authorities have a range of options available either by removing mandated access to lower rung wholesale access services or by gradually raising the price of those access products. As a result, new entrants having gained sufficient financial strength can start to move up the ladder for the purpose of searching for better margins created by wholesale and retail prices differences, although incumbents’ discretion to set margins available to competitors should be tempered by regulatory or competition law constraints over price squeezes. In relation to broadband access, this process stems initially from other access products such as IP-based and ATM-based bitstream access and then proceeds into using shared and finally fully unbundled local loops.
- Ultimately what occurs is that new entrants will start investing in their own telecommunications infrastructure and that facilities-based competition rather than services-based competition will develop.⁴

Concern has been expressed that service-based competition, as it is linked to LLU in its lessdeveloped context, cannot transform fragmented competition, which is dependent on the incumbent’s technical choices, into robust facility-based competition.⁵ Some have argued that the ‘ladder of investment’ concept is too theoretical and as such does not provide a model for regulators to manage. For example, regulators may have to decide the right sequence of rungs and construct a number of different ladders since new entrants may have different requirements for service provision. Some quantitative analysis in the United States has suggested that the share of alternative operators (competitive local exchange carrier (CLEC)) lines that are facility-based is lower in states where the wholesale price of unbundled lines is lower, implying that LLU decreases facility-based competition.⁶ The European Commission’s 12th Implementation report has collated data from EU Member States which according to the Commission showed that ‘[n]ew entrants, spurred on by adequate access price regulation, are climbing the ladder of investment by moving away from bitstream access (5.13 million lines) towards local loop unbundling (13.89 million lines) in the provision of broadband services’.⁷

2.2. *Intermodal competition*

Investment decisions may currently be influenced by intermodal competitions where, for example, fixed and cable operators are struggling to provide bundled services to offer multiple play packages. This

is the case, for example, in the United States where cable modem broadband service is preferred to copper line based DSL service with the former having 34 % of the market as compared to a 28 % by xDSL in the high speed line market as of June 2006⁸ and where fixed operators are willing to invest in large part for fear of losing market share to cable operators. Fixed and mobile wireless intrusions are also a significant factor for fixed operators.

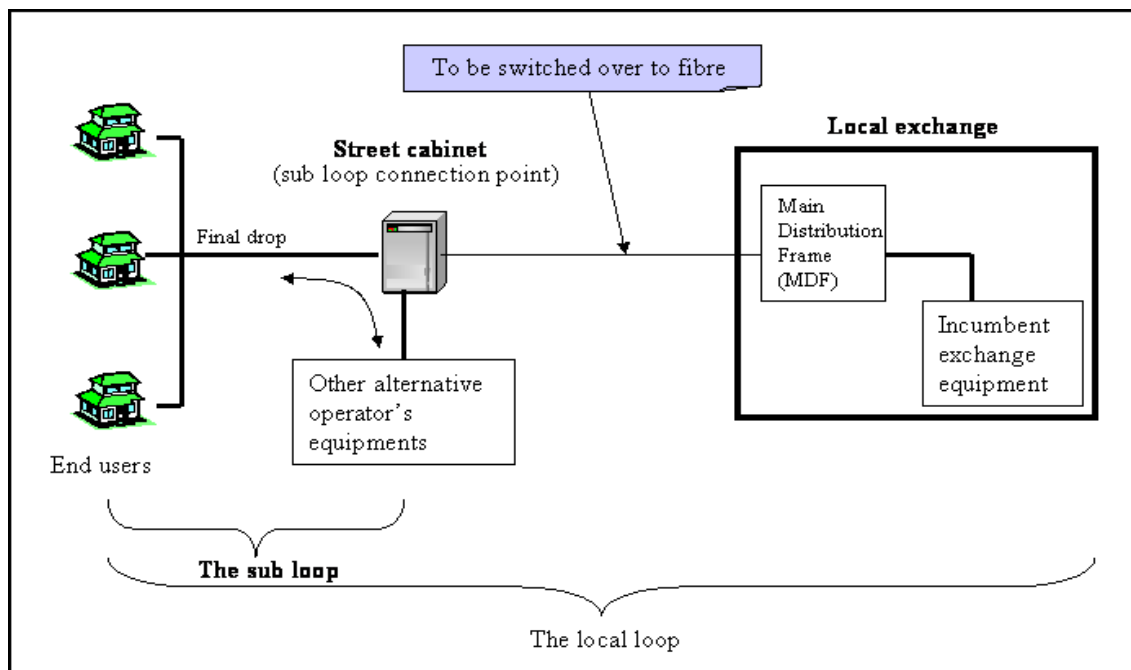
Other broadband related services, for example, cable telephony in the United States may cause the loss of lines for fixed operators⁹. As cable operators upgrade networks to achieve higher speeds (using Docsis 3.0) competition between the fixed line operators and cable can be expected to increase.

Although high speed wireless networks may not offer the same characteristics as fixed networks, for an increasing number of users they are becoming the main means of access to communication services. As operators shift their service from second generation networks to third generation networks, the shift to 'mobile only' households may increase. There are two factors driving investment in wireless networks. First, the declining revenue per user in 2G services has pushed mobile operators to seek other revenue opportunities. Second, fixed network operators are increasingly looking at offering fixed-mobile convergence services which may eventually start competing with mobile services.

2.3. Sub loop unbundling

Within the EU context, 'local sub loop' means a partial local loop connecting the network termination point at the subscriber's premises to a concentration point or a specified intermediate access point in the fixed public telephone network.¹⁰ It is required that alternative operators can interconnect with the local access network at a point (street cabinet) between the incumbent's exchange and the end user premises. Sub loop unbundling has not been utilised much. For example, KPN, the incumbent in the Netherlands, is obliged to offer sub-loop unbundling but there was no formal demand for this type of unbundling as of the end of 2004.¹¹

Figure 8. Diagram of sub loop unbundling and its usage



Source: 'The business case for sub-loop unbundling in the Netherlands', Analysys, 26 January 2007: 3; 'What is Local Loop Unbundling?', Ofcom.

However, with the increasing provision of advanced services, such as IPTV, DSL technologies which are able to deliver sufficient access speeds over copper loops of up to 1 km from the exchange, but whose speed drops quickly for longer loops, have not been able to cope with the increasing needs for bandwidth-consuming offerings. Rather, there is the possibility that fibre to the cabinet (often called fibre to the nodes [FTTN]) will be required in order to deliver the high-speed services to the local street cabinet and consequently, shorter copper loops with state-of-the-art technology such as VDSL (Very High Speed DSL) will be favoured in order to send them along the copper pair to the end user's premises.¹²

On the other hand, if the alternative operators install their own equipment adjacent to the street cabinet rather than at the incumbent's exchange and utilise the sub loop, they can offer high bandwidth services which can only be sent for a short distance on the copper networks, provided they do not use the unbundled fibre networks.

Some analysis indicates that the costs of sub loop unbundling are substantial. Basic cost factors are: new equipment at each cabinet which is likely to include a multi-service access node to deliver voice and data services; co-location facilities; backhaul links to individual street cabinets; writing-off of the value of equipment and co-location facilities (stranded investment). But according to the analysis the most difficult facet for alternative operators using sub loop unbundling is the limited economies of scale that they will be able to achieve. While the alternative operator with a modest market share of the DSL market might expect to gain 500 or more customers at a major exchange, it may only be possible to gain 10-20 customers at a single street cabinet. In contrast, the total costs for full unbundling does not change much even if the number of customers per exchange area are few.¹³

3. Market description in terms of OECD countries telecommunications investment

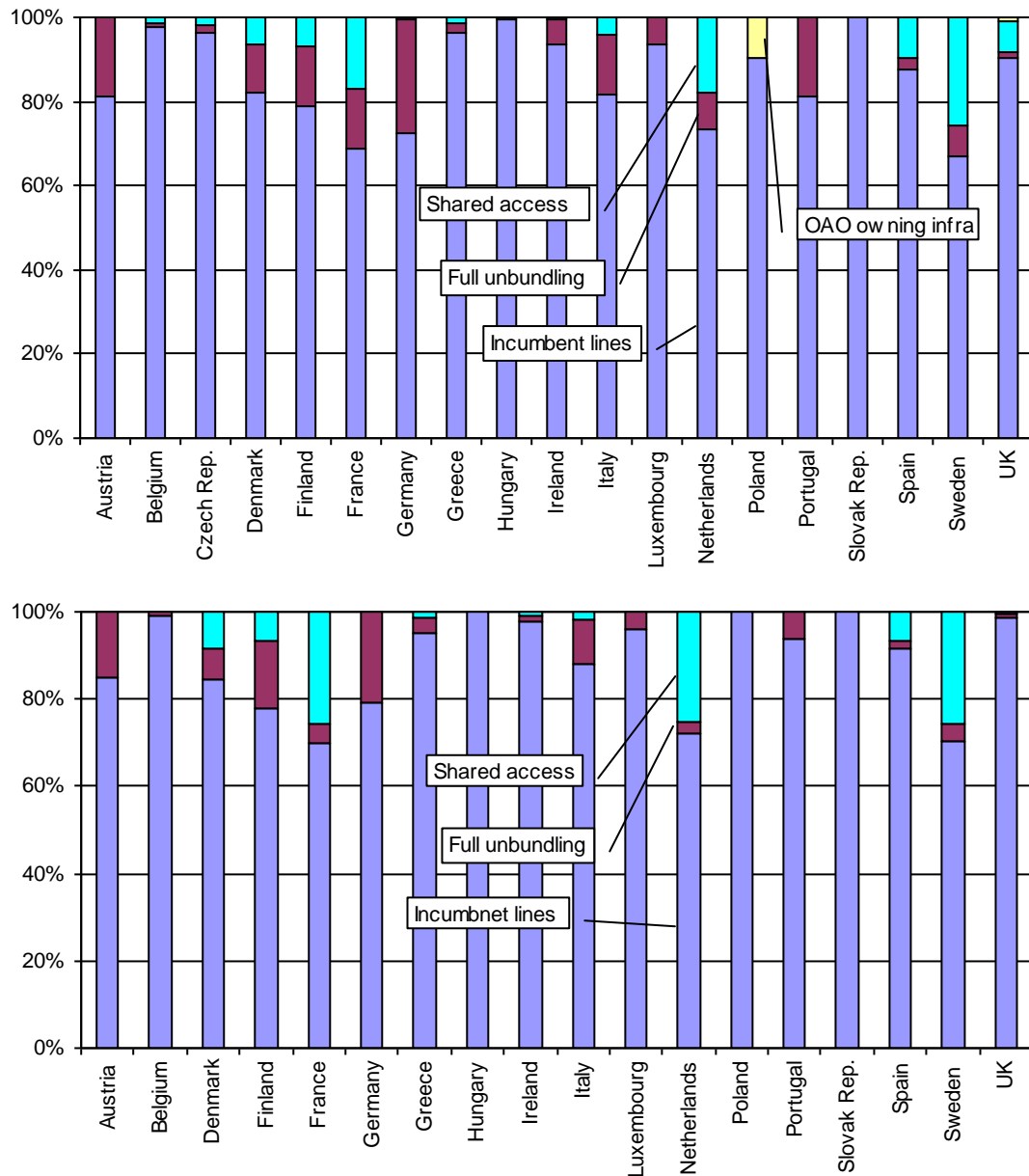
In examining the policy impact of investment, in particular when it relates to LLU, it is important to differentiate between the date when LLU was introduced through legislation or regulatory decision and the date when LLU became effective in that decisions on prices for unbundled loops, conditions of delivery for loops, collocation, etc., took in some cases several years before a satisfactory solution was agreed to. Most of the European Union OECD countries introduced LLU from around 2001 to 2002 (Table 2), when they implemented into national law the EU directive or regulations regarding unbundled access to the local loop.¹⁴ LLU was introduced much earlier in some countries, such as Canada, Finland, Germany, the Netherlands and the US. At that time, broadband was not so widespread and the main telecommunications service was voice, so that LLU did not play an important role.

Table 2. Year when LLU was introduced

Australia	2000
Austria	2001
Belgium	2001
Canada	1997
Czech Rep.	2003
Denmark	2000
Finland	1997
France	2001
Germany	1998
Greece	2001
Hungary	2002
Iceland	2000
Ireland	2000
Italy	2001
Japan	2000
Korea	2002
Luxembourg	2001
Mexico	N/A
Netherlands	1997
New Zealand	N/A
Norway	2001
Poland	2005
Portugal	2001
Slovak Rep.	2005
Spain	2001
Sweden	2001
Switzerland	N/A
Turkey	2004
UK	2001
US	1996

With the introduction of LLU, access to broadband using DSL has been provided by alternative operators as well as incumbent operators varying from country to country. Data for European countries (Figure 9) indicate that from 2005 to 2006 the proportion of DSL offered by incumbents has decreased while that of alternative operators has increased, mainly through full unbundling.

