

OFTA

Report on the
Effectiveness of Competition in
Hong Kong's Telecommunications Market:
An International Comparison

June 2003

Preface	1
1 Introduction	2
1.1 The importance of a competitive telecommunications industry	2
1.2 The importance of telecommunications to Hong Kong	2
1.3 Study objectives	3
1.4 Study methodology	3
1.5 Structure of this report	4
2 Competition environment and regulatory framework	5
2.1 Introduction	5
2.2 Hong Kong regulatory overview	5
2.3 Regulatory position	5
2.4 State involvement in the incumbent and foreign ownership restrictions	6
2.5 Local loop unbundling	6
2.6 Key conclusions	7
3 Development and effectiveness of competition	8
3.1 Introduction	8
3.2 Local fixed voice sector	8
3.3 Mobile sector	9
3.4 Data access sector	13
3.5 International services sector	14
3.6 Key conclusions	17
4 Consumer benefits	19
4.1 Introduction	19
4.2 Take-up of services	19
4.3 Cost of services	21
4.4 Consumer savings	23
4.5 Key conclusions	24
5 Industry investment	25
5.1 Introduction	25
5.2 Telecommunications investment	25
6 Hong Kong's overall performance	27
6.1 Core strengths	27
6.2 Key challenges	28
Appendix: Study methodology	29
Study objective	29
Analytical approach	29
Glossary	31

Preface

In August 2002, the Office of the Telecommunications Authority ("OFTA") commissioned Spectrum Strategy Consultants ("Spectrum") to undertake an international benchmarking study (the "Study") to assess the competitiveness of Hong Kong's telecommunications industry relative to other comparable and "best practice" markets. The Study was undertaken over the period August 2002 to May 2003.

This report summarises the conclusions of the Study. It was written entirely by Spectrum's project team. All the views and opinions expressed within this report, therefore, may not necessarily reflect the views and opinions of OFTA. Whilst Spectrum has exercised all reasonable endeavours in undertaking the Study, any assumptions, projections, findings, conclusions and recommendations represent Spectrum's best professional judgement based on the information made available during the course of the engagement.

1 Introduction

1.1 The importance of a competitive telecommunications industry

A dynamic, innovative, efficient and competitive telecommunications industry is fundamental to the economic development and prosperity of any market. Telecommunications networks create the links that facilitate transactions and relationships and thereby, economic activities. As economies, companies and people become more connected, the need to have high quality telecommunications infrastructure becomes increasingly important.

It is generally recognised that telecommunications networks and the services offered over the networks are enhanced through the process of competition. The specific benefits derived from a competitive and dynamic telecommunications industry are detailed below.

Exhibit 1: The benefits of a competitive and dynamic telecommunications industry

- A competitive telecommunications industry provides significant benefits to end-users
- A developing and competitive telecommunications industry generates significant direct employment, additional revenues and incremental investments in networks and services
- A well-developed telecommunications infrastructure is increasingly important to attract incremental investment and capital across all industry sectors
- A competitive, comprehensive and advanced telecommunications infrastructure supports the exchange of information, knowledge and ideas which is an important part of higher-order activities and sectors
- An improved telecommunications infrastructure encourages higher productivity levels in the wider economy resulting from a reduction in the transaction costs associated with business activities

Due to the increased importance of telecommunications in ensuring economic prosperity and the apparent link between competition and higher quality telecommunications networks, many policy-makers are focused on ensuring a healthy level of competition in their telecommunications industries. For those markets, therefore, which are dependent on attracting and fostering higher-order activities it is important to continually assess and review the actions of policy-makers in other comparable markets. If other comparable markets establish superior reputations for higher-quality and more cost-effective telecommunications networks and services, it clearly becomes increasingly difficult for the market to retain a leading international status.

This is the key issue for Hong Kong. The analysis presented in this Study, therefore, is an important input to this continual review and assessment of Hong Kong's relative performance.

1.2 The importance of telecommunications to Hong Kong

Hong Kong is one of the world's leading cities and one of the largest financial centres, comparable to London, New York and Tokyo. Its position as the regional centre for higher-order activities, for example financial services, professional services and corporate headquarters, has been achieved through a combination of its geographical location, regulatory and judicial frameworks and more recently, by the availability of high quality telecommunications services at competitive prices.

It is important for Hong Kong, therefore, to maintain a competitive telecommunications industry, not only to benefit existing users of telecommunications, but also to ensure the continued and enhanced prosperity of Hong Kong in future years. Any erosion in the quality of telecommunications networks or services may

reduce Hong Kong's role as a leading city in the Asia-Pacific region. Consequently, it is important for Hong Kong to continually assess its relative performance and to determine areas in which it performs well, but also to identify areas in which there is potential for further improvement.

1.3 Study objectives

OFTA is keen to ensure a competitive and dynamic telecommunications industry. Competitiveness, however, is a relative concept and in order to assess just how competitive the Hong Kong market is, it is necessary to benchmark Hong Kong's position against other markets.

Benchmarking analysis is needed because it is difficult to assess Hong Kong's performance based purely on historic performance or other internal parameters. Even if Hong Kong has been improving the competitiveness of its telecommunications industry, if it is discovered that other markets are consistently maintaining higher levels of competitiveness then it is possible to identify areas in which Hong Kong can improve its performance. This is particularly the case given the current rapid rate of technological innovation.

Given the need for benchmarking analysis, the primary objective of the Study was to assess the competitiveness of the Hong Kong telecommunications industry relative to other comparable and "best practice" markets. In particular, the analysis focused on four key competition issues.

Exhibit 2: Key competition issues addressed in the Study

- **The regulatory framework**
 - the extent to which the regulatory framework promotes the development of competition including issues related to interconnection, the strength and effectiveness of the regulator and other issues to promote competition
- **The development and effectiveness of competition**
 - the liberalisation process and timetable, and the number of operators in the different industry sectors
 - the degree to which the market has become increasingly competitive and the incumbent's position and market dominance has been eroded, i.e. whether new entrants have been able to gain market share
- **The consumer benefits which have been derived from competition**
 - with a specific focus on take-up and use of services, pricing and consumer savings which have resulted from higher levels of competition
- **The impact on the investment behaviour of operators**
 - the relationship between competition and industry investment, with a specific focus on industry investment between 1991 and 2001

The analysis assessed the above issues for the four most important sectors within the telecommunications industry. These are the local fixed voice sector; the mobile sector; the data access sector; and the international services sector. These sectors constitute the majority of the telecommunications industry and trends within these sectors have profound impacts on end-users and the general industry structure.

1.4 Study methodology

The Study compared Hong Kong's performance against seven markets: Australia; Japan; Singapore; South Korea; Sweden; UK; and the US. These markets were selected as they are widely seen to have well-developed and competitive telecommunications industries. It was considered appropriate, therefore, to compare Hong Kong's relative performance against these markets.

1.5 Structure of this report

The following report summarises and presents the results of the benchmarking analysis undertaken. Chapters 2 to 5 highlight Hong Kong's performance for each of the key competition issues detailed above. Chapter 6 details Hong Kong's overall performance. An appendix at the end of the report provides details of the methodology used in the analysis.

2 Competition environment and regulatory framework

2.1 Introduction

It is important to recognise that competition is neither created nor fostered simply by the process of licensing new operators but by the ability of new entrants to access end-users and the extent to which the incumbent is able to constrain the development of competition. Consequently, the regulatory framework is very important in determining the effectiveness of competition as measured by the ability of new entrants to acquire subscribers and gain market share. For example, in those markets where the regulator has not necessarily adopted a strong and focused approach to the promotion and development of competition, it is possible for the impact of competition to be relatively small regardless of the number of new entrants licensed.

The Study has, therefore, undertaken an assessment of the regulatory framework and environment in Hong Kong relative to the comparison markets, with specific reference to the extent to which regulators can be viewed as pro-competition and consumer-focused.

2.2 Hong Kong regulatory overview

OFTA has established an international reputation for its consistent and transparent regulation of the Hong Kong telecommunications industry. Since its foundation in 1993, OFTA has recognised that market forces are most efficient in determining the appropriate market structure and ensuring that consumer benefits are maximised. It has, therefore, adopted a pro-competition regulatory approach across all sectors. As well as permitting a relatively large number of new entrants into each sector, OFTA has further encouraged the development of competition through a technology-neutral licensing regime and no restrictions of the level of foreign ownership in any Licensee. Competition is also encouraged through pro-competition safeguards in the Telecommunications Ordinance and in the terms and conditions of all licences. Furthermore, to ensure a high level of transparency, all regulatory policies and decisions are clearly indicated and communicated to the industry and the public through OFTA's web-site.

2.3 Regulatory position

Regulators differ in their approaches towards competition and its promotion. There is a broad range of regulatory behaviour in the telecommunications industry from very pro-competitive stances to a desire to actually reduce levels of competition. This Study, therefore, undertook a qualitative assessment of recent regulatory actions in Hong Kong and the review markets based on publicly available news in order to determine the extent to which regulators could be considered pro-competitive.

On the basis of the analysis, it is clear that some regulators appear to have established greater industry credibility than others, especially with respect to the development and promotion of competition, whilst others seem to have reduced their focus on competition and consumer benefits. In some markets, for example, consolidation has been actively encouraged and in others, the regulator has struggled to influence the behaviour of the incumbent.

The Hong Kong regulator is consistently perceived as very focused on the development and promotion of competition with a strong emphasis on maximising consumer benefits. It has established this reputation by maintaining a consistent focus and approach over time. The closest comparable regulator is considered to be the US regulator, although there are similarities between the Hong Kong regulator and those in the UK and Sweden.

