DEPOCEN

Working Paper Series No. 2008/34

Trade liberalization and development in ICT sector and its impact on household welfare in Vietnam

Tran Quoc Trung *
Nguyen Tung
Le Thuc Duc
Nguyen Cao Duc
Tran Hao Hung

* Ministry of Planning and Investment
2 Hoang Van Thu - Ba Dinh - Ha Noi - Vietnam
tquoctrung@gmail.com

ASIA-PACIFIC RESEARCH AND TRAINING NETWORK ON TRADE (ARTNeT)

TRADE LIBERALIZATION AND DEVELOPMENT IN ICT SECTOR AND ITS IMPACT ON HOUSEHOLD WELFARE IN VIET NAM

Prepared by CFP Research Team:

Tran Quoc Trung
Nguyen Tung
Le Thuc Duc
Nguyen Cao Duc
Tran Hao Hung

Corresponding author:
Tran Quoc Trung
Ministry of Planning and Investment
2 Hoang Van Thu - Ba Dinh - Ha Noi - Vietnam
tquoctrung@gmail.com

Hanoi, March 2007

Table of Contents

List of Tables

List of Figures

List of Appendixes

ABBREVIATIONS

ADSL	Asymmetric Digital Subscriber Line
ASEAN	Association of Southeast Asian
BTA	Bilateral Trade Agreement
CAGR	Compound Annual Growth Rate
ETC	Electric Telecommunication Company
FBO	Facility-based operators
FDI	Foreign Direct Investment
FPT	Corporation for Financing and Promoting Technology
GDP	Gross Domestic Product
GPC	Vietnam Telecom Services Company
GSO	General Statistical Office
Hanoi Telecom	Hanoi Telecom Company
HCMC	Ho Chi Minh City
HH	Household Head
ICTs	Information and Communication Technologies
ISPs	Internet service providers
IT	Information Technology
ITU	International Telecommunication Union
IXPs	Internet exchange points
MARD	Ministry of Agriculture and Rural Development
MDG	Millennium Development Goals
MIMAP	Macroeconomic and Adjustment Policies
MOET	Ministry of Education and Training
MOSTE	Ministry of Science Technology and Environment
MPT	Ministry of Posts and Telematics
Netnam	Netnam Company
OIC	Internet Service Stock Company
OLS	Ordinary Least Squares
OSP	Online service provider
PTDS	Telecom Sector Development Policy
SBO	Services-based operators
SOEs	State owned enterprises
SPT	Saigon Posts and Telecommunications Service Corporation
TIENET	TIE Trade Import Export Company
UNDP	United Nations Development Program
USAID	U.S. Agency for International Development
USD	U.S. Dollars
VAT	Value Added Tax
VCIT	Viet Nam-Canada Information Technology Project
VDC	Vietnam Data Communication Company
VHLSS	Viet Nam Household Living Standards Survey
Viettel	Viettel Corporation
Vishipel	Vietnam Maritime Communications and Electronics Company
VLSS	Viet Nam Living Standards Survey
VND	Viet Nam Dong
VNPT	Vietnam Posts and Telecommunications Corporation
VoIP	Voice over Internet Protocol
VOV	Voice of Viet Nam
VTV	Viet Nam Television

1. Introduction

The term of "information society" was first introduced by Malchup and Porat in the 1970s. Since then information has increasingly been considered as a critical factor in the development process. Various scholars have used information deficiencies to explain development differences among countries and argued that information and communication technologies (ICTs)[1] may facilitate and speed up the development process by providing cheaper and more efficient ways and tools of information gathering, processing and dissemination. They are helping accelerate productivity gains and access to health information or educational services, and are modifying the way people learn and interact, and exchange and voice their interests. It is impossible for a developing country to integrate into the "global information society" if that country has not an adequate access to ICTs (Greenwald and Stiglitz, 1986; Stiglitz, 1988, 1989; the World Bank, 1998; Hamelink, 1997; UNCTAD, 2006).

ICT access and use can contribute to productivity growth in both developed and developing countries. UNCTAD (2006) shows that ICT adoption can make an important positive contribution to gains in per capita income - even in poorer countries. ICTs as measured by the Infodensity[2] index can contribute to the GDP per capita (PPP) growth rate with an increase of 0.1 in 1996 to 0.3 percentage points in 2003. But countries that already have the intermediate level of ICT uptake seem to benefit most from the opportunities provided by ICTs. Less developed countries should therefore work toward narrowing the digital divide between and, even more importantly, within countries (David, 2004).