Figure 9. Proportion of each service type based on the number of DSL lines (Top: September 2006, Below: September 2005)



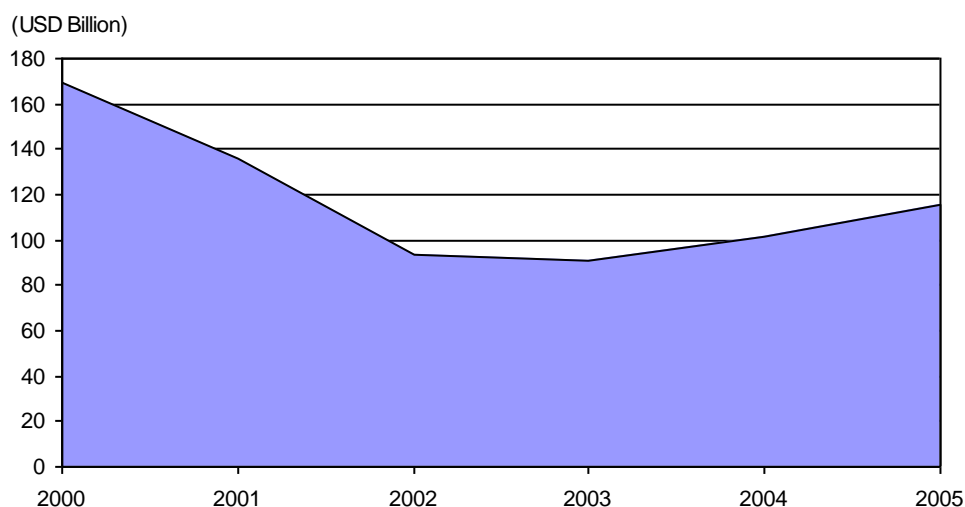
Note: OAO means Other Authorised operator - i.e. alternative operators.

Data source: ECTA Broadband Scorecards.

3.1. General trend of the investments by incumbent operators in the OECD countries

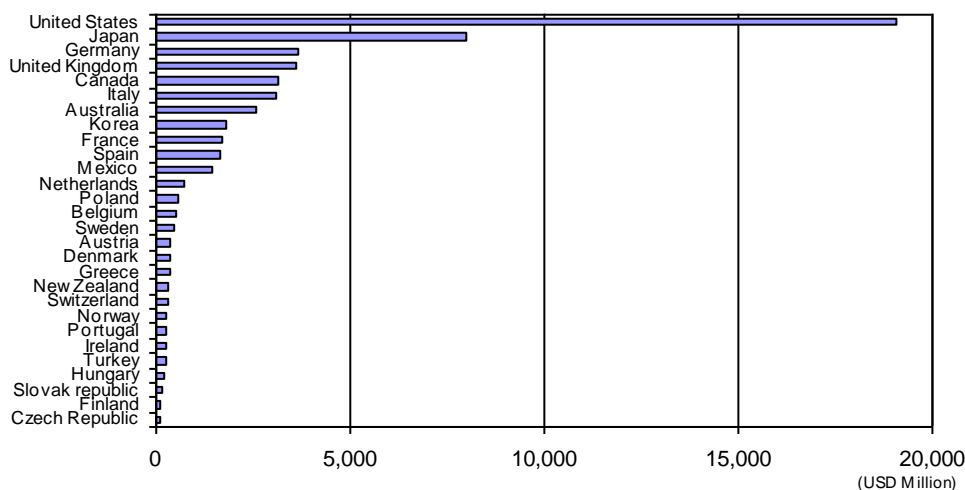
Figure 10 shows the total consolidated capital expenditures of incumbent operators in OECD countries (see also data in Annex). Consolidated capital expenditure includes all of the activities of enterprises so it can include fixed, mobile, or international operations. The effect of the “dot-com bubble”, including companies’ acquisition of bankrupt carriers preceding it, as discussed in the first section, is evident in the sharp reduction in investment from 2000 to 2002.

Figure 10. Total consolidated investment (capital expenditures) of incumbent operators in OECD countries (USD Billion)



In Figure 11 the annual average capital expenditure for the fixed network by incumbent operators in OECD countries is shown (see also data in Annex.). These are calculated for 2004 and 2005, that is after the recovery from the “dot-com bubble”. Investment by the United States with the largest telecommunications market in the OECD (approximately one-quarter of OECD’s fixed lines) clearly dwarfs that of other OECD countries.

Figure 11. Annual average of capital expenditure for fixed network activities (2004-2005) by incumbent operators in OECD countries



Notes: 1) Data for Iceland and Luxembourg are not available.

2) Australia, France and Germany include portions of international operations.

3.2. Trends in incumbent investment

The investment performance of incumbent operators for OECD countries is shown in the following graphics covering the period 2000 to 2005 (see also data in Annex). These data are collected directly from

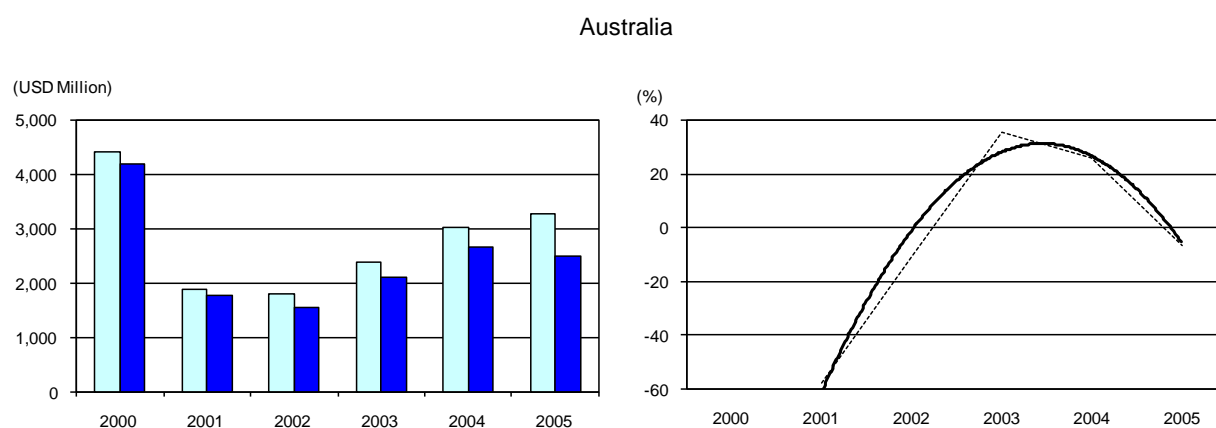
annual reports of telecommunication operators. In some cases data is not sufficient to differentiate between the total telecommunication investment of a company from the fixed network investment. The bar charts show total telecommunication investment by incumbents (white bar) and capital expenditure for the fixed network by incumbents (black bar). For some countries total telecommunication investment (consolidated investment) may include mobile network operations and international investments, while fixed network investment data may at times also include international investment (when it was not possible to exclude it from the data).

The right-hand graphic for countries shows the year to year growth of fixed network investment (unless these data were not available) as a dotted line and the trend line in investment (bolded line). In cases in which data for ‘capital expenditures for fixed network activities’ are not available, the growth rate and its trend is calculated from figures of ‘consolidated capital expenditures’.

Almost all OECD countries were affected in different ways by the “dot-com bubble”, including companies’ acquisition of bankrupt carriers preceding it, and their investment cycle seems to differ with some countries seeing a slowdown in investment by incumbents during 2004-2005 whereas others, most impacted by the “dot-com bubble”, were increasing investment levels back to those of 2000. The growth in communication markets spurred on by broadband undoubtedly played a part in stimulating investment in most countries as incumbents upgraded their networks to support xDSL and in many cases to provide wholesale access to 3rd parties. The decline in the number of fixed line subscribers experienced by many incumbent operators resulting from mobile substitution has led many incumbents to place emphasis on broadband services and in offering triple play. So that, although there is no evidence of any persistent decline in investment by incumbents during 2000-2005, it is not possible to say what the levels of investment would have been in those countries if unbundling had not been mandated. Statements on the rollout plans for xDSL of many European incumbents from their annual reports in the early 2000 indicates that their national coverage of broadband would not be complete until the 2010 period, whereas in many cases these plans accelerated significantly because of unbundling requirements.

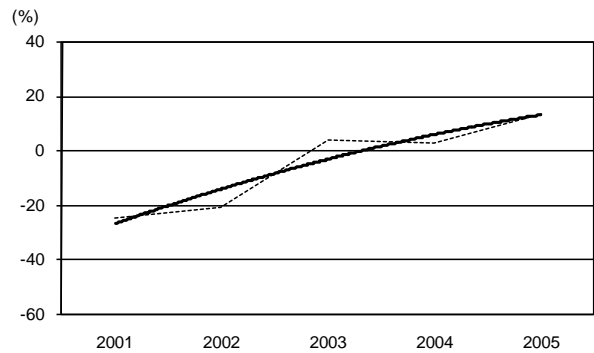
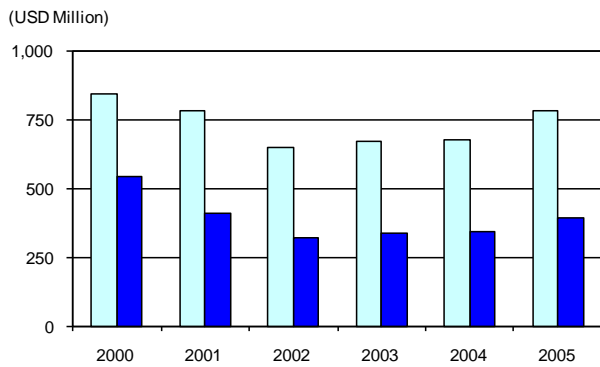
The United States, which was most affected by the “dot-com bubble” both in terms of the number of firms exiting the market through financial failures as well as by a significant drop in investment, had not attained the level of investment reached in 2000 by the end of 2005. Greece, where the rollout of xDSL by the incumbent was very slow (with a subsequent impact on broadband penetration) performed poorly in investment with total investment only picking up only in 2005.

Figure 12. Investments by incumbent fixed operators in OECD countries

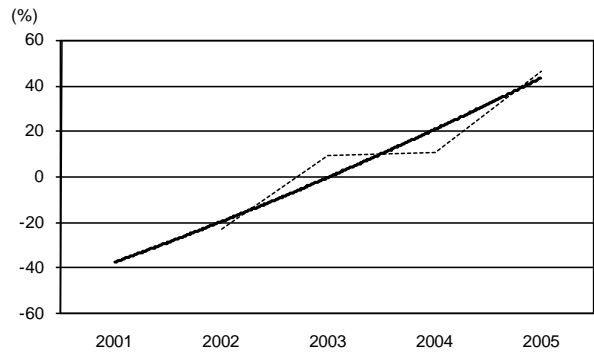
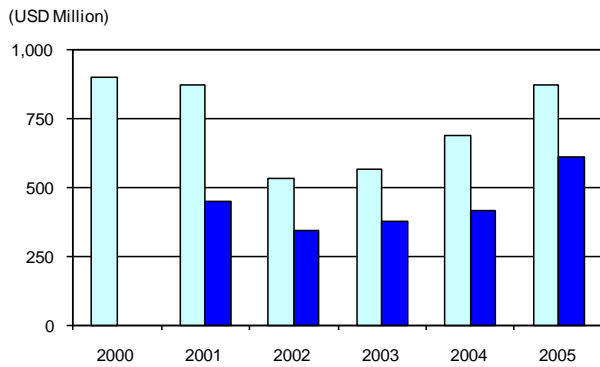


Note: Only data for the fixed network business, including international operations, are available.

Austria

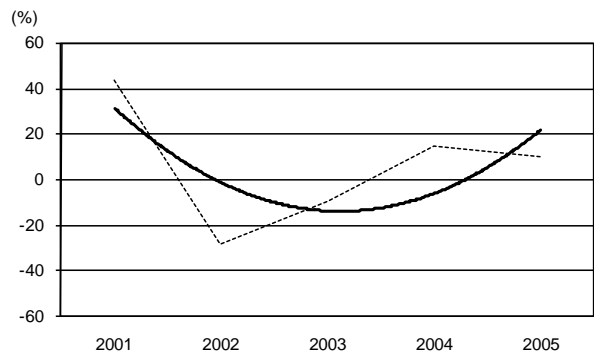
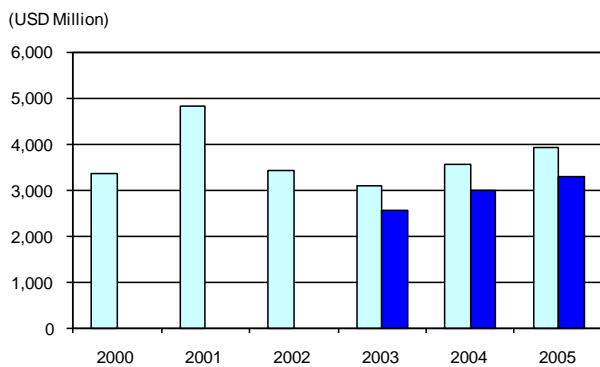


Belgium



Note: Data for the fixed network business for 2000 are not available.