2.4 State involvement in the incumbent and foreign ownership restrictions

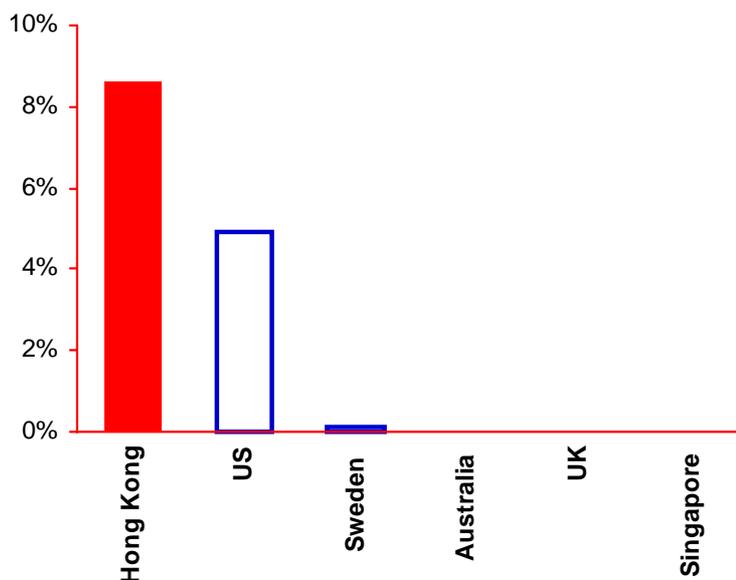
It can be argued that any state ownership or involvement in the incumbent may be detrimental to the development of competition. In contrast to a number of other review markets but comparable to the UK and US, Hong Kong does not have any government ownership in the incumbent operator. Similarly there are no foreign ownership restrictions but this is a feature that is more common across the review markets. Although a number of markets limit foreign ownership of the incumbent there is a general trend to permit unlimited foreign ownership of new entrants. In this respect, there is little to differentiate Hong Kong from the review markets.

2.5 Local loop unbundling

It often takes significant capital investment and time for new entrants to build a local access network to connect with end-users and provide services in competition with the incumbent. This capital investment may be prohibitively expensive and may, therefore, constrain the development of competition to the possible detriment of consumers.

In order to increase competition, therefore, a number of regulators have sought to unbundle the legacy copper local fixed voice networks of the incumbents. This is known as local loop unbundling (“LLU”). However, this policy has not been adopted by all markets and even where it has been implemented, the incumbent has often been able to reduce the competitive impact to a minimal level. Consequently, the total number of unbundled lines (whether used for broadband or narrowband services) account for a significant percentage of total local access lines in only a small number of markets.

Exhibit 3: Unbundled lines as a percentage of all local access lines (used for broadband or narrowband services)



Note: In Hong Kong, includes Type II interconnection
 Does not include lines provided on a wholesale / resale basis
 Data for year end 2002
 There are an estimated 100 unbundled lines in Australia. In April 2002, there were 250 unbundled lines in the UK.
 Accurate information on the number of LLU lines in Japan and South Korea is not available at time of publication.
 No significant number of unbundled lines in Singapore

Source: FCC, ECTA & OFTA

Hong Kong and the US have established themselves as the leading markets with respect to the LLU process. LLU is also understood to have been relatively successful in Japan but accurate information of the exact number of unbundled lines remains unclear at date of publication. This promotion of LLU by Hong Kong may have accelerated the development of competition with consequent impacts on market structure and derived consumer benefits.

2.6 Key conclusions

The Hong Kong regulator has adopted a pro-competitive stance on most issues and has created a regulatory environment that facilitates competition and promotes consumer benefits. Compared to Hong Kong, few other markets are considered to have created such a strong regulatory environment to develop and promote competition, although the US also has a strong emphasis on competition in its regulatory framework and shares many similar traits.

The Hong Kong regulatory environment is very progressive with a strong emphasis on network and service based competition. The regulator has consistently sought to create a regulatory framework that is stable, coherent and market-orientated. Compared to many other markets the resulting framework is very pro-competitive and consumer-focused and as a framework designed to promote competition, it has been very successful.

The key conclusions for Hong Kong are summarised below.

Exhibit 4: Key conclusions for Hong Kong

- The Hong Kong regulator appears to be far more focussed on the development of competition and the promotion of consumer benefits than the regulators of other reviewed markets. This is reflected not only in its actions, but also in wider public perception
- Although Hong Kong does not have any general competition laws, the Telecommunications Ordinance appears to cover all the key anti-competitive practices covered by competition laws in other review markets for the telecommunications industry
- The Hong Kong government has traditionally not involved itself in the telecommunications industry beyond its regulatory duties. In contrast to many other markets, it has not had any ownership in either the incumbent nor any other operator and has no foreign ownership restrictions for any operator, not even the dominant operator in the market. This has allowed the regulator to adopt policies which it considers most beneficial for Hong Kong and for end-users, rather than being constrained by either a direct or indirect relationship with a particular operator in the market
- The LLU process in Hong Kong is significantly more advanced than for other markets. This has facilitated market entry and has helped to increase the level of competition in the local fixed voice sector in Hong Kong

Reflecting its broader objectives, the regulatory framework constructed by the Hong Kong regulator has provided an environment conducive to the development of competition and market entry by new players. The actual impact of this regulatory framework in ensuring effective and strong competition in the telecommunications industry is discussed in the following chapter.

3 Development and effectiveness of competition

3.1 Introduction

The introduction and development of competition in all telecommunications sectors has become a primary driving force for regulators across most markets. The 1990s were characterised by the deregulation of fixed-line sectors, both local and international, and an increase in competition in the mobile sector.

However, although many markets have introduced competition in all their telecommunications sectors it is recognised that it may take time for the introduction of market competition to result in significant changes in market structure. In particular, differences in the liberalisation process, regulatory frameworks and regulatory focus (as discussed in the previous chapter) as well as different market characteristics all have an impact on the ability of new market entrants to acquire subscribers and gain market share. This may in turn impact on derived consumer benefits, although it is noted that consumers can also derive significant benefits from a benevolent incumbent which retains a high market share.

The objective of the Study, therefore, was to compare the development and effectiveness of competition in the Hong Kong telecommunications industry against the review markets. Specifically the Study assessed the rate of introduction of competition in the different telecommunications sectors and also assessed the effectiveness of competition as measured by changes to the market structure. This is measured with reference to two issues. First, the market share of the incumbent; and second, the level of market concentration, i.e. the extent to which the market has become increasingly fragmented.

3.2 Local fixed voice sector

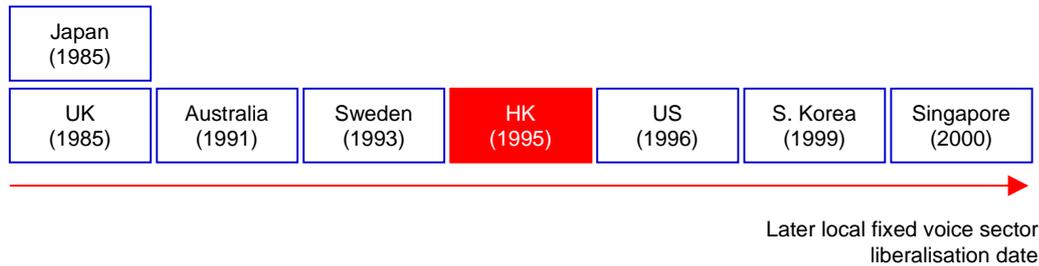
3.2.1 *Hong Kong overview*

Competition in the local fixed voice sector was introduced through a series of steps. It was first introduced in the Hong Kong local fixed voice sector in 1995 with the licensing of three additional fixed telephone network service ("FTNS") operators to compete with the incumbent. In 2000, OFTA licensed a further five wireless-based FTNS, and the cable TV operator to provide telecommunications services over its HFC network. From the 1st January 2003, the local fixed telecommunications market was fully liberalised. At the time of publication, there are seven wireline FTNS licensees, one FTNS over HFC licensee and two wireless FTNS licensees. The introduction of competition has eroded the incumbent's market share and at the end of 2002, the incumbent accounted for approximately 82% of the local fixed voice sector. In particular, the development of competition in this sector has been facilitated through the implementation of local loop unbundling that has increased the ability of new entrants to access end-users and compete with the incumbent.

3.2.2 *International comparison*

Nearly all the review markets had liberalised their local fixed voice sectors by 1999 and Singapore followed in 2000. The liberalisation process sometimes took the form of the introduction of duopoly or controlled competition, with full competition being introduced later.

Exhibit 5: Dates of initial liberalisation in the local fixed voice sector



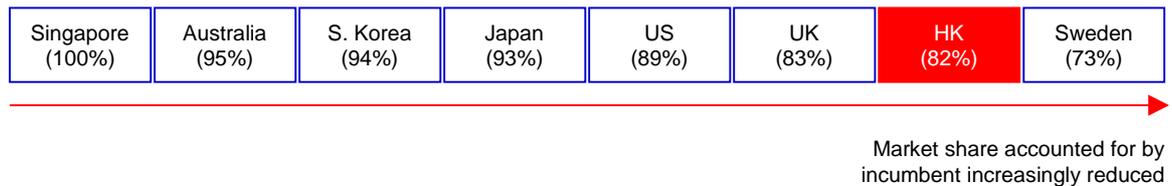
Note: Liberalisation date generally taken to be date when licences can be utilised.

Source: Various

In Asia, Hong Kong was one of the first markets to liberalise its local fixed voice sector, although it did so significantly later than Japan and the UK. However, full competition in Hong Kong's local fixed voice sector was only introduced from the beginning of 2003. Until then, there were four wireline operators licensed to provide local fixed voice services at the end of 2002¹. This compares to more than 250 reporting local exchange carriers in the US and in New York City, a comparable area to Hong Kong, there are 29 reporting local exchange carriers. Similarly, in the UK and Japan there is significantly larger number of licensed local service providers, even when the larger size of these markets is considered.