During the last decade, there have been a number of global initiatives using ICTs to address issues of poverty, welfare and gender equality in developing countries. There is a common observation that ICTs positively impact poverty alleviation, even though they have to be accompanied with other factors such as transportation, education, health, social and cultural facilities (Flor, 2001; Swaminathan, 2005; Harris, 2002; Greenberg, 2005). It has been observed repeatedly that ICTs such as radio, television and telephone and Internet (though still a luxury in many poor areas) are good tools to help the poor increase their access to information on health, financial, and government services, production, storage and marketing of farm and non-farm products, which results in improvements of their productivity

[1] In definition, ICTs consist of computer, internet, radios, television, telephone among various others, and procedures and processes that support the processing, storage and dissemination of the information. While radios, television and telephone and the like are traditional communication tools, the use of internet and wireless mobile phones has been emerged substantially for the last two decades with premium advantages including economical costs, national and international reach, permanent availability and interactivity.

[2] Infodensity = sum of all ICT stocks (capital and labour).

and income (UNCTAD, 2002; Joseph, 2005). However, it should be noted that in some cases the poor benefit proportionally less than the non-poor (OECD, 2005).

An interesting study by Gi-Soon (2005) of rural Lao PDR indicates that telecommunication services have as much positive impact on household welfare as other infrastructures, i.e., electricity and irrigation. Telephone use has a positive impact on the consumption level of rural households. Telephone use improved both total and cash-income consumptions, but the impact was greater on cash income than on total consumption, confirming the assumption that rural households use telephone services to improve their economic performance and increase income. Gi-Soon also suggests that one of the potential risks in introducing ICTs to developing countries is that ICTs may widen the gaps between the rich and the poor. Though ICT impact on the consumption seems greater among the poor than the non-poor, a relatively low usage rate among the poor and the less educated raises the concern of a widening gap between users and non-users.

This paper examines the above issues in Viet Nam. The ICT sector in Viet Nam had not been developed until the 1980s. However, over the last decade of rapid growth, it has had a powerful impact on many aspects of life in this country. Although the ICT sector is still at an early stage of development and lags behind many other countries in the region, the government of Viet Nam made strong commitments to upgrade the nation's ICT capability and implemented significant reforms in terms of trade and investment liberalization in ICT sector over the last decade. This commitment has probably been the most important factor in accelerating ICT usage in society and government. It may also have partially contributed to achieve an average annual economic growth rate of 7.6 percent over the period 1991-2006 and reduce the poverty rate from 57 percent of the population in 1993 to less than 20 percent in 2004 (Duc, *et al.,* 2006; VDR, 2005; GSO, 2004). Therefore, the relationship between ICTs development and household welfare in Viet Nam under the dynamic changes over the last decade need to be examined in more details. This is made possible by the availability of four high-quality household surveys[3] spanning the period 1993-2004.

Since ICTs are quite new technologies in Viet Nam, most existing studies are not very diverse in terms of areas and themes. Frequently researched topics are the impact of ICTs on economic growth (at macro level) and on productivity of firms and industries (at micro level).

[3] Information on ICT and household welfare can be derived from four large-scale household surveys in Vietnam, namely the Vietnam Living Standards Survey in 1992-1993 and in 1997-1998 (VLSS93/98), and the Vietnam Household Living Standards Survey in 2002 and 2004 (VHLSS02/04). The total number of households interviewed was respectively 4,800, 6,000, 30,000 and 9,000 and these surveys are representative for Vietnam (GSO 2003). The VHLSS02/04 questionnaire is similar in many respects to the VLSS93/98 questionnaire. More importantly, there are 4,305 panel households in VLSS93/98 and 4,008 panel households in VLSS02/04.

Particularly, those studies deal with ICT policies and development strategies, ICT development trend (Elmer, L., 2002 and ITU, 2002); competitiveness in telecom sector (An, D. V. *et al.*, 2005 and VNCI, 2005), gendered impacts of the development of ICT (Duc *et al.*, 2006), gender bias in the ICT (McDonald, 1999), ICT usage in achieving some Millennium Development Goals (UNDP, 2003), or ICT usage in enterprises in Viet Nam (MPDF, 1999).

Our study differs from these studies in that we study the impact of trade liberalization and development in the ICT sector on household welfares in Viet Nam, providing a more dynamic picture of the ICT sector in a transition economy.

In section 2, we look more closely at the ICT enabling environment and liberalization in Viet Nam and discuss constraints in the current ICT policies and regulations and implementation in practice. In section 3, we will analyze the access to and use of ICTs by households. The impact of access to and use of ICTs on poverty reduction and household welfare in Viet Nam will be quantitatively analyzed in section 4. In section 5 we conclude the paper by discussing the policy implications from our study.

2. Trade Liberalization of the ICT Sector and Regulatory Constraints

2.1. Trade Liberalization of the ICT Sector

Starting at very low levels, ICT usage of Viet Nam has been developing impressively over the last several years. Viet Nam's ICTs as measured by Infostate[4] index increased from 2.7 in 1995 to 37 in 2003 (UNCTAD 2006). Low awareness, high communication costs and shortage of expertise however are still hampering ICT development progress, especially for individuals (An, D.V. *et al.*, 2005).