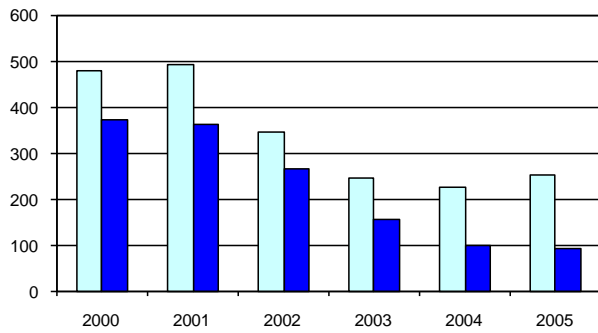
Canada



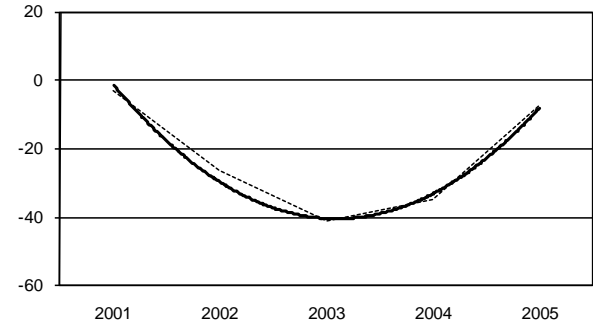
Note: Data for the fixed network business from 2000 to 2002 are not available. The trend of the growth rate is from figures of consolidated capital expenditures for convenience.

Czech Republic

(USD Million)

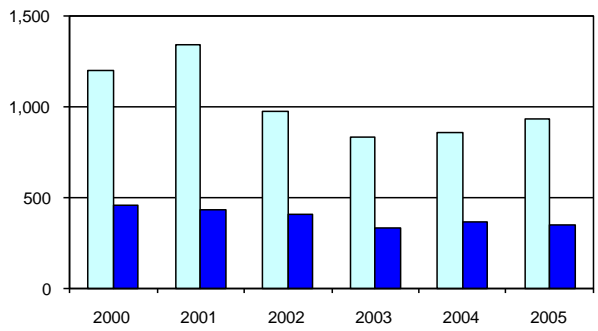


(%)

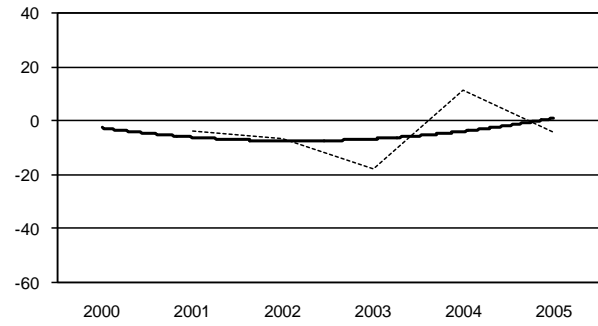


Denmark

(USD Million)

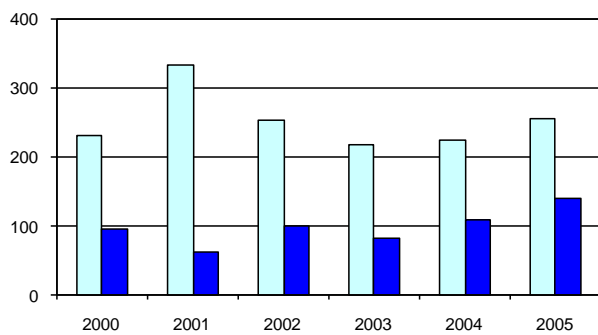


(%)

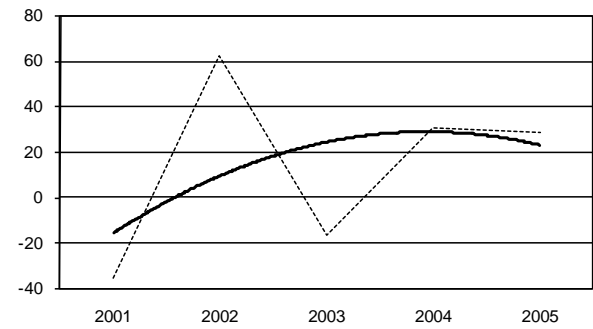


Finland

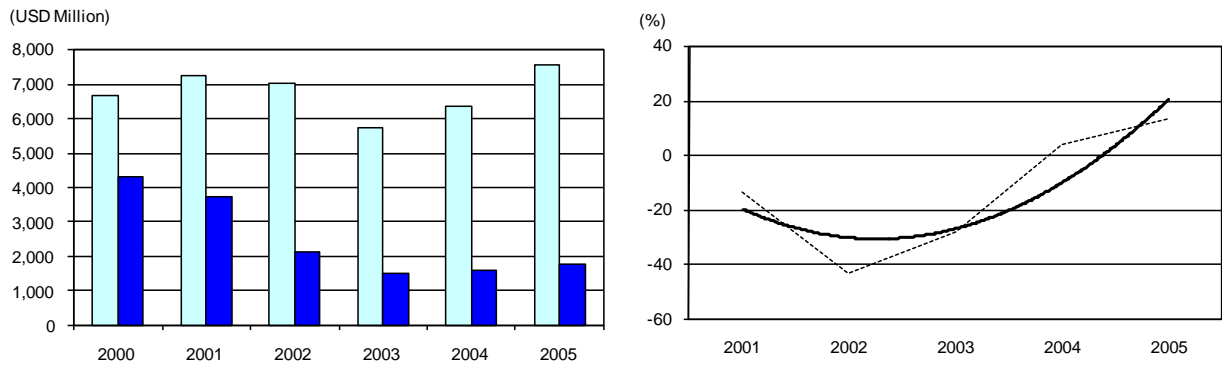
(USD Million)



(%)

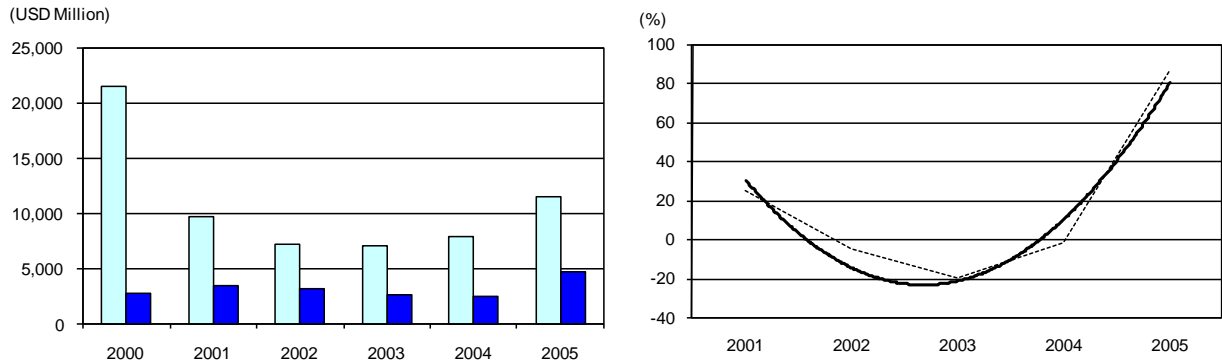


France



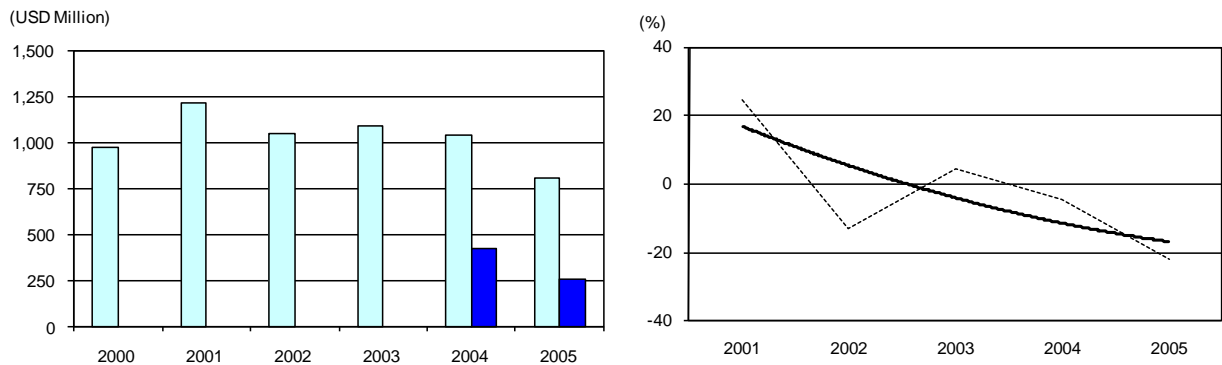
Note: Only data for the fixed network business, including international operations are available.

Germany



Note: Only data for the fixed network business, including international operations are available.

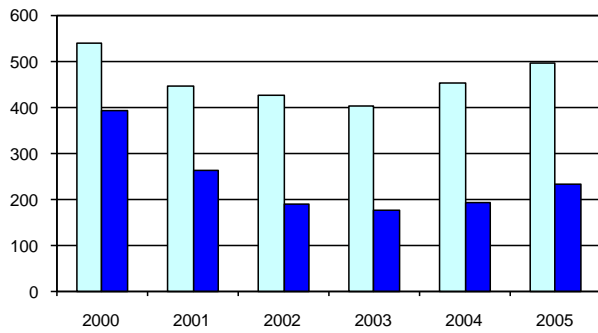
Greece



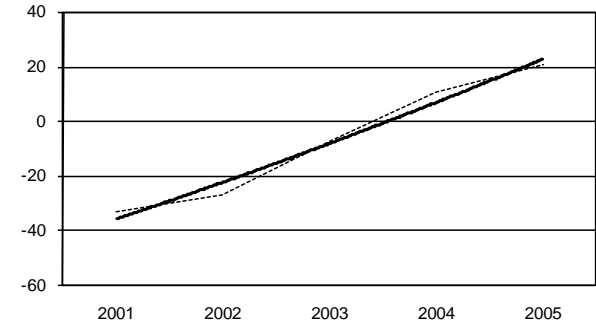
Note: Data for the fixed network business from 2000 to 2003 are not available. The trend of the growth rate is from figures of consolidated capital expenditures for convenience.

Hungary

(USD Million)

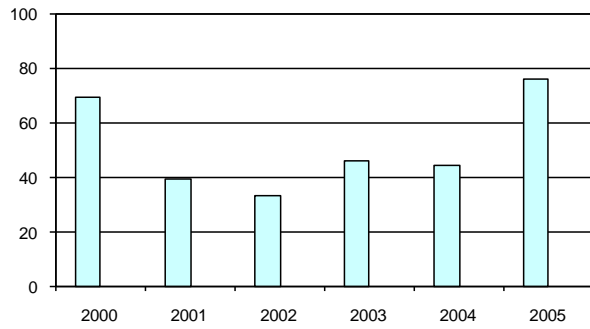


(%)

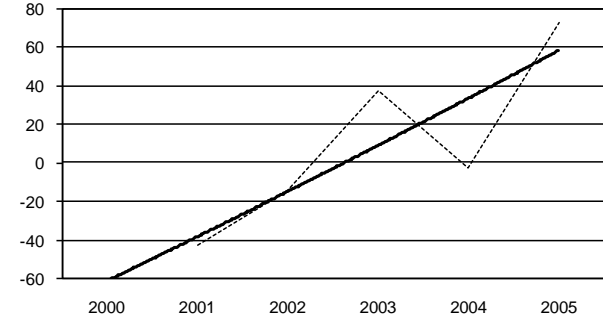


Iceland

(USD thousand)



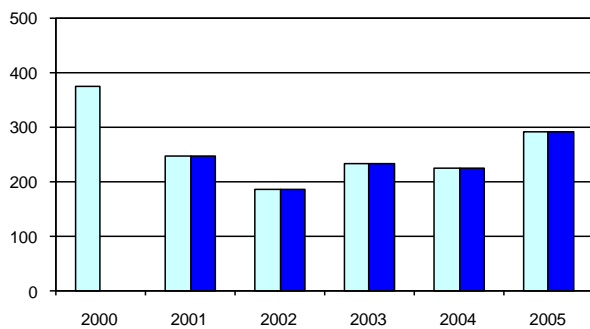
(%)



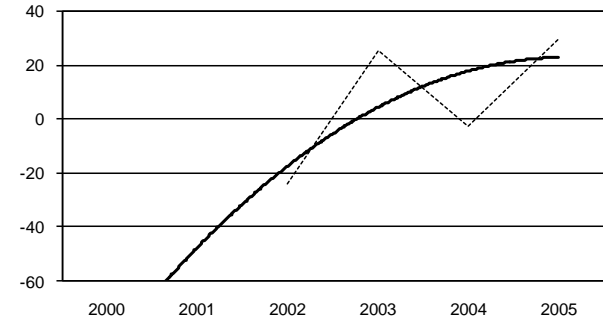
Note: Data for the fixed network business are not available. The trend of the growth rate is from figures of consolidated capital expenditures for convenience.