Despite the introduction of competition, it is clear that in most markets the local fixed voice incumbent has been relatively successful at retaining market share although this is often a function of the regulatory environment. In Hong Kong, however, the incumbent has lost more market share than in many other review markets. Only in Sweden have new entrants gained greater market share in the local fixed voice sector than new entrants in Hong Kong.

Exhibit 6: Local fixed voice sector market share of incumbent operators



Note: Data for year end 2002, except Japan and US data (3Q 02) and Sweden and UK (2Q 02)

Despite liberalisation of the Singapore local fixed voice sector in 2000, there was no significant competition to incumbent by year end 2002. Hence, the incumbent operator practically retains around 100% market share.

Source: Various including Merrill Lynch, CSFB, OFTA, PTS, OFTEL & FCC

3.3 Mobile sector

3.3.1 Hong Kong overview

The Hong Kong Government has sought to encourage a high level of competition in the Hong Kong mobile sector. In 1984, three licences for cellular service provision were issued with a fourth licence subsequently issued in 1992. In 1996, a further six PCS licences were issued. Two of the PCS licences were issued to

¹ If Hong Kong Broadband Network, a LMDS operator until end-2002, is included, there were 5 operators providing local fixed voice services at year-end 2002.

existing mobile licensees taking the total number of mobile operators to eight. Subsequent consolidation in Hong Kong has taken the number of mobile network operators to six and in 2001, OFTA has issued four 3G licences.

Competition in the market has, however, been further developed through the development of Mobile Virtual Network Operators (“MVNOs”). There are currently six MVNOs active in Hong Kong and OFTA has provided a framework for 3G MVNO access that ensures that 3G network operators must provide at least 30% of their network capacity to non-affiliated MVNOs. Competition has also been promoted in the mobile sector through the introduction of mobile number portability (“MNP”) in March 1999 which significantly reduced a barrier that a subscriber may have faced when moving between mobile service providers.

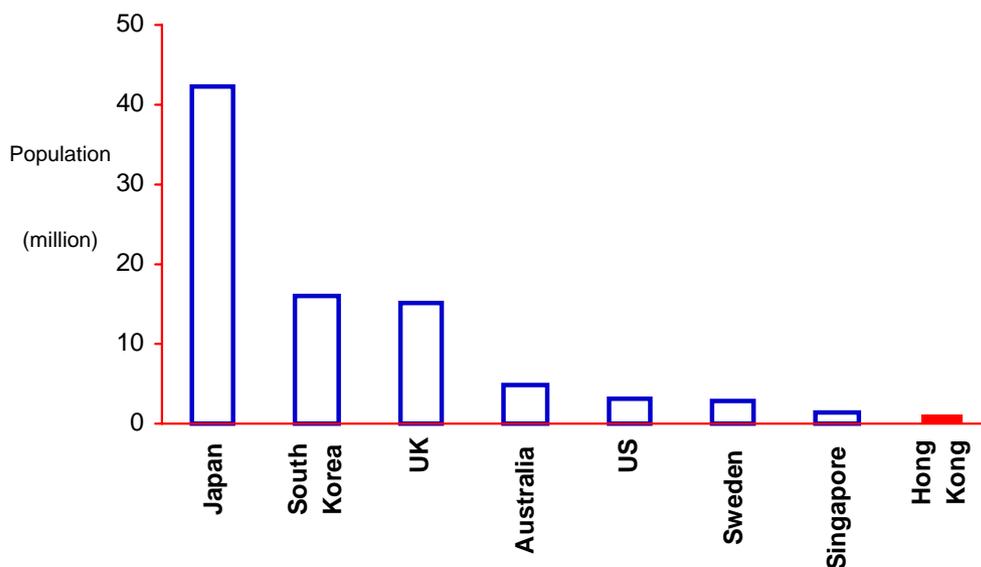
Given the high level of competition, Hong Kong has a more fragmented sector than any other review market and no mobile operator accounts for more than 30% of the market.

3.3.2 International comparison

All the review markets introduced greater competition into their mobile sectors during the 1990s. Hong Kong, with Japan, the UK and the US, led in terms of introducing competition in the mobile sector. In 1984, the government licensed three mobile operators - significantly more than many other markets at a comparable stage of sector development. Furthermore, competition was not introduced in the South Korean mobile sector until 1996 and in the Singapore mobile sector until 1997.

Due to spectrum limitations and other policy considerations, the number of network operators in all markets is controlled. Some regulators, however, have licensed more mobile operators relative to the size of their markets than others. This can be described as the population to mobile network operator ratio.

Exhibit 7: Average population base per mobile network operator, 2002

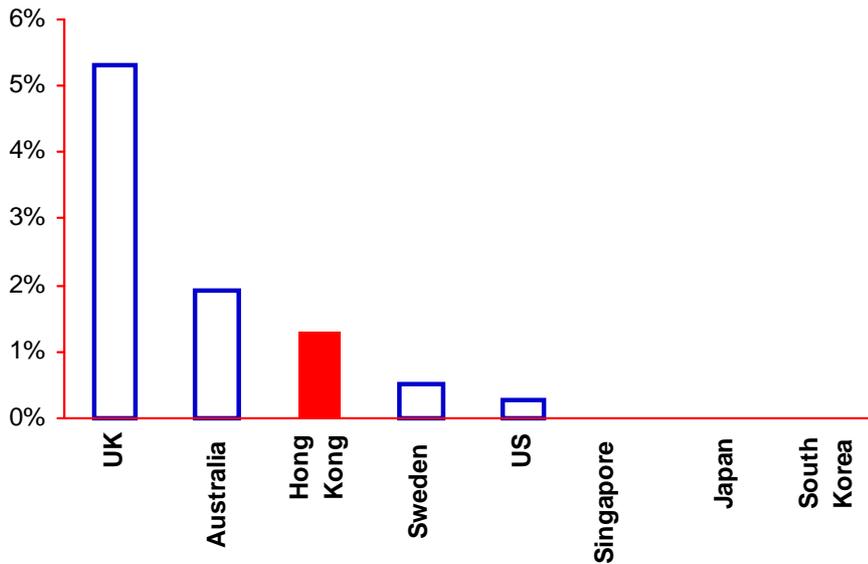


Note: The figure for the US is for New York State

Source: Spectrum analysis, EIU

Hong Kong has the lowest population to mobile operator ratio, reflecting the competitive status of Hong Kong's mobile market. Competition in Hong Kong is further increased through the presence of MVNOs. Hong Kong is just one of the two review markets (the other being Sweden) to have a defined MVNO framework.

Exhibit 8: MVNO subscribers as percentage of total mobile subscribers



Note: Data for year end 2002.

No MVNO subscribers in Singapore, Japan and South Korea.

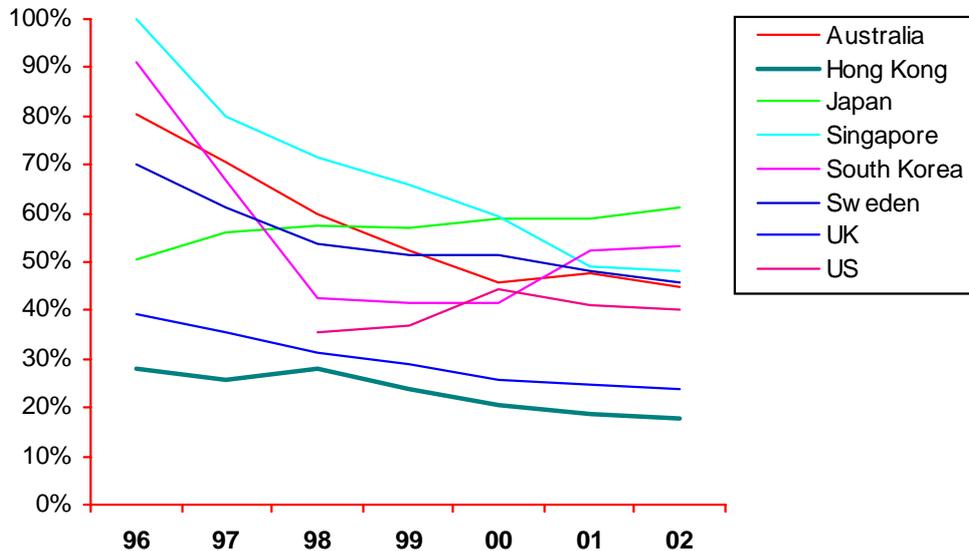
Source: Spectrum analysis

MVNO activity in Hong Kong is less significant than in the UK and Australia as many of the MVNOs in Hong Kong have a shorter history than those in the UK or Australia. The 6 MVNOs in Hong Kong account for more than 1% of Hong Kong's total mobile subscriber base, which is less than that recorded by MVNOs in UK and Australia. MVNO activity in Hong Kong, however, is creating further competitive forces in an already highly competitive sector.

In the mobile sector, the Hong Kong incumbent (defined in this analysis as CSL due to its previous affiliation with HKT) has never had a strong market position as recorded by incumbents in other markets due to the licensing framework². This is a similar situation to that experienced in the UK. In the other review markets, the incumbents retain approximately 40-60% market shares and in a number of markets, the incumbent has actually been able to increase its market share in recent years.

² The unique licensing arrangements of the UK and Hong Kong mobile markets are noted. Although BT Cellnet / O₂ and CSL are considered the mobile incumbents in their respective markets due to their links with the fixed line incumbent, it is noted that they were not the only Licensees at the outset of mobile services.