Ireland

(USD Million)



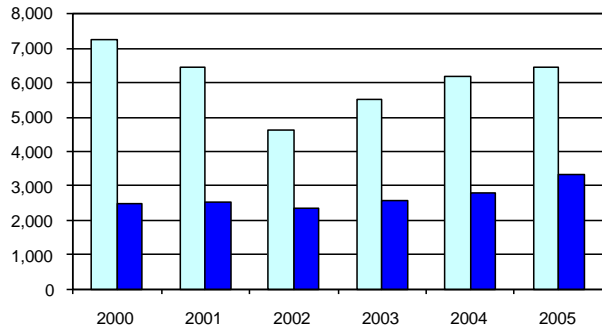
(%)



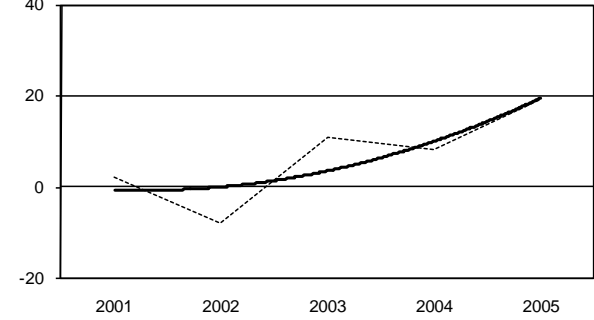
Note: Data for the fixed network business in 2000 are not available.

Italy

(USD Million)

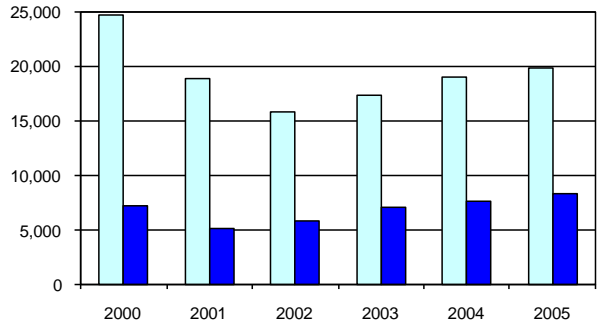


(%)



Japan

(USD Million)

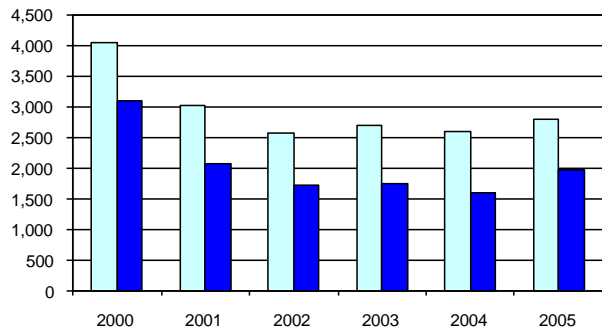


(%)

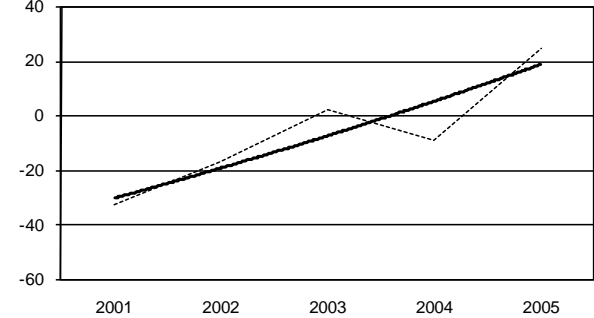


Korea

(USD Million)

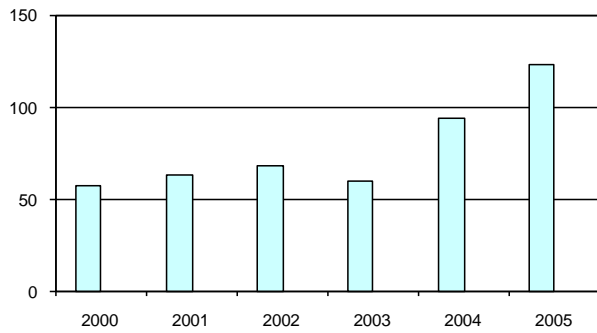


(%)

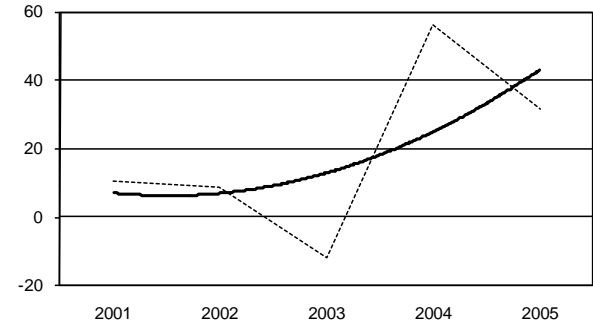


Luxembourg

(USD Million)



(%)

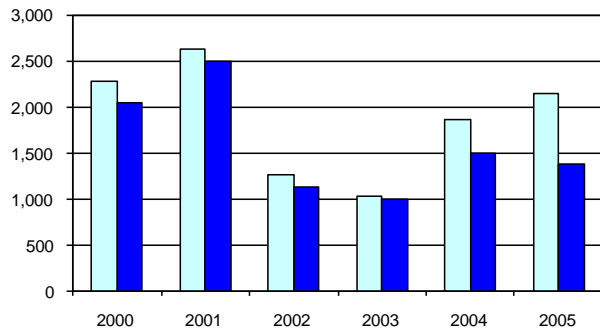


Notes: 1) Data for the fixed network business are not available. The trend of the growth rate is from figures of consolidated capital expenditures for convenience.

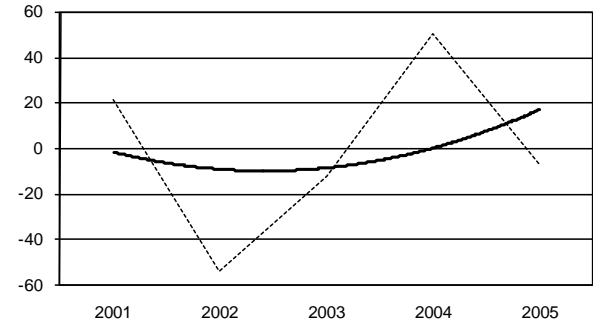
2) Investment includes postal services.

Mexico

(USD Million)

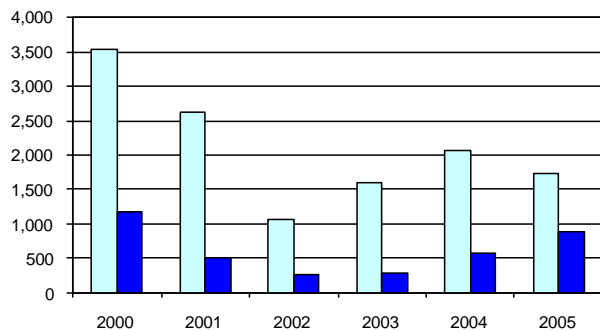


(%)

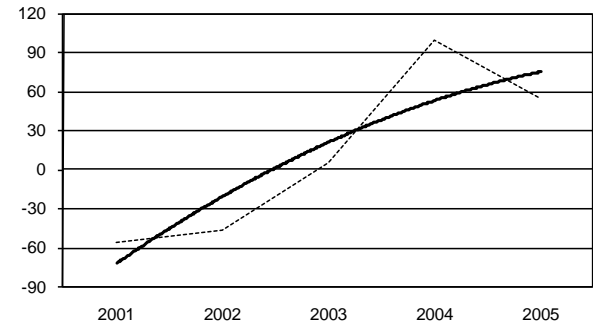


Netherlands

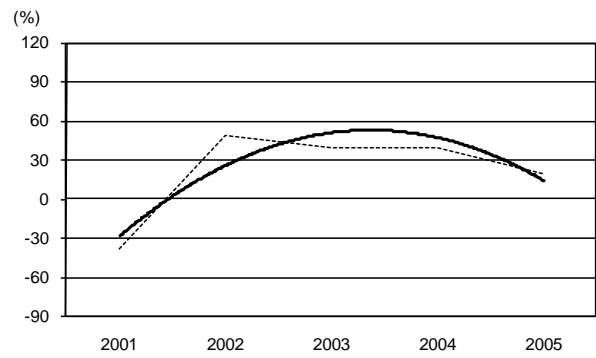
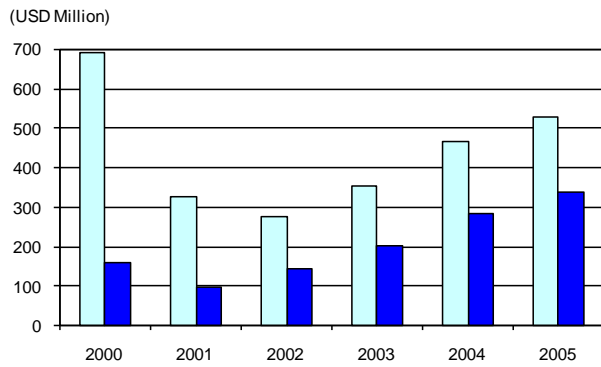
(USD Million)



(%)

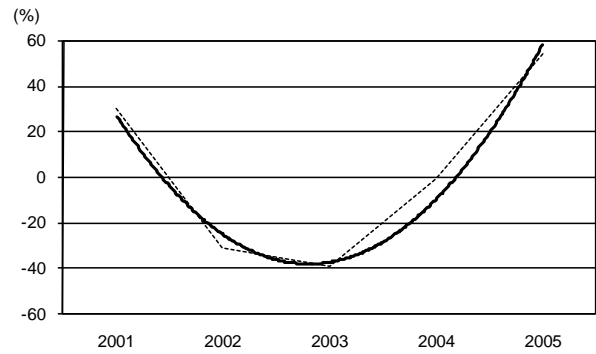
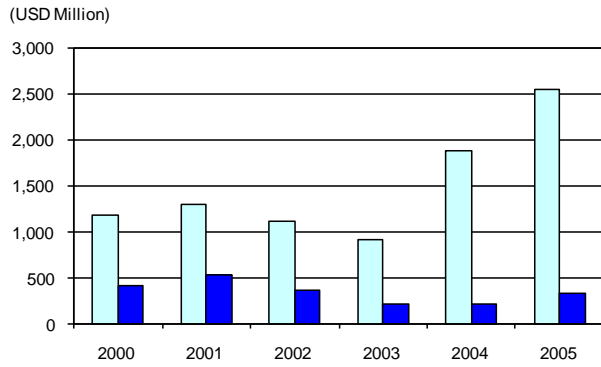


New Zealand

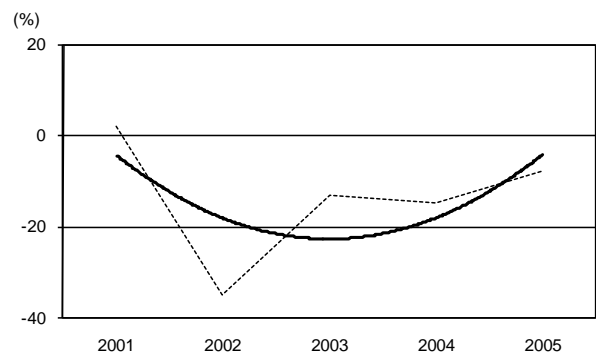
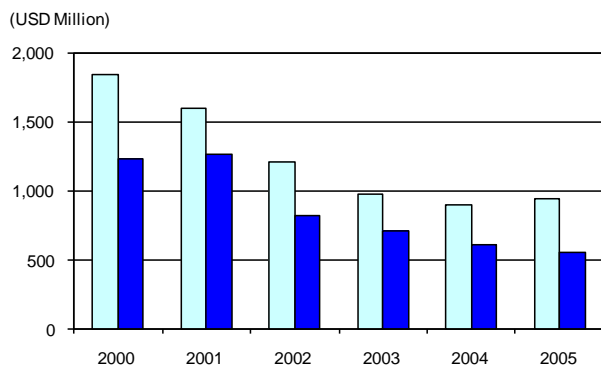


Note: Consolidated capital expenditures include some portions in Australia.

Norway

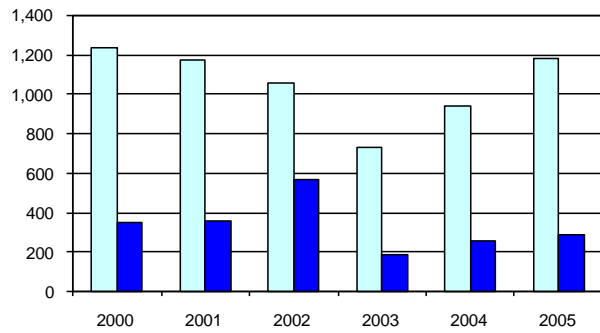


Poland



Portugal

(USD Million)

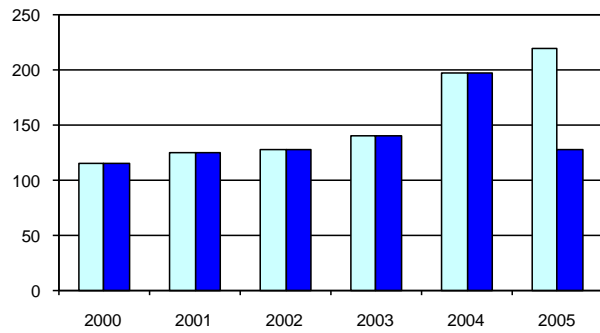


(%)

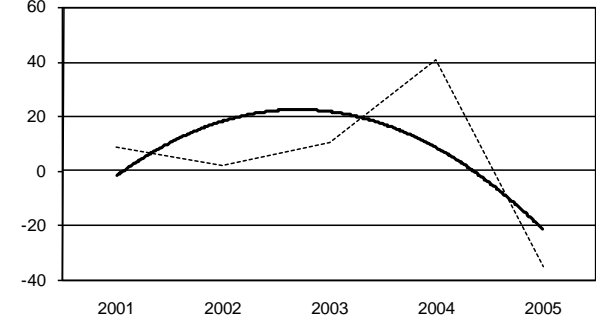


Slovak Republic

(USD Million)

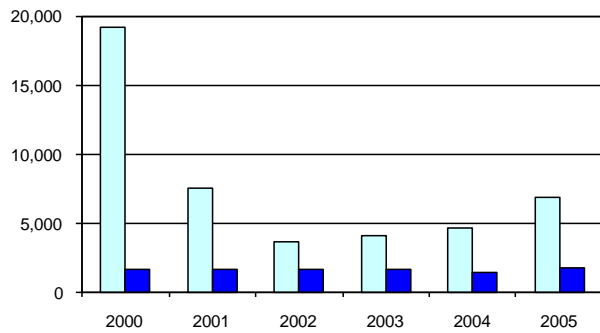


(%)

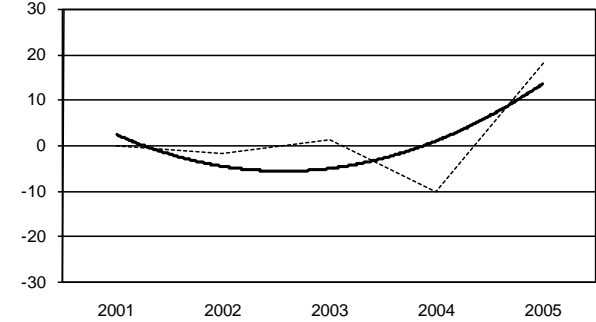


Spain

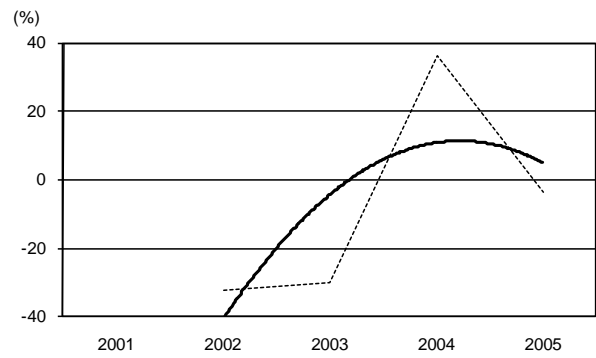
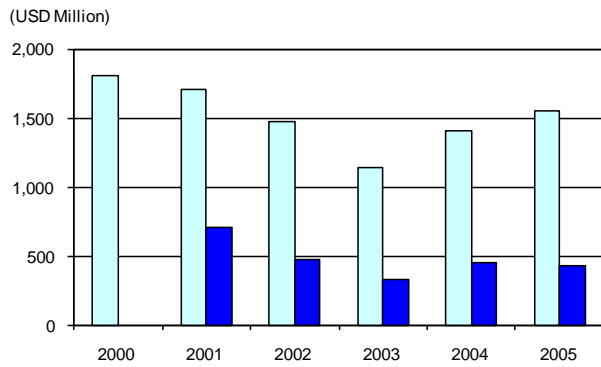
(USD Million)



(%)

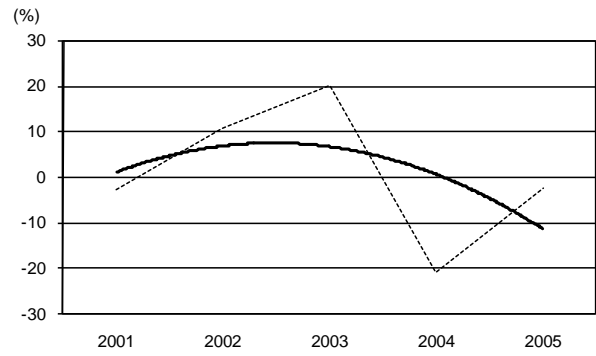
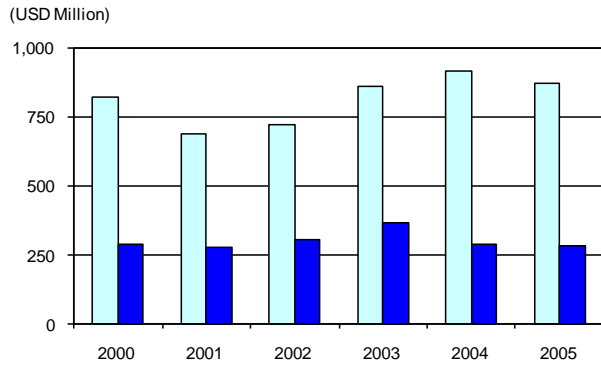


Sweden

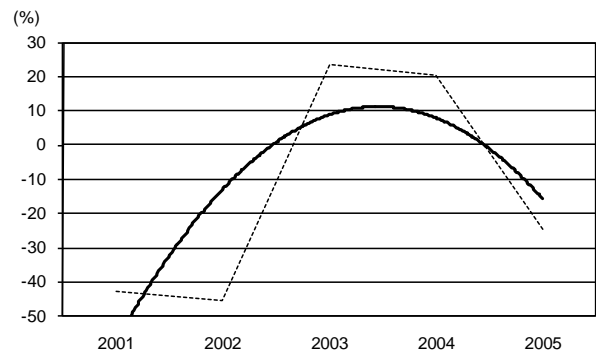
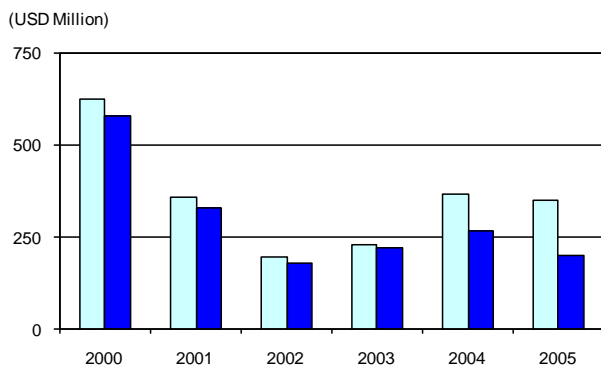


Note: Data for the fixed network business for 2000 are not available.

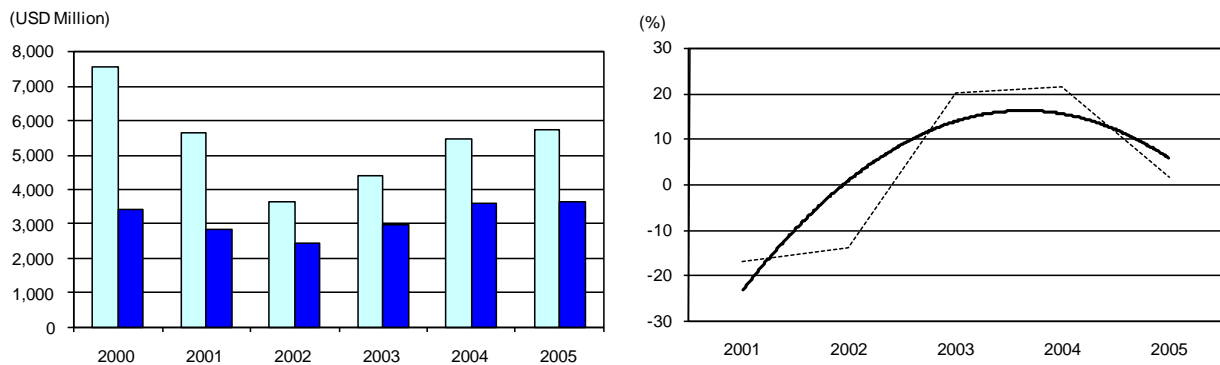
Switzerland



Turkey

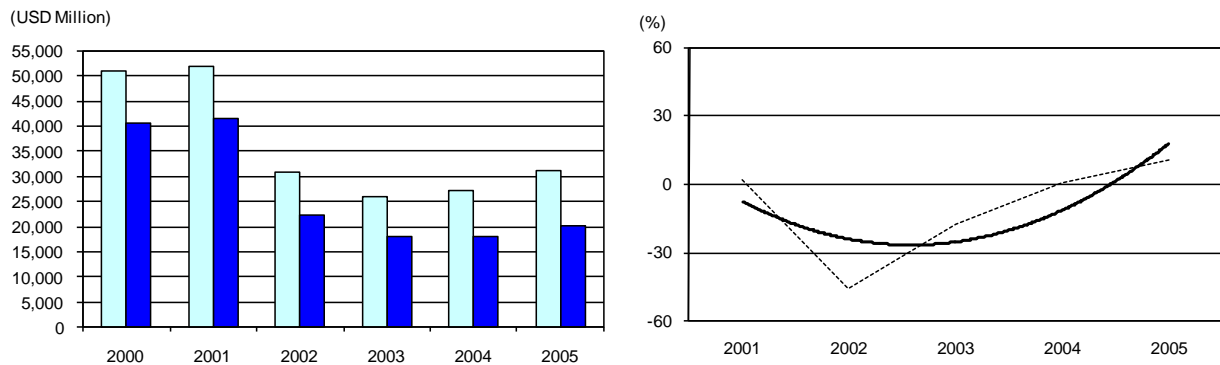


United Kingdom



Note: Capital expenditures for fixed network business are from BT Wholesale.

United States



Note: Only AT&T's 'capital expenditures for fixed network business' are not available, so 'consolidated capital expenditures' are used instead.