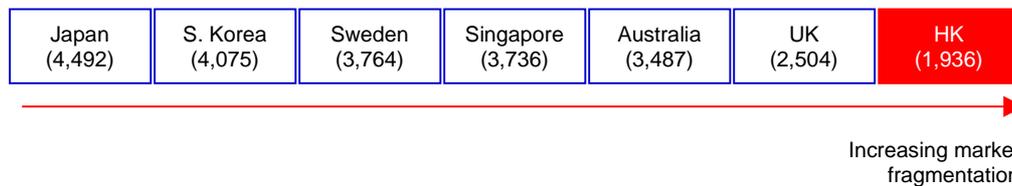
Exhibit 9: Mobile market share of incumbent operators



Source: Various including Baskerville, PTS & CTIA.

An alternative measure to assess the development of competition is that of market concentration, i.e. the extent to which one or any number of market participants dominate the market. The Herfindahl-Hirschman index ("HHI") of market concentration for the mobile sectors in the review market is detailed below³.

Exhibit 10: Mobile sector concentration ratio, as measured by HHI



Note: US not included due to lack of data

A ratio of 10,000 implies a pure monopoly with one operator recording 100% market share and a ratio of 0 implies a totally atomised market with all market participants recording market share of 0%.

Given the underlying methodology a market with four mobile operators will have a minimum HHI score of 2,500.

Source: Spectrum analysis

Hong Kong has the most fragmented mobile sector when compared to the other review markets. It is significantly less concentrated than the mobile sectors in Japan, South Korea, Sweden, Singapore and Australia. Although the UK remains relatively comparable, the Hong Kong mobile sector by both measures presented here (i.e. the mobile market share of incumbent operator and mobile market concentration ratio) is considered to be more competitive.

³ See Appendix for a more detailed overview of the HHI.

3.4 Data access sector

3.4.1 *Hong Kong overview*

The data access sector in Hong Kong is competitive, especially in the corporate sector with a large number of broadband service providers. There are currently 234 ISPs in Hong Kong, a significant increase from one in 1993 and 124 in 1997. Internet traffic volumes have increased significantly with traffic via broadband networks reaching approximately 28,000 Terabits in December 2002. There has, however, been a gradual decline in the amount of data traffic carried via PSTN networks, i.e. narrowband Internet access, with minutes of use reaching 355m in December 2002 from approximately 560m in March 2002. This indicates the growing importance of broadband access with the number of broadband subscribers reaching nearly one million at the end of 2002 representing a population penetration rate of approximately 14.5% and a household penetration rate of 42%. In terms of broadband subscribers, the residential market share accounted for by the incumbent is approximately 54%.

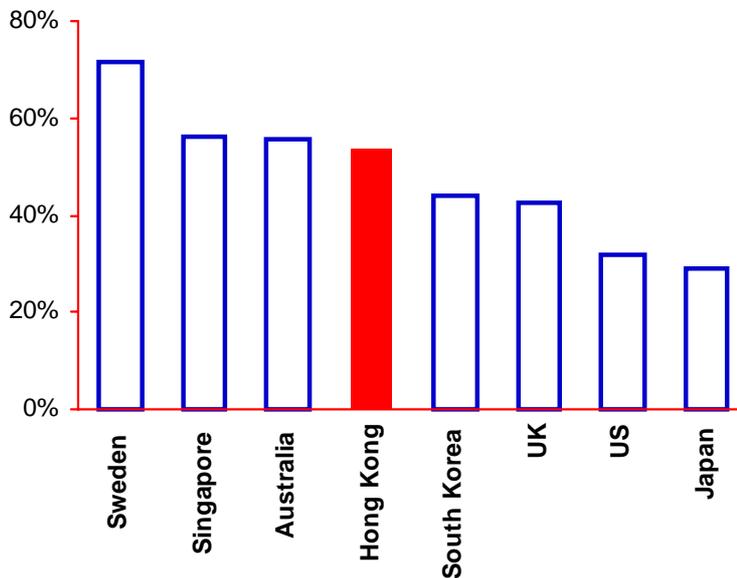
3.4.2 *International comparison*

The provision of data services is a relatively recent development with most markets not reporting any significant take-up of residential broadband services until 2000 and 2001. In most markets, there exists strong infrastructure competition for the residential market between the incumbent local fixed voice operator and cable access television ("CATV") operators who both perceive broadband provision as an extension of existing activities. Furthermore, data access provision in the corporate market remains highly competitive in most markets with a full range of service providers competing for subscribers.

It is difficult to assess consistently and accurately the number of data access service providers in the review markets over time. Therefore, this Study has not been able to quantitatively assess the development of competition in this sector over time.

It is, however, possible to examine the current status of competition in the broadband sector. The broadband sector is relatively new and is still developing, especially residential provision. In most markets, despite the introduction of network unbundling, the existing infrastructure operators, either the local fixed voice incumbent or the CATV operator(s), remain dominant in the provision of broadband access services to residential households. The exhibit below details the residential broadband market share claimed by the local fixed voice incumbent.

Exhibit 11: Broadband residential market share of incumbent operators



Note: Share of residential broadband accounts
Data for year-end 2002, except Sweden & US (3Q 02)
Source: Baskerville, KRNIC, PTS, OFTEL & FCC

The incumbent in Hong Kong commands a higher market share than its contemporaries in South Korea, UK, US and Japan. But at slightly more than 50% of the total market, this is less than Australia, Singapore and Sweden. Furthermore, the Hong Kong incumbent's market position has declined since 2001 suggesting increasing levels of competition in this sector.

3.5 International services sector

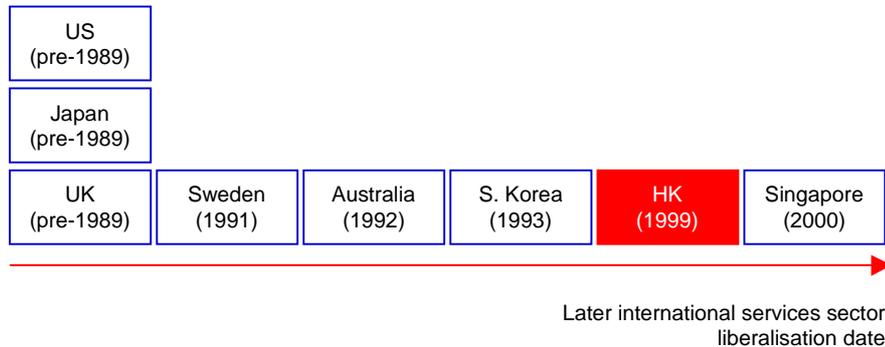
3.5.1 Hong Kong overview

Hong Kong's international services market was liberalised from 1st January 1999 and the international facilities market on 1st January 2000. Up to May 2003, there are four satellite-based External FTNS licensees and 17 cable-based External FTNS licensees. In addition, there are 224 External Telecommunications Service (ETS) operators in Hong Kong. The introduction of competition has been associated with a substantial increase in the use of international services with the number of outgoing international direct dial minutes per person increasing from approximately 290 in 1998 to nearly 520 in 2001. The new entrants have been able to rapidly gain market share and the market share accounted for by the incumbent is now less than 30%. This is less than the market share recorded by the incumbent in any other review market.

3.5.2 International comparison

Hong Kong was relatively late to liberalise its international services sector and in this sample, only Singapore introduced competition into this sector after Hong Kong.

Exhibit 12: Dates of liberalisation in the international services sector



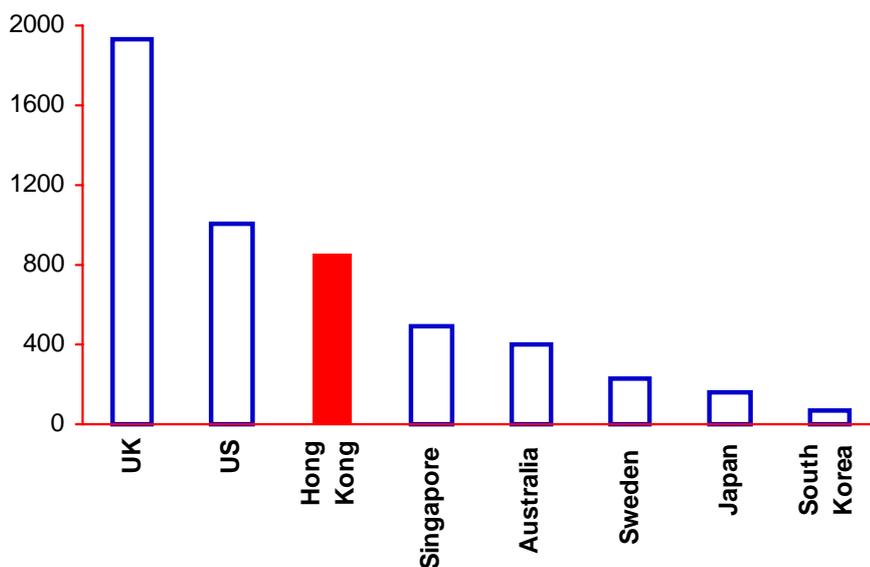
Source: Spectrum analysis

Since liberalisation, all markets have experienced significant increases in the number of licensees providing international services to end-users. It is, however, difficult to track the actual number of licensees providing international services and facilities, especially as service-based competition is increasingly important in this sector.

One measure that may be indicative of the development of competition and capacity in the international services sector is that of Internet international bandwidth and connectivity. This measure is considered indicative of the development of competition in this sector since the availability of international connectivity determines the ability of new entrants to provide effective service level competition. It would be expected, for example, that markets with a higher level of international connectivity would be able to sustain a higher level of service based competition in the international services sector than markets with a lower level of international connectivity.

International connectivity has increased significantly in all the markets between 1999 and 2001.

Exhibit 13: International Internet bandwidth per capita (Mbps per capita)



Note: Data for year end 2001

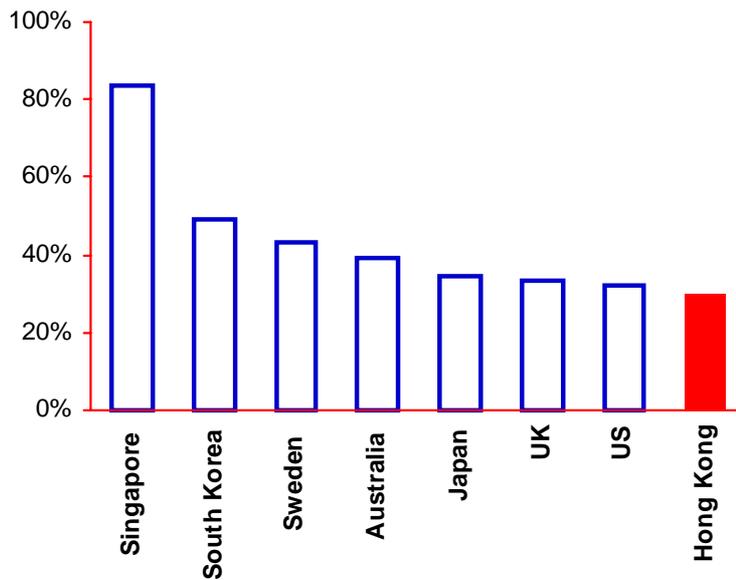
Data for major cities in each market: UK (London); US (New York, San Francisco, Washington, Chicago, Seattle and Los Angeles); Australia (Sydney); Sweden (Stockholm); Japan (Tokyo); and South Korea (Seoul)
 Does not include domestic or inter-regional Internet bandwidth
 May not include all international connectivity

Source: TeleGeography

Hong Kong has experienced a dramatic increase in available international Internet bandwidth capacity since liberalisation. Furthermore, it should be noted that the Hong Kong figure may not include the connectivity between Hong Kong and China which would further increase Hong Kong's performance in this particular variable significantly.

Given the fact that the Hong Kong international services sector was liberalised relatively later than many of the review markets, the impact of increased competition on the market share of the incumbent has been dramatic. By June 2002, the Hong Kong incumbent's share of the sector had been reduced to less than 30%, significantly less than the market share accounted for by the incumbents in the other review markets despite longer periods of sector competition.

Exhibit 14: International services market share of incumbent operators

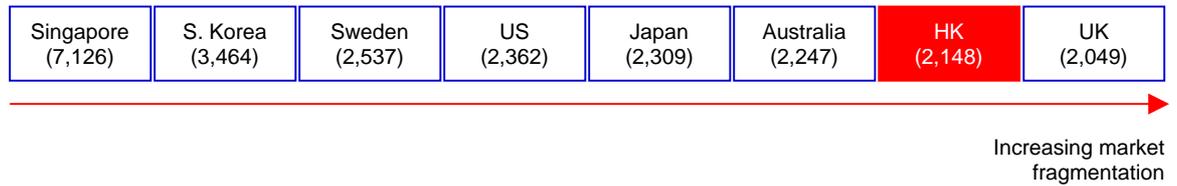


Note: Market share of outgoing IDD minutes. Does not include the introduction of call-back services which were introduced in a number of markets prior to full liberalisation
 PCCW's market share in the international services sector is less than 30%
 Data for June 2002

Source: TeleGeography & OFTA

Furthermore, not only has the incumbent lost significant market share, the Hong Kong international services sector has also become very fragmented as many new entrants have entered the market.

Exhibit 15: International services sector concentration ratio, as measured by HHI



Note: See methodological note above

Source: Spectrum analysis

Since liberalisation, the Hong Kong sector has gone from a HHI of 10,000 (i.e. complete monopoly) to a far more fragmented market with a HHI of 2,148. This makes the Hong Kong international services sector one of the most competitive with only the UK recording a less concentrated market.

3.6 Key conclusions

Compared to a number of review markets, Hong Kong was relatively late to liberalise certain sectors in its telecommunications industry. However, all the Hong Kong telecommunications sectors have now been fully liberalised.

Although Hong Kong records a very strong performance with respect to the development of competition in the mobile sector with a relatively large number of licensees, this is offset by weaker performance in the local fixed voice sector. In particular, Hong Kong liberalised its local fixed voice sector later than a number of other markets. In addition, Hong Kong also performs less well with respect to the international services sector with a relatively late liberalisation process. Despite this, Hong Kong has experienced a significant increase in the available international bandwidth both in absolute and per capita terms.

The late liberalisation of certain sectors, however, does not necessarily mean that the actual impact of competition has been any less than that recorded in the other review markets. The actual effectiveness of competition, as measured by the ability of new entrants to compete with the incumbent, is often a function of the regulatory environment.

Therefore, despite the relatively late liberalisation of a number of Hong Kong telecommunications sectors when compared to the other review markets, the analysis undertaken in the Study found Hong Kong to be the leading market in terms of the effectiveness of competition in the telecommunications industry with particular strong levels of competition in the local fixed voice, mobile and international services sectors.

In particular, Hong Kong has the most competitive mobile sector with the lowest level of market concentration in the sample. The market is fragmented significantly between the different operators. The UK has a very competitive mobile sector, but the level and success of competition is significantly less than that recorded in Hong Kong. Similarly, in the local fixed voice and international services sector, the Hong Kong incumbent has experienced rapidly declining market shares as new entrants successfully acquire users. Despite the relative strength of the incumbent in both these sectors, these sectors are increasingly competitive and fragmented in structure.

The corporate broadband market is generally recognised to be very competitive in most markets, including Hong Kong. In the residential broadband market, however, the Hong Kong incumbent retains a greater market share than that recorded in a number of other markets. However, the level of competition in this sector is increasing and the market is becoming more fragmented as new entrants gain market share.

Specific conclusions include:

Exhibit 16: Key conclusions for Hong Kong: effectiveness of competition

- The effectiveness of competition in Hong Kong's local fixed voice market has been significant with new entrants rapidly gaining market share although the incumbent remains strong in this sector. This process has been supported by OFTA's promotion of LLU and the deployment of additional fixed-line networks
- Hong Kong's emphasis on the promotion of competition in the mobile sector has resulted in substantial competitive pressures and ensured the effectiveness of competition in the sector. It is the most competitive market among the review markets
- The impact of competition has been less significant in the data access market. However, a number of new operators are entering the market and it is expected that competitive pressures will be more effective once they establish a market position
- The international sector in Hong Kong has become increasingly competitive as new entrants are successful in gaining market share. Despite relatively late liberalisation in this sector, Hong Kong already has one of the lowest market concentration ratios when compared to other review markets

The high level of competition in all telecommunications sectors should provide substantial consumer benefits. This is discussed in the following chapter.

4 Consumer benefits

4.1 Introduction

The introduction of competition was often justified by the potential consumer benefits that would be derived in competitive markets. Competition between operators to acquire and retain users of their products and/or services and to develop new revenue streams tends to result in declining prices and the development and deployment of new and/or higher quality products, services and technologies. All these trends provide substantial benefits to consumers that would otherwise be foregone in non-competitive markets.

The objective of this component of the Study, therefore, was to assess the extent to which consumers have benefited from the introduction of competition in the different review markets and specifically, to assess Hong Kong's relative performance. The analysis identified and investigated two key issues which are indicative of the benefits resulting from competition: first, the take-up of services and / or products; and second, the relative cost of using the service, including affordability.

4.2 Take-up of services

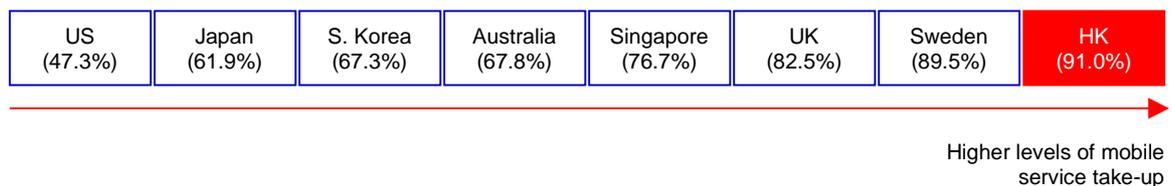
Higher levels of competition tend to be associated with greater take-up of services as competition generally results in declining prices and increasing affordability of services and products. The take-up of services, therefore, is a good indicator of the extent to which consumers have benefited and the extent to which telecommunications services are accessible by all socio-economic population groups.

In all the review markets, local fixed voice teledensity (i.e. number of local fixed telephone lines per 100 population) is relatively high and there has been little significant variation over recent years. Hong Kong's local fixed voice teledensity of 56% in 2002 is comparable to that recorded in the UK and Japan.

Reflecting technological developments, however, all the review markets have experienced increases in the take-up of mobile and broadband services, although there are significant variations between the markets.

In particular, mobile take-up in Hong Kong is higher as a percentage of the population than any other review market and significantly higher than mobile penetration in the US, Japan and South Korea. The mobile penetration rate of 91% implies that consumers who not only need but also want access to mobile telephony are able to secure this access implying a high level of service affordability and competition between the various mobile operators to secure subscribers.