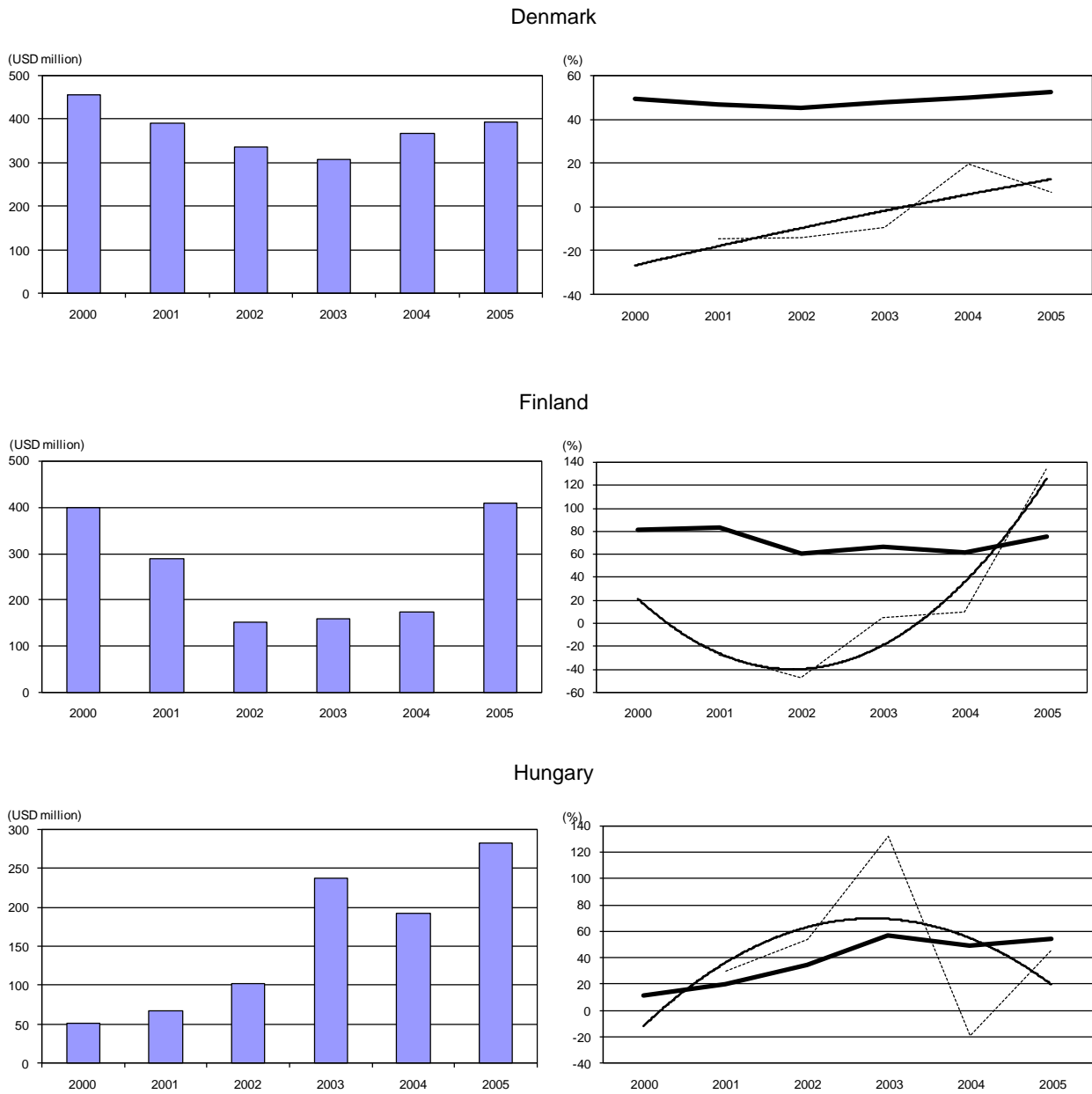
3.3. Investment by alternative operators

Investment data for alternative fixed operators are difficult to obtain. In spite of this, such investment has played an important role, for example, for the United States where cable operators took the early lead in mass market broadband deployment and alternative operators (rather than incumbents) took the early lead in FTTH deployment. Figure 13 only provides investment data for alternative operators in 9 OECD countries (see also data in Annex). The left hand graphic for each country in Figure 13 shows investment during 2000-2005 by alternative fixed operators. The right hand graphic in Figure 13 for each country shows in bold lines the ratio of investments by all alternative fixed operators as a percentage of investments by all fixed operators in the country. The year-to-year growth rate in investment by alternative operators is shown by a dotted line and the non-bolded line indicates the trend line.

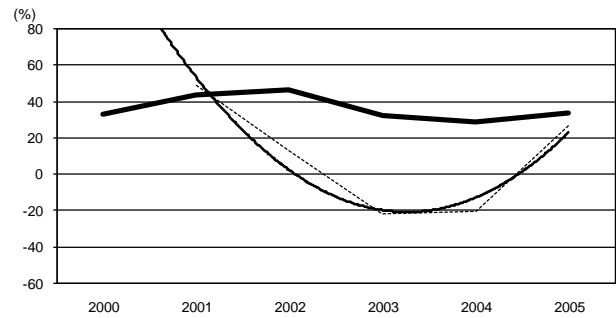
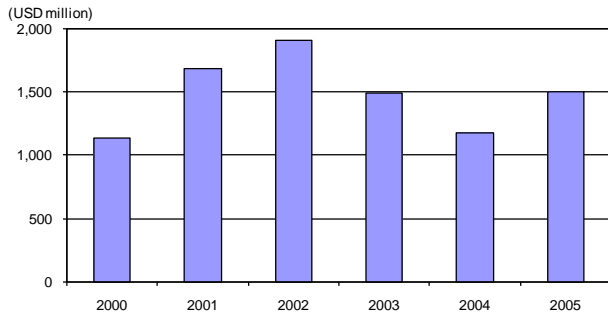
The data in Figure 13 indicate that for a number of countries the ratio of investment by alternative fixed operators to total fixed telecommunication investment declined (Italy, Japan, Portugal, United States) indicating a faster growth in investment by incumbents. At the same time several countries experienced a rising trend in investment by alternative operators (Denmark, Finland, Hungary, Japan, Portugal, and Switzerland).

In reference to countries which do not have a dot-com trend explicitly, Hungary indicates a significant increase in the growth rate just after the implementation of the LLU. In Sweden ‘investments by all alternative fixed operators over investments by all fixed operators’ sharply increased from 10% to 60 %.

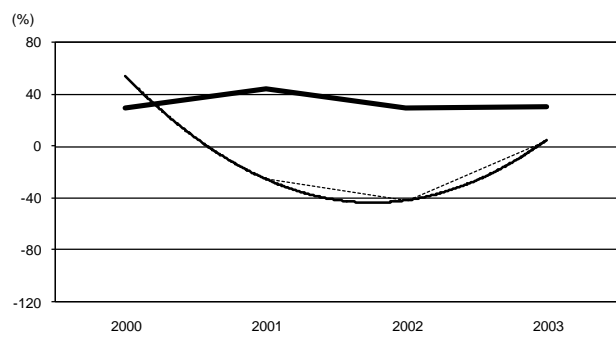
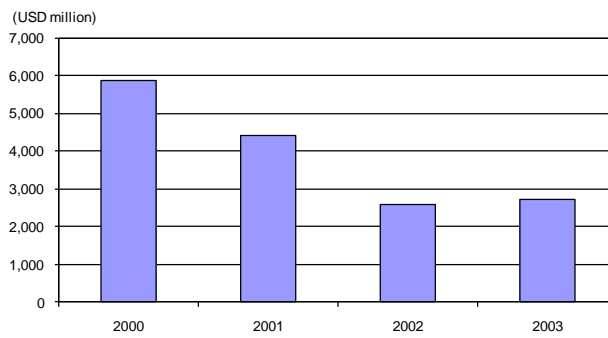
Figure 13. Investment by alternative fixed operators in OECD countries



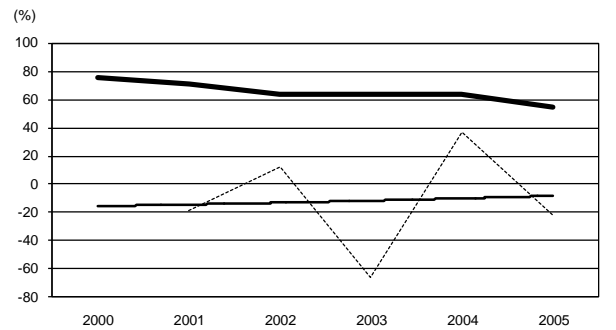
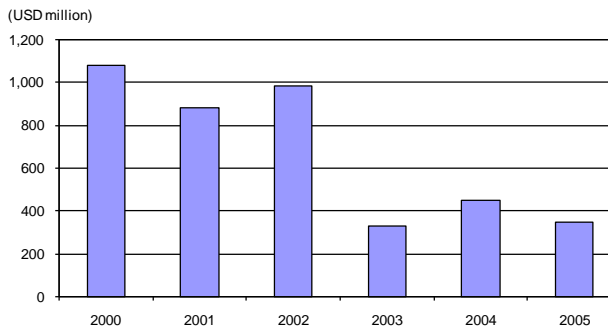
Italy



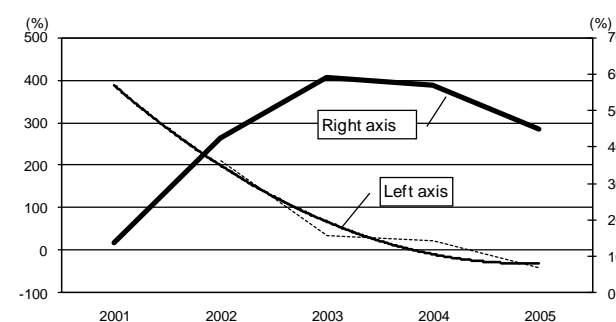
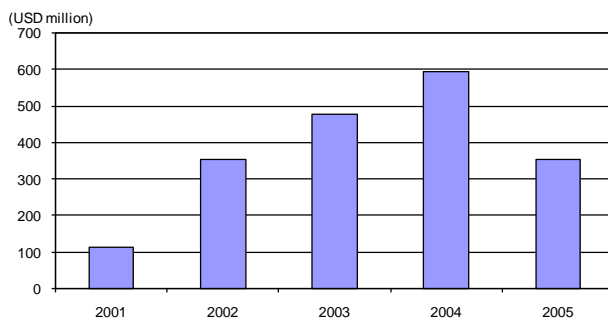
Japan



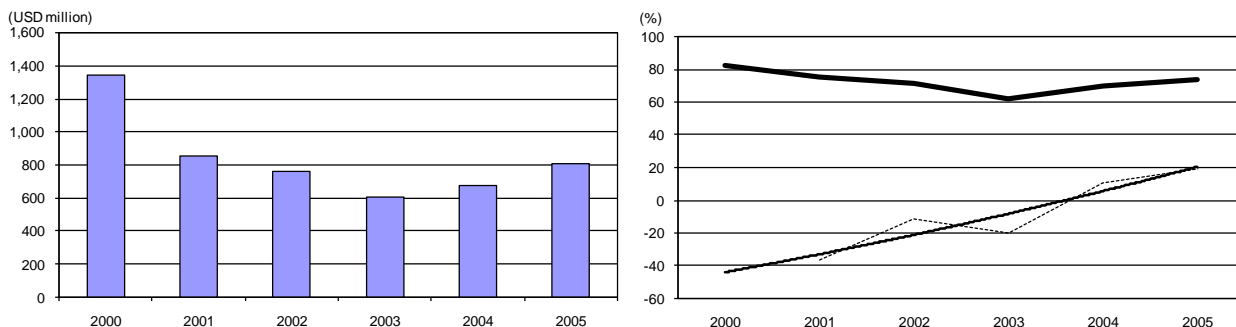
Portugal



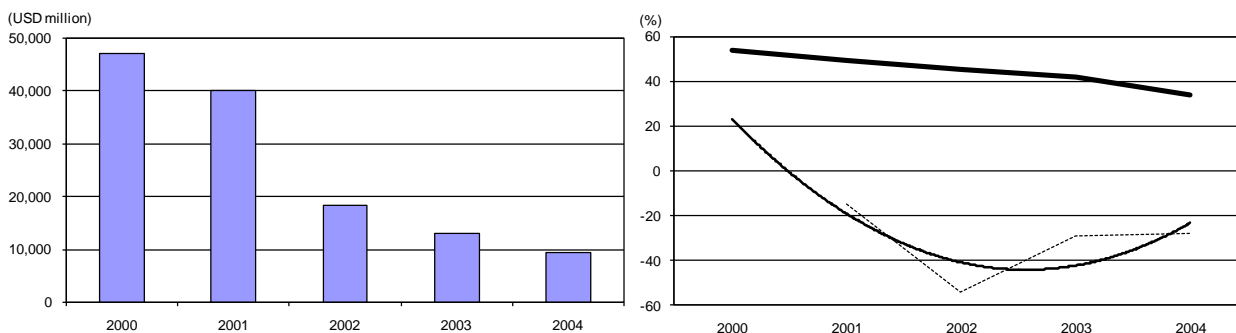
Sweden



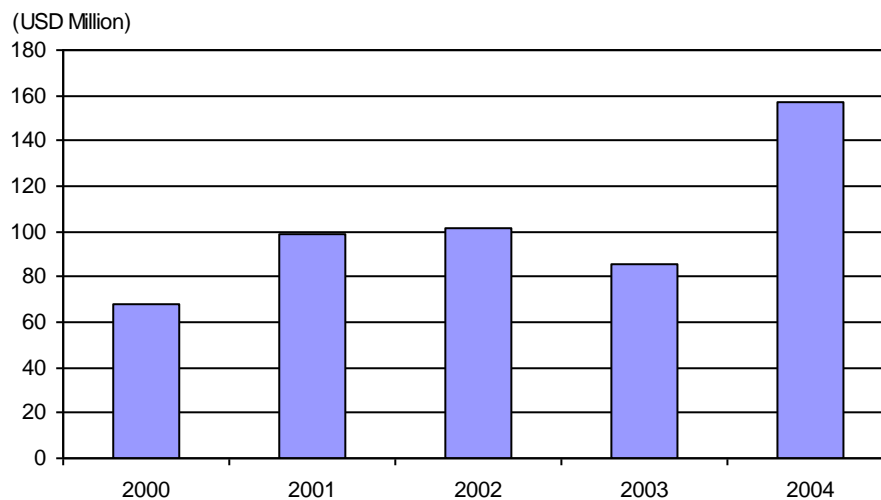
Switzerland



United States



Investments by ISPs may or may not be considered as investment by alternative operators. In many cases the major ISPs are owned and operated by the incumbent telecommunication operator. Investment by ISPs not owned by incumbent telecommunication operators would normally be considered as investment by alternative operators, but much of this data is not included in these data, since these companies have not been considered as telecommunication operators. However, it is these ISPs who have benefited most from LLU policies. An example of an ISP which is both an incumbent in its own market and a new entrant in other markets is Wanadoo, a brand name of France Telecom. Although data are available for all Wanadoo investments, a country by country breakdown of data are not available. Figure 14 shows the development of investment by Wanadoo. In some markets this investment has increased in recent years, for example, investment by Wanadoo U.K. increased by USD 45 million compared with 2004 and Wanadoo Netherlands investment increased by USD 12.5 million compared with 2004.¹⁵ €