Exhibit 17: Take-up of mobile services in Hong Kong and the review markets

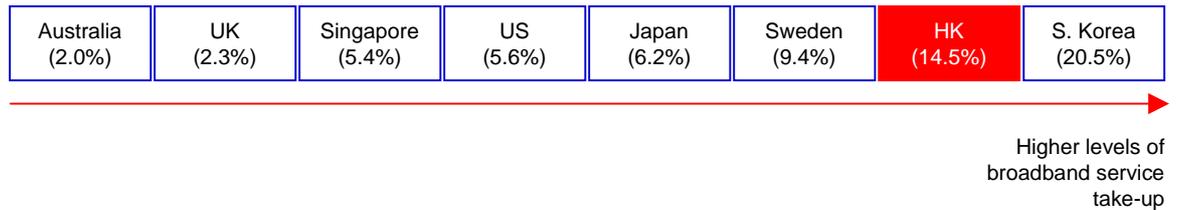


Note: Percentage indicates mobile subscribers as a percentage of total population
 May not consider role of inactive accounts (a mobile user having more than one SIM card) and different reporting methodologies
 Data for year end 2002

Source: Various including OFTA, Oftel, PTS, FCC, Baskerville & EIU

Similarly, Hong Kong is the second most successful market in terms of accelerating broadband take-up in terms of population and household penetration. It records a higher broadband penetration rate than many other markets, with the sole exception of South Korea which is currently considered the leader in terms of broadband take-up, and broadband subscribers account for approximately 14.5% of Hong Kong's population and 42% of Hong Kong's households.

Exhibit 18: Take-up of broadband services in Hong Kong and the review markets

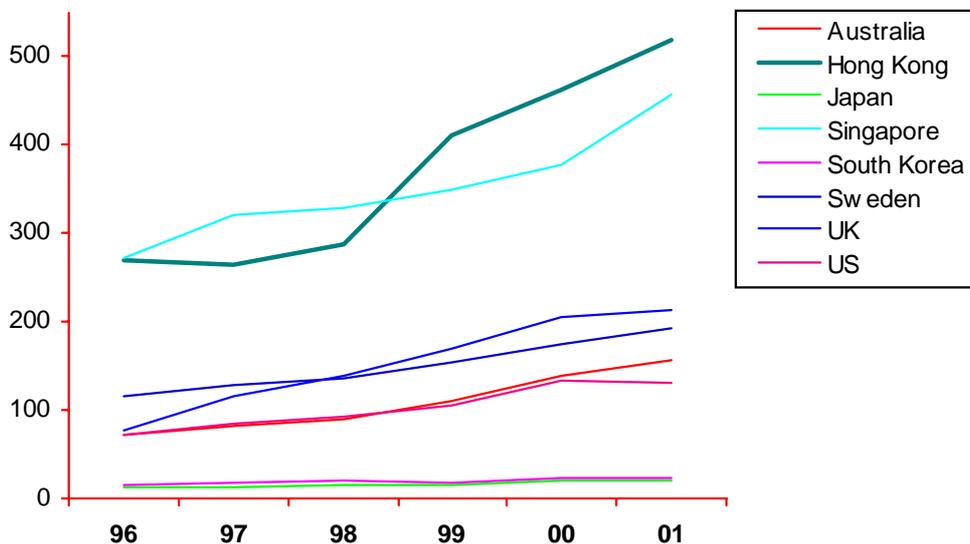


Note: Percentage indicates mobile and broadband subscribers as a percentage of total population
Data for year end 2002

Source: Various including OFTA, Oftel, PTS, FCC, Baskerville & EIU

Not only does Hong Kong record strong take-up of mobile and broadband services, but it has also experienced a significant increase in the use of international services, especially since the introduction of competition in 1999.

Exhibit 19: Outgoing international minutes per capita



Note: Only based on IDD outgoing minutes

Source: TeleGeography & EIU

Hong Kong records the highest international call volume per capita in the review markets with an average of 518 minutes of outgoing international traffic per capita in 2001. Between 1998 and 2001, Hong Kong's international traffic volume per capita increased 80.3%. This suggests that increasing competition has significantly encouraged take-up of international services, especially as these services have become increasingly affordable over the same time period.

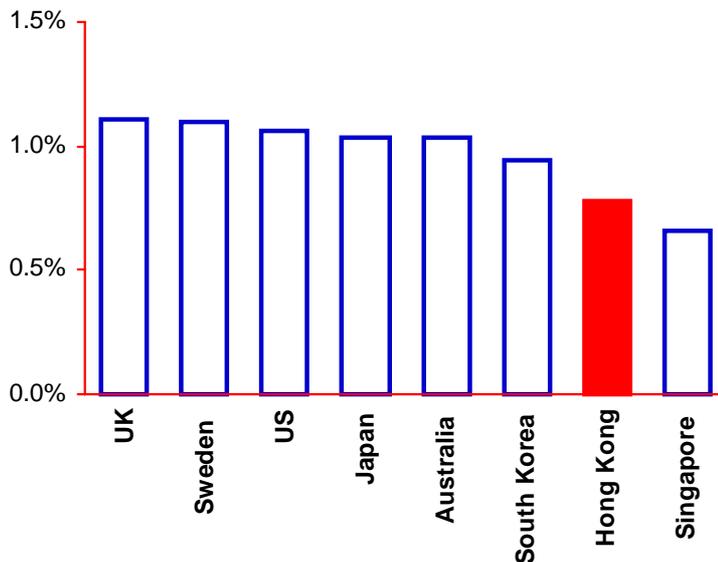
Across the four sectors investigated in this Study, increasing competition in Hong Kong between providers of telecommunications services and products has encouraged take-up. The full range of telecommunications services in Hong Kong is now widely used and consumers appear to have greater access to telecommunications services than their contemporaries in many other markets.

4.3 Cost of services

Prices of telecommunications services tend to experience substantial declines after market liberalisation, increasing their affordability and widening market demand.

The one sector in which there is not necessarily a direct relationship between the introduction of competition and price declines is the local fixed voice sector. Local fixed voice charges have increased in a number of markets through rate re-balancing exercises to facilitate the introduction of competition⁴. This has also occurred in Hong Kong which has seen local fixed voice charges increase over recent years. However, despite these increases, Hong Kong’s local fixed voice charges remain more affordable than the other review markets. Only in Singapore do the same services account for a lower percentage of real disposable income per capita.

Exhibit 20: Purchasing Power Parity (PPP) adjusted local fixed voice basket charges as percentage of real disposable income per capita (Please refer to the Glossary for the explanation of PPP)



Note: Basket charges based on 20 x 3 minute local peak calls per month and including subscription charges
Data for 2000 (latest consistent data set available at time of publication)

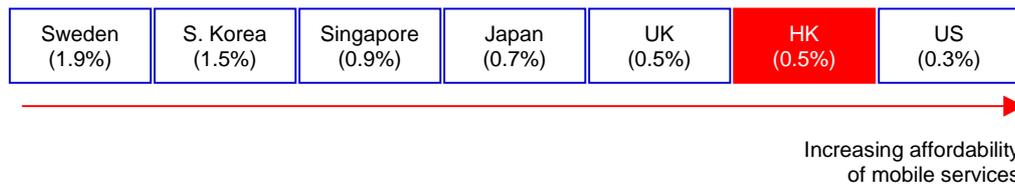
Source: ITU & EIU

⁴ Historically, fixed line operators had the monopoly in both the local fixed voice and international voice segments. In order to reduce the price charged in the local fixed voice sector, these operators would levy a premium on international voice services in order to subsidise the local sector. In certain situations, this meant that the operator was offering local services at less than cost. If continued, this would clearly prevent new entrants from competing effectively. Therefore, many regulators over a period of time allowed their incumbents to increase the local call charges that they charged - the re-balancing exercises.

Assessment of price changes in the mobile sector remains more difficult, but it is important to determine price changes over time in order to assess the impact of competition in the market and the subsequent level of consumer benefits.

As of 2000, Hong Kong had some of the most affordable mobile charges in the sample when assessed against real disposable income per capita with twenty 3-minute local peak calls per month (reflecting an appropriate level of use for comparison purposes) accounting for 0.5% of real disposable income.

Exhibit 21: PPP adjusted annual mobile charges as percentage of real disposable income



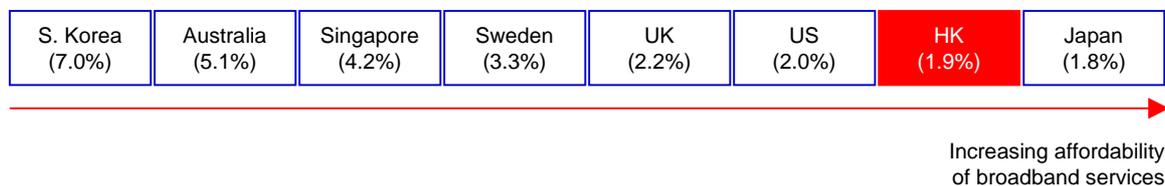
Note: Based on 20 x 3 minutes local peak calls per month
 Data for 2000 (latest consistent data set available at time of publication)
 Data for Australia not included

Source: ITU & EIU

It is important to note, however, that these figures may have changed significantly given developments in all these review markets. In 2000, for example, Hong Kong mobile charges were already significantly less than recorded in 1996. Given continued price competition in the mobile sector, it should be expected that Hong Kong mobile services have become increasingly affordable which may be a factor in explaining the high mobile penetration rate previously described.

Given the recent development of broadband there is limited historical data available on price trends in this sector. Furthermore, comparison between markets is complicated by the varying nature of products offered by operators. The Study, however, attempted to find a common basis for comparison between the markets and to determine the relative cost of the benchmarked products when compared against real disposable income.