Figure 14. Wanadoo investment

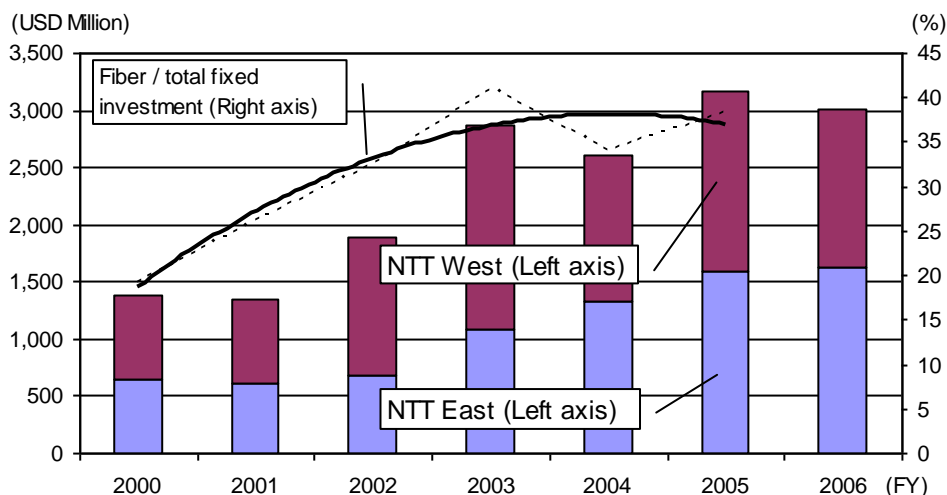
In the United Kingdom, companies including Sky, Orange, Tiscali and Carphone Warehouse have all invested heavily in LLU to compete in the broadband market since the development of operational separation resulting from the creation of BT's Openreach came into existence in 2006.¹⁶

3.4. *Other issues (investment in fibre networks)*

Data for investment in fibre networks, at least for 2000 to 2005, are not readily available except for Japan or Korea, although the situation is changing as an increasing number of incumbent operators start to invest in Next Generation Network (NGN) access networks. Generally speaking, the proportion of investment in fibre networks as a proportion of investment in total fixed networks by incumbent operators is not available. However, data from the Japanese incumbent, NTT, show that after 2001 the proportion of investment in fibre networks has been fairly constant, in the region of 40 % (Figure 15).

Data about investment by alternative operators in fibre networks in Japan are not available, but it is clear that alternative operators increasingly use NTT's fibre at NTT buildings (Figure 16). In Japan FTTH subscriptions are increasing while DSL subscriptions are decreasing, especially in metropolitan areas.¹⁷ In France both the incumbent and new entrants have started to invest in fibre networks and even alternative operators such as Iliad (Free) is expressing its intention to unbundle its own fibre networks.¹⁸

Figure 15. NTT's investment in fibre networks



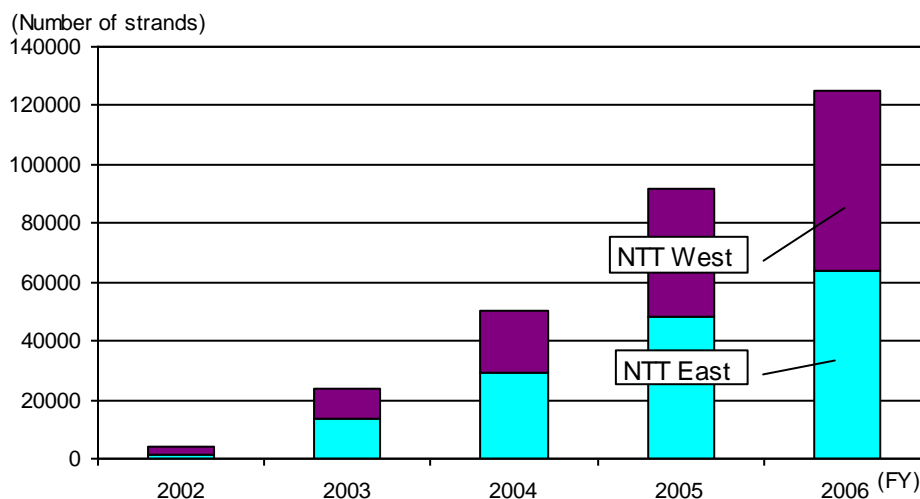
Notes: 1) Data for investment are only for access network of NTT East and West. (Transmission networks are almost 100% fibred.)

2) Bold line is trend line (2nd order).

3) Data for 2006 are estimates.

Data source: OECD, MIC, Japan

Figure 16. The number of strands of NTT's own fibre networks at NTT buildings used by alternative operators



Note: In FY 2006, for example, 69,000 strands are connected to NTT's fibre local loop network as of November 2006. There are also cases that alternative operators install their own fibres facilities at the NTT buildings. In this case as of November 2006, 196,000 strands are connected to NTT's fibre local loop network. (Data are from 'Opinions by NTT East about 'Provision of interconnection rules in relation to the revision of collocation rules etc.' 26 February 2007.)

Data source: 'Provision of interconnection rules in relation to the revision of collocation rules etc.', 26 January 2007, MIC, Japan: 8.

In Korea, for example, the fibre deployment pilot project in Gwangju City aims to deploy fibre infrastructure to 20 thousand subscribers in 5 years (2005-2009) and to provide convergence services through a 100 Mb/s optical pipe.¹⁹ The project is expected to cost approximately USD 119.4 million but will not require government subsidies for investment or subsidised loans although it is implemented under the scope of the '839 strategy' planned by the government.

4. Regulation and investment

The volume of investment can vary in accordance with the aims or priorities set by operators depending on demand for services and products, competition, as well as on regulatory considerations. Unfortunately, the quality of data on investment by new entrants in telecommunication markets is poor. Definitional problems also exist in that the players in communication markets are no longer the traditional alternative operators providing voice services but a range of service providers including Internet Service Providers and cable television service providers who, through cable modems, provide VoIP services and broadband access. As such it is much harder to make judgements about how various policies, for example, local loop unbundling, impacts on investment. The track record of countries with unbundling, as measured by the number of fully unbundled lines, would indicate that unbundling policies have been successful at least as far as creating competition to incumbents in a number of xDSL markets and in providing voice competition. For example, following the introduction of functional separation of the incumbent operator BT and the creation of the separate access division, Openreach, there has been a significant and substantial increase in the take-up of unbundled local loops by alternative communications providers in the United Kingdom. According to figures from the Office of the Telecommunications Adjudicator (OTA), the number of unbundled local loops for communication providers reached 2.247 million lines by May 2007: there were less than 200,000 lines unbundled prior to the introduction of functional separation in the United Kingdom.²⁰ At the end of 2006 France had 2.1 million fully unbundled local loops and the total for the EU was 4.1 million fully unbundled lines at the end of 2006 representing 7.5% of total lines in the EU.²¹ In this context the EC has empirical evidence that the proportion of resale has fallen in favour of new entrants taking up bitstream access and also shifting from bitstream access to the use of unbundled lines, giving some indication that the 'ladder of investment' is indeed working.²² However, in contrast, US carriers have also undertaken significant investment in upgrading their networks to high speed broadband but have not been subject to extensive unbundling requirements.

As indicated at the beginning of this paper, a number of studies which have tried to correlate unbundling and investment have tended to ignore the impact of the "dot-com bubble" on investment. They also have tended to ignore the complexity of ensuring that effective unbundling is in place. Unbundling has required a number of decisions including determinations on pricing for fully unbundled local loops, collocation decisions, etc. In many countries the implementation of these decisions took one or more years after a decision to require mandatory unbundling was put in place. Thus, until unbundling policies have been fully put in place, it is difficult to support conclusions on their effectiveness in stimulating investment with hard data.

The question of whether service competition leads to facilities competition, and therefore results in further investment in networks, is more complex, partly because investment in broadband facilities has also been robust in some countries that disfavour unbundling. However, data from some countries, such as France, indicate that new entrants that began offering services through unbundling are changing strategy and beginning to invest in their own networks. Neuf Cegetel in announcing its plans for FTTH in April 2007 indicated that it would cover areas which would not cost much and that it would also examine cost-sharing with other operators if possible.²³ One argument in favour of such a strategy is that, once a certain market size is attained in terms of number of customers, it becomes cheaper to construct a network taking into account savings made from not paying monthly rental charges to the incumbent for unbundled lines. On this basis it will only be the new entrants which have reached a certain market size and possibly only

those in the larger urban centres that will construct networks. Since a high percentage of the cost in network construction is for the rights of way and related engineering, the shift to facilities-based investment may only occur where access to rights of way can be obtained at a reasonable price. In the Netherlands as well, new fibre deployment has occurred by new entrants.

A further complication is that as the communications network becomes all IP, investment in networks will shift from copper to fibre and, depending on the architecture of the fibre network, sub-loop unbundling may become the focus for alternative operators. Fibre to the cabinet (see Figure 8) could have significant adverse effects for alternative operators using the LLU, particularly if the incumbent sells off its existing exchanges to pay for fibre installation, *i.e.* the LLU at the exchange will not be available any more. The Association of Licensed Telecoms Operators (ALTO) in Ireland, for example, expressed concern over the delivery of the next-generation network by Eircom, the Irish incumbent, because investments by alternative telecommunication operators in the LLU could be rendered obsolete.²⁴ In this scenario, alternative operators may have to choose between withdrawing from the LLU-based product to a wholesale DSL product (Bitstream) for the time being and investing in sub-loop unbundling at the street cabinet.²⁵ The latter especially means that alternative operators will have to commit significant amounts of investment to build fibre from their equipment to the cabinets in order to unbundle sub-loops or investment in incumbent's local buildings (exchanges) in order to unbundle fibre local loops and copper sub loops (see Figure 8).²⁶ In the United States, incumbent operators must provide public notice of any network change that will affect a competing operator's performance or ability to provide service when incumbent operators retire copper loops or sub-loops they have replaced with FTTH loops; and parties are allowed to file objections to the incumbent operator's notice of such retirement.