Exhibit 22: PPP adjusted annual broadband charges as percentage of real disposable income



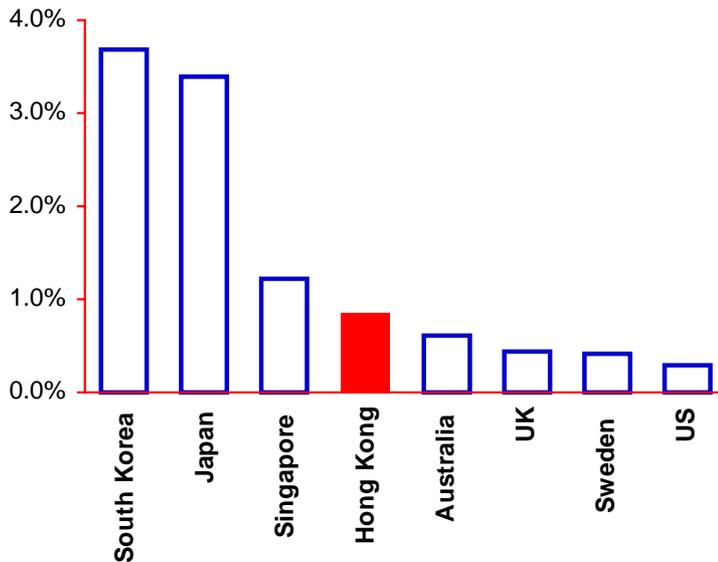
Note: Data for 2002
Source: Fixed line incumbents in each market

Hong Kong is clearly one of the least expensive markets for broadband markets in terms of relative cost.

Similarly, competition in the international service sector has resulted in substantial savings for consumers as prices have declined dramatically. The cost of some international services originating in Hong Kong have

fallen by more than 80% since the introduction of competition. This has significantly increased the affordability of these services when compared against disposable income.

Exhibit 23: PPP adjusted annual international basket charges as percentage of real disposable income



Note: Based on blended weighted average of the cost of 3 min calls to the top 5 IDD international destinations
 Baskets assumes 60 minutes of calls to top 5 IDD international destinations per month
 PCCW 0060 service charges used for Hong Kong
 Data for June 2002

Source: TeleGeography, PCCW & EIU

Although Hong Kong remains marginally more expensive in relative terms than comparable markets including Australia, UK and Sweden, it is significantly less expensive than South Korea, Japan and Singapore. Furthermore, there is evidence of continued downward pressure on prices in this particular sector.

The high level of competition in many of Hong Kong's telecommunications sectors has resulted in significant price declines. These declines have contributed to increasing the affordability of services and encouraging take-up. This is particularly the case in the mobile and international services sectors. Competition has, therefore, provided immediate benefits to Hong Kong consumers. The following section attempts to quantify the benefits in these two particular sectors.

4.4 Consumer savings

It is possible to provide indicative assessments of the aggregate savings experienced in a market resulting from the introduction of competition in Hong Kong. These assessments are based on the differential between historic prices and current prices and underlying usage.

- In the mobile sector, it is estimated that cumulative savings recorded by consumers between 1996 and 2002 resulting from competition induced price declines are more than US\$9bn or HK\$70.2bn

- In the international sector, it is estimated that cumulative savings recorded by consumers between 1999 and 2001 is nearly US\$4bn⁵ or HK\$31.2bn

These indicative savings are substantial. Consumers have clearly derived significant savings from the introduction of competition and it is debatable whether without the development of competition these savings would have been experienced.

4.5 Key conclusions

The key conclusion from the analysis presented in this chapter is that Hong Kong consumers have derived substantial benefits from the introduction and development of competition in the market.

Exhibit 24: Key conclusions for Hong Kong

- Local access voice service charges remain relatively inexpensive despite tariff re-balancing, especially when assessed as a percentage of disposable income per capita
- Hong Kong consumers have derived substantial consumer benefits from the high levels of competition in the mobile sector with a very high take-up of mobile services, rapidly declining prices and increasing affordability of mobile services. Hong Kong consumers appear to have derived greater benefits from the trends in the Hong Kong mobile sector than consumers in any other review market, especially in terms of price and relative affordability
- The take-up of residential broadband access has recently seen a significant increase and the broadband penetration rate in Hong Kong is now second only to South Korea. Consumers in Hong Kong have benefited in particular from relatively low access prices. Unlimited broadband access in Hong Kong is more affordable when assessed against disposable income than in many other review markets
- Use of IDD services in Hong Kong has continued to grow rapidly and on a per capita base, Hong Kong generates more IDD traffic than any other review market. Costs of international services continue to fall and are becoming increasingly more affordable when assessed against disposable income

Hong Kong consumers have experienced significant benefits, both in terms of take-up of telecommunications services and the decline in prices of those services. However, these benefits have been possible because of the willingness of all service providers to invest in the industry. This is discussed in the following chapter.

⁵ Spectrum's estimated indicative figure is higher than the figure published by OFTA, i.e. HK\$17.5 billion for the period from 1999 to 2001 because OFTA's published figure was based on the assumption that the IDD prices would drop due to the competition from callback services even if the monopoly on IDD was not terminated in 2000. On the other hand, Spectrum assumed that the IDD prices would remain constant during the period from 1999 to 2001 if the monopoly had continued. This assumption is necessary in order to compare Hong Kong with the other seven markets.

5 Industry investment

5.1 Introduction

Assessments of the introduction and impact of competition tend to focus more on the analysis of price, product and service innovation, and consumer take-up in the liberalised industry. This focus reflects the direct benefits that end-users derive from a competitive market. However, an understanding of operator investment behaviour is also important as it has implications as to whether the introduction of competition will actually mean more choice for end-users and the extent to which operators will be innovative with their development and deployment of new services and products in the long run.

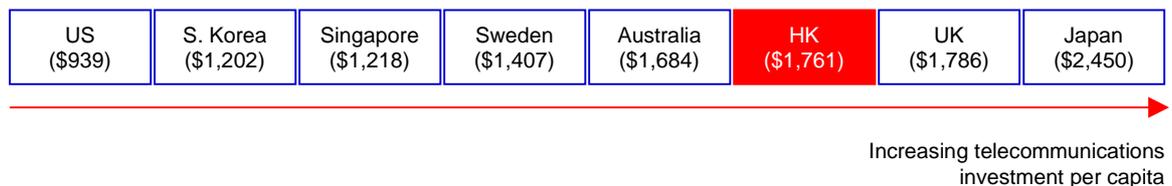
The Study, therefore, researched historic investment behaviour in the review markets. Specifically, it sought to determine how Hong Kong performed with respect to historic investment in the telecommunications industry⁶.

5.2 Telecommunications investment

Investment in the telecommunications industry increased in all the review markets between 1991 and 2001 resulting in significant sums being invested in all eight markets. Over the period, for example, more than US\$260bn was invested in the US telecommunications industry, nearly US\$110bn in the UK and approximately US\$12bn in Hong Kong.

Although there may appear to be significant differences between the review markets, such comparisons do not consider the different sizes of the various markets and it is important to standardise either to population base or size of the economy in order to derive a relative measure.

Exhibit 25: Cumulative total investment and cumulative total investment per capita, 1991-2001



Note: All figures in US\$

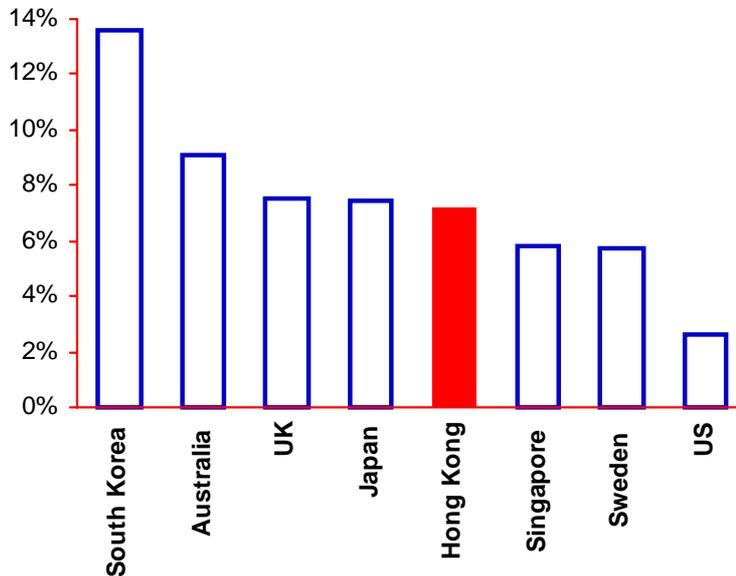
Source: ITU & EIU

In terms of per capita investment, the Hong Kong telecommunications industry has invested more than all the other review markets with the exception of Japan and the UK. Hong Kong’s relative investment of US\$1,700 per capita over the period is comparable to that recorded by the UK and significantly higher than the figures for South Korea and Singapore.

Compared to the relative size of the economy, the cumulative telecommunications investment in Hong Kong between 1991-2001 represented 7.2% of Hong Kong’s 2001 GDP. This is comparable to the UK and Japan but significantly less than South Korea and Australia. For all markets, however, telecommunications investment has grown as a percentage of GDP throughout the period indicating the growing importance of the industry in this particular decade.

⁶ It should be noted that this analysis may in part be impacted by variations in exchange rates over the period of review.

Exhibit 26: Telecommunications investment as percentage of 2001 GDP



Source: ITU & EIU

It is also relevant to note that the significant majority of investment undertaken in the Hong Kong telecommunications industry was incurred between 1996-2001, i.e. during the period of significant market liberalisation in the fixed, mobile and international sectors. The process of market liberalisation resulted in a significant increase in the level of industry investment. When assessed against population size, only Japan and the UK experienced a higher level of investment per capita than Hong Kong between 1991-2001. This high level of investment has facilitated the development of competition in the market and the consequent consumer benefits, as previously described in this report. It is doubtful whether without this high level of investment Hong Kong consumers would have derived the relatively high level of benefits that they have subsequently enjoyed.

Key conclusions resulting from the analysis of investment in the telecommunications industry of Hong Kong and the review markets include:

Exhibit 27: Key conclusions for Hong Kong

- Market liberalisation and the introduction of competition significantly increased the level of telecommunications investment in Hong Kong. The relative increase in investment was higher in Hong Kong than in any other market and between 1991 - 2001 only Japan and the UK invested more per capita than Hong Kong
- The high level of investment has benefited consumers significantly. Operators have been able to deploy networks and consequently, deliver innovative products and services to end-users. Without this high level of investment, it is doubtful if Hong Kong consumers would have benefited to the degree that other analyses in this report suggest

To conclude, Hong Kong consumers have derived substantial benefits from the introduction of strong and effective competition in all the telecommunications sectors in Hong Kong. These benefits have been primarily derived because operators (both incumbent and new entrants) have invested substantial amounts in the industry after liberalisation. The key issue is whether this very high relative level of investment will be maintained in to the future as new services and technologies are deployed.

6 Hong Kong's overall performance

This chapter summarises the findings of the Study with respect to Hong Kong's overall headline performance when compared against the review markets. It highlights areas where Hong Kong performs very well but also identifies potential challenges facing the Hong Kong telecommunications industry.

6.1 Core strengths

Hong Kong has established the enviable position of being one of the most competitive markets in this analysis and one of the most competitive markets in the world.

This strong overall performance has been primarily achieved through the Government's adoption of an aggressive market liberalisation and competition policy, and a strong focus on the facilitation of market forces. Hong Kong's strong record in creating a pro-competition regulatory environment has already been detailed and this approach created significant incentives for large-scale investment into the Hong Kong telecommunications industry. There appears to be a strong relationship between Hong Kong's regulatory environment, significant industry investment and the subsequent high level of consumer benefits.

Competition in Hong Kong has been very effective and consumers have derived substantial benefits as operators compete to acquire and retain users. In particular, take-up and usage of services has increased as prices have declined. As shown previously, Hong Kong consumers are considered to have benefited more from competition than consumers in any other review market.

Hong Kong performs very strongly relative to the other review markets in a number of key areas. These core strengths are detailed below.

Exhibit 28: Key areas of strength

- A pro-competition and consumer orientated regulator and regulatory framework, with no state interest in any of the market operators and no constraints on foreign ownership of operators
- Rapid tariff re-balancing and mobile number portability in order to facilitate market entry and the development of competition in the local fixed voice and mobile sectors
- A recent rapid erosion of the incumbent's market share in the local fixed voice, mobile, data access and international services sector
- High take-up of telecommunication services, with Hong Kong recording the highest mobile penetration rates, the highest level of IDD traffic per capita and a broadband penetration rate which is second only to South Korea
- Rapid price declines, especially in the mobile sector, where services have become increasingly affordable, and in the broadband access sector, where charges as a percentage of disposable income are amongst the lowest when compared against the review markets
- One of the highest levels of relative telecommunications investment in the sample of eight markets

The Hong Kong telecommunications industry has experienced a dramatic transformation over the previous five years with significant benefits to consumers of telecommunications services. It is doubtful whether this transformation or the derived benefits would have been achieved without the relatively strong pro-competitive framework adopted by OFTA and the consequent market trends and dynamics.

In particular, Hong Kong consumers and businesses have benefited significantly from the high levels of competition in the review telecommunications sectors with consequent benefits to the wider economy. Hong

Kong's international position, therefore, has been substantially enhanced through the competitive and dynamic telecommunications industries.

6.2 Key challenges

The analysis, however, has also established a number of areas in which Hong Kong performs less well when benchmarked against the other review markets and/or represent key challenges for the Hong Kong telecommunications industry in the future. These include:

Exhibit 29: Key challenges

- Despite the recent rapid erosion of its market share, the incumbent continues to have a strong position in the local fixed voice and data access sectors, although it is recognised that the incumbent in Hong Kong has lost more market share than its peers in many other markets; and
- Reliance on market forces suggests that there may be potential future consolidation between current operators

This last point may be a key future issue for the industry. OFTA has accepted that its promotion of market forces to determine the appropriate industry structure implies a willingness to permit new entrants but also to allow market exit. However, any market consolidation raises potential questions as to whether Hong Kong's historically strong performance at ensuring strong and effective competition and the consequent high levels of derived consumer benefits, is sustainable in the longer term. OFTA recognises this concern and remains committed to the promotion of competition. For example, the regulatory framework enforced by OFTA helps to reduce the level of financial commitments necessary for smaller operators and new entrants to compete in the market, for example, by mandating 3G mobile virtual network operator ("MVNO") capacity and local-loop unbundling ("LLU").

In conclusion, Hong Kong has established an enviable position of being one of the most competitive markets in this analysis. Consumers have recorded substantial benefits as take-up and usage of services have increased and prices have declined. All these have been achieved through an aggressive market liberalisation and competition policy and a strong focus on market forces. The Hong Kong telecommunications industry has changed immeasurably over the past five years ensuring high quality telecommunications networks and services and supporting Hong Kong's position as a leading global city. The key challenge for OFTA is to ensure that the industry retains its vigour, dynamism and competitiveness over the next five years.

Appendix: Study methodology

This chapter provides an overview of the methodology and approach adopted for the Study. It also explains the approach adopted to create the indices and the variables included in the analysis.

Study objective

The primary objective of the Study was to assess the overall competitiveness of the Hong Kong telecommunications industry relative to other comparable and "best practice" markets.

It is recognised that there are numerous factors that explain the level of competitiveness but this analysis has identified four broad areas of concerns which altogether explain the competitiveness of a telecommunications industry. These were:

- The regulatory framework which defines and determines the level of competition;
- The development and effectiveness of competition;
- The level of consumer benefits derived from competition; and
- The investment behaviour of operators in competitive markets.

Analytical approach

Selected comparative markets

The Study compared Hong Kong's performance against seven markets: Australia; Japan; Singapore; South Korea; Sweden; UK; and the US. These markets were selected as they are widely seen to have developed and competitive telecommunications industries. It was considered appropriate, therefore, to compare Hong Kong's relative performance against these markets.

The Herfindahl-Hirschman Index

The Herfindahl-Hirschman Index, sometimes known as the "Herfindahl index" or the "Hirschman index" is a commonly accepted measure of market concentration and extensively used by the US Department of Justice when assessing the impact of merger and acquisition activity on the competitiveness of an industry market. It is calculated as:

$$HHI = \Sigma(a^2 + b^2 \dots y^2 + z^2)$$

where a, b ... y and z are the market shares recorded by the firms active in the defined market sector. For example, if a defined sector had five firms with market shares of 30%, 20%, 20%, 20% and 10%, then the HHI would be:

$$HHI = \Sigma (30^2 + 20^2 + 20^2 + 20^2 + 10^2) = 2,200$$

The HHI takes into account the relative size and distribution of the firms in a defined market sector. A HHI score closer to 0 implies increasing competition with a large number of firms accounting for relatively small and equal proportions of the market. In contrast, a higher HHI score implies a market with a small number of firms and increasing disparity between the market participants, i.e. one or a limited number of participants dominate the market.

The US Department of Justice defines markets in which the HHI is less than 1,000 to be un-concentrated, markets with a HHI of between 1,000 and 1,800 to be moderately considered and those in which the HHI is

above 1,800 to be concentrated. Presumptively, any horizontal merger or acquisition activity which increases the HHI by more than 100 points in a moderately concentrated market or more than 50 points in a concentrated market to raise anti-trust concerns under guidelines issued by the Department of Justice and the Federal Trade Commission.

Data sources

The Study sourced data for the variables from a variety of sources. These included:

- Regulatory sources;
- Research houses;
- Internal analysis; and
- Trade journals and industry press

At all stages, the authors ensured the consistency, robustness and credibility of sourced data. Where necessary, this involved cross-checking different sources of data and using the primary data source wherever possible.

Glossary

ARPU	Average Revenue Per User: A measure traditionally used by analysts and operators to determine the revenue being derived from individual end-users. Various measures of ARPU exist, for example, total ARPU and APRU minus interconnection, and although relatively simple to compute, it provides no indication of underlying profitability of each user
CATV	Cable Access Television Service: television services delivered via a cable network rather than terrestrially or via satellite
FTNS	Fixed Telephone Network Service: A generic term which refers to the provision of telephony services using fixed (wireline) technologies, rather than wireless systems
GDP	Gross Domestic Product: The total value of goods and services produced by a specific nation within that nation
HFC	Hybrid Fibre Co-axial: Telecommunications network in which optical fibre and co-axial cable are used in different sections of the network to provide higher bandwidth capacity to end-users. The optical fibre cable is used in the backbone component of the network and co-axial cable is used to serve individual end-users
HHI	Herfindahl-Hirschman Index: A measure used by the United State's Department of Justice and the Federal Trade Commission to assess the level of concentration in any defined market
ISP	Internet Service Provider: Company or other entity that provides end-users with access to the Internet. Typically an ISP will have a point-of-presence (PoP) for connection to the Internet in each defined geographic area served into which end-users connect
LLU	Local Loop Unbundling: A process where the incumbent is mandated to offer its local access lines to other competing service providers often at a regulated access charge
MNP	Mobile Number Portability: Regime that allows a mobile subscriber to retain his/her existing mobile number when changing between mobile operators / service providers
MVNO	Mobile Virtual Network Operator: A mobile operator which acquires bandwidth capacity from a Mobile Network Operator on a wholesale basis to provide retail mobile services to end-users without the need to acquire spectrum or build a radio network
PCS	Personal Communication Services: Digital mobile service which generally operates in the 1800-1900 MHz bands. Several technologies are used for PCS including Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and Global System for Mobile (GSM)
PPP	Purchasing Power Parity: The purchasing power parity process aims to facilitate more accurate comparisons between markets. The use of nominal exchange rates in such practices often does not
OFTA	Office of the Telecommunications Authority: The telecommunications regulator in Hong Kong