GLOSSARY

ATM	Asynchronous Transfer Mode
CREC	Competitive Local Exchange Carrier
DSL	Digital Subscriber Line
ECTA	European Competitive Telecommunications Association
FCC	Federal Communications Commission
FTTH	Fibre to the Home
FTTN	Fibre to the Nodes
IP	Internet Protocol
IPTV	Internet Protocol Television
ISP	Internet Service Provider
LLU	Local Loop Unbundling
MIC	Ministry of Internal Affairs and Communications (Japan)
NGN	Next-Generation Network
OAO	Other Authorised Operator
PSTN	Public Switched Telephone Network
UNE	Unbundled Network Elements
VDSL	Very high speed (high-bit-rate) Digital Subscriber Line
VoIP	Voice over Internet Protocol

ANNEX

**Consolidated capital expenditures of incumbent operators in OECD countries
(USD)**

	2000	2001	2002	2003	2004	2005
Australia	4,420,930,233	1,897,409,326	1,810,869,565	2,391,558,442	3,036,029,412	3,284,732,824
Austria	841,926,606	785,446,429	648,113,208	674,606,742	676,790,123	784,500,000
Belgium	901,834,862	870,535,714	533,962,264	564,044,944	686,419,753	870,000,000
Canada	3,370,671,141	4,838,258,065	3,443,885,350	3,109,785,714	3,567,692,308	3,923,140,496
Czech Republic	480,932,642	493,927,445	345,479,536	247,961,716	225,953,307	253,422,371
Denmark	1,202,103,960	1,344,831,731	975,792,142	835,356,601	859,432,387	937,333,333
Finland	231,192,661	333,035,714	253,773,585	217,977,528	224,691,358	255,000,000
France	6,646,788,991	7,224,107,143	7,019,811,321	5,714,606,742	6,338,271,605	7,556,250,000
Germany	21,592,660,550	9,703,571,429	7,193,396,226	7,148,314,607	7,913,580,247	11,586,250,000
Greece	976,542,056	1,214,375,000	1,049,905,660	1,092,921,348	1,041,481,481	809,125,000
Hungary	541,441,633	445,903,871	426,491,915	404,743,435	452,517,879	498,045,896
Iceland	69,433	39,472	33,598	45,860	44,281	76,224
Ireland	376,146,789	246,428,571	185,849,057	232,584,270	224,691,358	291,250,000
Italy	7,246,788,991	6,456,250,000	4,623,584,906	5,498,876,404	6,175,308,642	6,466,250,000
Japan	24,737,867,681	18,859,540,854	15,771,712,258	17,369,084,793	19,016,554,210	19,886,699,329
Korea	4,052,311,311	3,035,035,903	2,583,623,880	2,693,310,731	2,594,363,147	2,803,186,150
Luxembourg	57,513,761	63,312,500	68,622,642	60,280,899	94,111,111	123,500,000
Mexico	2,275,898,520	2,637,794,433	1,265,734,990	1,027,340,130	1,864,747,564	2,150,366,972
Netherlands	3,529,357,798	2,633,035,714	1,072,641,509	1,596,629,213	2,059,259,259	1,742,500,000
New Zealand	693,181,818	326,890,756	277,777,778	353,488,372	465,562,914	528,873,239
Norway	1,184,204,545	1,294,104,561	1,113,909,774	911,581,921	1,890,949,555	2,552,639,752
Poland	1,845,747,126	1,603,422,983	1,209,803,922	981,491,003	898,907,104	940,123,457
Portugal	1,236,055,046	1,175,178,571	1,060,754,717	732,134,831	939,753,086	1,179,000,000
Slovak republic	115,660,295	125,542,916	127,707,920	140,794,126	197,830,130	219,890,393
Spain	19,229,706,422	7,518,651,786	3,703,981,132	4,163,820,225	4,651,975,309	6,835,750,000
Sweden	1,810,043,668	1,714,714,424	1,472,792,608	1,145,488,257	1,405,578,231	1,550,602,410
Switzerland	823,076,923	691,124,260	722,435,897	862,962,963	916,129,032	869,600,000
Turkey	623,140,913	360,019,418	197,850,091	229,974,627	368,050,650	351,143,331
United Kingdom	7,554,545,455	5,663,768,116	3,649,253,731	4,381,967,213	5,474,545,455	5,712,727,273
United States	51,145,000,000	52,077,000,000	30,981,000,000	25,904,000,000	27,262,000,000	31,027,000,000
Total	169,743,341,831	135,633,257,105	93,790,551,181	90,687,733,655	101,523,220,900	115,988,978,451

**Capital expenditures for the fixed network business by incumbent operators in OECD countries
(USD)**

	2000	2001	2002	2003	2004	2005
Australia	4,194,186,047	1,765,284,974	1,566,847,826	2,121,428,571	2,670,588,235	2,488,549,618
Austria	545,596,330	409,732,143	323,962,264	337,078,652	346,172,840	392,625,000
Belgium	N/A	451,785,714	346,226,415	377,528,090	417,283,951	610,000,000
Canada	N/A	N/A	N/A	2,561,285,714	3,016,384,615	3,305,123,967
Czech Republic	374,715,026	363,722,397	267,104,459	156,114,853	101,245,136	94,240,401
Denmark	455,816,832	436,177,885	404,714,829	330,364,188	367,662,771	349,866,667
Finland	95,412,844	61,607,143	100,000,000	83,146,067	108,641,975	140,000,000
France	4,313,761,468	3,737,500,000	2,116,037,736	1,523,595,506	1,582,716,049	1,797,500,000
Germany	2,738,532,110	3,420,535,714	3,240,566,038	2,595,505,618	2,544,444,444	4,741,250,000
Greece	N/A	N/A	N/A	N/A	425,185,185	261,875,000
Hungary	393,840,811	261,963,768	190,953,507	176,817,797	194,791,615	234,557,571
Iceland	N/A	N/A	N/A	N/A	N/A	N/A
Ireland	N/A	246,428,571	185,849,057	232,584,270	224,691,358	291,250,000
Italy	2,486,238,532	2,537,500,000	2,334,905,660	2,586,516,854	2,798,765,432	3,337,500,000
Japan	7,200,519,625	5,192,133,630	5,823,941,303	7,014,681,273	7,679,628,431	8,279,413,899
Korea	3,090,589,411	2,074,122,960	1,714,672,805	1,748,365,657	1,587,771,976	1,977,531,930
Luxembourg	N/A	N/A	N/A	N/A	N/A	N/A
Mexico	2,053,000,000	2,495,000,000	1,138,000,000	996,000,000	1,499,000,000	1,382,000,000
Netherlands	1,173,394,495	508,928,571	271,698,113	286,516,854	571,604,938	882,500,000
New Zealand	158,636,364	97,478,992	145,370,370	202,325,581	282,119,205	337,323,944
Norway	409,431,818	531,701,891	365,789,474	221,468,927	218,545,994	336,801,242
Poland	1,237,471,264	1,263,080,685	819,852,941	712,596,401	607,650,273	560,185,185
Portugal	348,532,110	356,160,714	570,471,698	185,730,337	255,308,642	291,375,000
Slovak Republic	115,660,295	125,542,916	127,707,920	140,794,126	197,830,130	127,917,473
Spain	1,683,376,147	1,677,839,286	1,645,273,585	1,663,483,146	1,490,802,469	1,758,200,000
Sweden	N/A	708,615,682	477,926,078	333,498,146	453,605,442	436,412,316
Switzerland	286,982,249	278,106,509	307,051,282	368,148,148	290,322,581	282,400,000
Turkey	579,021,541	329,230,359	178,549,142	220,682,309	266,196,257	200,019,769
United Kingdom	3,443,939,394	2,860,869,565	2,465,671,642	2,965,573,770	3,601,818,182	3,660,000,000
United States	40,757,000,000	41,422,000,000	22,172,000,000	18,173,000,000	18,153,000,000	20,032,000,000

**Investments by all alternative fixed operators in OECD countries
(USD Million)**

	2000	2001	2002	2003	2004	2005
Denmark	455	390	337	307	368	393
Finland	399	288	152	160	175	409
Hungary	51	66	102	237	193	282
Italy	1,006	1,353	1,761	2,140	1,342	1,143
Japan	12,508	4,748	2,961	1,797	N/A	N/A
Portugal	1,081	879	984	331	451	348
Sweden	N/A	114	354	478	594	354
Switzerland	1,342	855	761	609	676	809
United States	47,062	40,157	18,338	13,000	9,387	N/A

List of the year end

	Year end
Australia	June
Austria	December
Belgium	December
Canada	December
Czech Republic	December
Denmark	December
Finland	December
France	December
Germany	December
Greece	December
Hungary	December
Iceland	December
Ireland	March
Italy	December
Japan	March
Korea	December
Luxembourg	December
Mexico	December
Netherlands	December
New Zealand	June
Norway	December
Poland	December
Portugal	December
Slovak Republic	December
Spain	December
Sweden	December
Switzerland	December
Turkey	December
United Kingdom	March
United States	December

Note: Figures within the year end other than December are put in the previous year.

Exchange rates

	2000	2001	2002	2003	2004	2005
Australia	1.72	1.93	1.84	1.54	1.36	1.31
Austria	1.09	1.12	1.06	0.89	0.81	0.8
Belgium	1.09	1.12	1.06	0.89	0.81	0.8
Canada	1.49	1.55	1.57	1.4	1.3	1.21
Czech Republic	38.6	38.04	32.74	28.21	25.7	23.96
Denmark	8.08	8.32	7.89	6.59	5.99	6
Finland	1.09	1.12	1.06	0.89	0.81	0.8
France	1.09	1.12	1.06	0.89	0.81	0.8
Germany	1.09	1.12	1.06	0.89	0.81	0.8
Greece	1.07	1.12	1.06	0.89	0.81	0.8
Hungary	282.18	286.49	257.89	224.31	202.75	199.58
Iceland	78.62	97.42	91.66	76.71	70.19	62.98
Ireland	1.09	1.12	1.06	0.89	0.81	0.8
Italy	1.09	1.12	1.06	0.89	0.81	0.8
Japan	107.77	121.53	125.39	115.93	108.19	110.22
Korea	1130.96	1290.99	1251.09	1191.61	1145.32	1024.12
Luxembourg	1.09	1.12	1.06	0.89	0.81	0.8
Mexico	9.46	9.34	9.66	10.79	11.29	10.9
Netherlands	1.09	1.12	1.06	0.89	0.81	0.8
New Zealand	2.2	2.38	2.16	1.72	1.51	1.42
Norway	8.8	8.99	7.98	7.08	6.74	6.44
Poland	4.35	4.09	4.08	3.89	3.66	3.24
Portugal	1.09	1.12	1.06	0.89	0.81	0.8
Slovak Republic	46.04	48.35	45.33	36.77	32.26	31.02
Spain	1.09	1.12	1.06	0.89	0.81	0.8
Sweden	9.16	10.33	9.74	8.09	7.35	7.47
Switzerland	1.69	1.69	1.56	1.35	1.24	1.25
Turkey	0.63	1.23	1.51	1.5	1.43	1.34
United Kingdom	0.66	0.69	0.67	0.61	0.55	0.55
United States	1	1	1	1	1	1

NOTES

- ¹ Several countries had adopted local loop unbundling in the early period of market liberalisation mainly as a means of stimulating service competition in telephony markets.
- ² Pio Baake, Brigitte Preissl (2006) 'Local Loop Unbundling and Bitstream Access: Regulatory Practice in Europe and the U.S.', DIW Berlin, *Politikberatung kompakt* 20: 123.
- ³ Cave, M and I, Vogelsang (2003) 'How access pricing and entry interact', *Telecommunications Policy* 27: 722.
- ⁴ Cave, M and I, Vogelsang (2003) 'How access pricing and entry interact', *Telecommunications Policy* 27: 725-726; Waverman, L and K, Dasgupta (2006) *Investment in Telecommunication Networks: A 21st Century Perspective*, LECG: 19-20; Genna, I. M. (2007) *Telecommunications Liberalisation: Issues and Players ECTA's view*, Zagreb, Croatian Chamber of Commerce, February 21: 12.
- ⁵ Pio Baake, Brigitte Preissl (2006) 'Local Loop Unbundling and Bitstream Access: Regulatory Practice in Europe and the U.S.', DIW Berlin, *Politikberatung kompakt* 20: 29.
- ⁶ Crandall, R. W. et al. (2004) 'Do Unbundling Policies Discourage CLEC Facilities-Based Investment', An Article Submitted to *The B. E. Journals in Economic Analysis & Policy* (manuscript 1136), Berkeley Electronic Press.
- ⁷ Page 36,
http://ec.europa.eu/information_society/policy/ecom/comm/doc/library/annualreports/12threport/sec_2007_403.pdf
- ⁸ See http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/IAD/hspd0607_tables.xls, Table 1.
- ⁹ Triennial Review Order, FCC 03-36: 173.
- ¹⁰ Regulation (EC) No 2887/2000 of the European Parliament and of the Council of 18 December 2000 on unbundled access to the local loop, Article 2 (d).
- ¹¹ Pio Baake, Brigitte Preissl (2006) 'Local Loop Unbundling and Bitstream Access: Regulatory Practice in Europe and the U.S.', DIW Berlin, *Politikberatung kompakt* 20: 42.
- ¹² 'Fibre to the cabinet: a disaster for local loop unbundlers?', Analysis, February 2007, at: <http://www.analysys.com/pdfs/february07.pdf>: 1; 'What is Local Loop Unbundling?', Ofcom.
- ¹³ 'Is fibre to the cabinet a disaster for local loop unbundlers?', Total Telecom, 9 February 2007, at: <http://totaltele.com/View.aspx?ID=89841&t=2>.
- ¹⁴ Regulation (EC) No 2887/2000 of the European Parliament and of the Council of 18 December 2000 on unbundled access to the local loop. Regulation does not need to be incorporated in the domestic laws in each country, so it became effective from January 2001.

- 15 See at: http://www.francetelecom.com/en/financials/investors/data/20f/att00002297/20f_2005.pdf: 196.
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- 19 Yoon, Jong-Lok ‘KT’s FTTH Service Scenario’, 4 September 2006, at: http://www.apoc2006.org/apoc_plenary_file/Plenary%20JR%20Yoon_KT.pdf.
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- 21 See EC 12th Implementation Report, http://ec.europa.eu/information_society/policy/ecom/doc/implementation_enforcement/annualreports/12threport/sec_2007_403.pdf
- 22 *ibid.* page 36.
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- 26 ‘Unbundling is on the up in Western Europe – but incumbents can retain significant market share’, research.analysis, December 2006, at: <http://research.analysis.com/default.asp?iLeftArticle=2279>.