Information Technology

Following a regional strategy[5] set by ASEAN for harmonizing ICT development in the region, significant reforms in some areas including ISP licensing, price changes and authorizations for new basic and cellular operators have been implemented. The most critical of these, Directive 58 issued by the Communist Party's Politburo of Viet Nam in October 2000, was official policy guidance for government to plan and implement program in support of the following goals on the use and development of IT. A series of government decisions

[4] Infodensity = sum of all ICT stocks (capital and labour)
Info-use = consumption flows of ICTs/period
Infostate = aggregation of infodensity and info-use

[5] E-ASEAN framework agreement on ICT products and services (4/2000) includes provisions on connectivity and regional content development, a seamless legal and regulatory environment, a common marketplace for ICT products and services, human resource development and e-governance.

guide the implementation of Directive 58 and a number of important strategic and policy initiatives set national ICT goals for the period 2001 – 2010, covering (i) upgraded the telecommunications and Internet infrastructures, (ii) developed IT human resource base, (iii) developed software industry, and (iv) developed hardware industry.

Numerous ministerial and provincial groups have developed action plans for IT development: e.g., IT Master Plan for E-Commerce (Ministry of Trade); Master Plan for Education and Training (MOET); Master Plan for Telecommunications (MPT); and IT Master Plan for agriculture and rural development (MARD); and IT Master Plan of Hanoi and HCMC Peoples' Committees. Appendix 1 presents key policy development in the IT sector. Most recently, the National Assembly approved a Law on IT which governs IT development and application activities, guarantee measures on IT development and application, rights and responsibilities of institutions and individuals involved in IT development and application activities.

Telecommunication and Internet

The policy of telecom liberalization in Viet Nam is based on the participation of multi-economic ownership sectors in the telecom sector, a commercially-oriented state-owned incumbent operator and a gradual increase in competition. These policies are stated in the form of general policies announcements as well as being included in legislation passed by the National Assembly.

The Telecom Sector Development Policy (PTDS) and Internet Development Plan to 2005 and most recently to 2010 states that all economic ownership sectors are encouraged to participate in the investment and doing business to provide the telecom and Internet services in a fair and transparent competitive environment. Enterprises operating in the sector are diversified. They included those with 100 percent state capital, majority state, or special state shares, and ones from other economic ownership sectors. The Post and Telecom Ordinance affirms the policy.

However, private participation in the telecom sector currently varies among the different telecom activities. Enterprises operating networks, including the ones providing IXP, must be ones with 100 percent state capital, or have majority state or special state shares. While enterprises providing telecom services can be all legally registered and operated enterprises regardless ownership in Vietnam, including ones providing ISP and OSP Internet

services and shall meet certain technical conditions and requirements. This applies to most value added services.

The PTDS confirms a change from a monopolistic to a competitive telecom sector, in which the state sector plays the dominant role. Particularly, the market share on key services such as international calls, leased channel, mobile phone information and broadband Internet access of non-incumbent enterprises is expected to reach 40-50 percent by 2010. The general approach is to expand the fair and transparent competitive telecommunication and Internet market by facilitating all economic sectors to invest and provide telecommunication and Internet services, especially in resale of telecommunication and Internet services and provision of value added and Internet services. Telecommunication and Internet enterprises are strongly encouraged to effectively exploit local markets and gradually approach to expand their investment and business operation to international markets. Moreover, as a result of Viet Nam's international commitments foreign investors are entering the telecom market progressively. Therefore, telecom and Internet services are more open than the telecom network operation and control.

ICT Market Opening

Table 1 shows the timeline of telecommunications liberalization in Viet Nam. Before 1995 where there was only VNPT, Viettel and SPT were firstly reorganized and established respectively by the Government in 1995 to participate in the telecommunications sector. In 1997 Viettel and SPT were licensed to provide telecommunication services. Vietshipel followed in 2000 when licensed to provide Inmasat services and ship-to-ship, ship-to-mainland information. In 1997 five ISPs were also licensed, including: VNPT, Viettel, SPT, FPT and Netnam. Viettel and SPT were licensed to provide VoIP in 2001 and ETC was licensed.

Table 1: Timeline of market opening in Viet Nam

Before 1995	1995	1997	2000	2001	2003	2005	2006
Only VNPT	Viettel was reorganized and SPT was established	Viettel and SPT were licensed to provide telecom services	Vietshipel was licensed to provide Inmasat services and ship-to-ship, ship-to-mainland information	Viettel and SPT were licensed to provide VoIP	Foreign service providers with foreign ownership not exceeding 50 percent can provide value added services according to VN-US BTA	Foreign service providers with foreign ownership not exceeding 49 percent are allowed to set up joint ventures in the basic telecom services according to VN-US BTA	Foreign service providers with foreign ownership not exceeding 51/49 percent are allowed to set up joint ventures in the non facilities-based/facilities-based basic telecom services respectively according to WTO
		5 ISPs were licensed, including: VNPT, Viettel, SPT, FPT, Netnam		ETC was licensed			

The openness of Vietnamese telecom sector to the foreign competition is marked by the commitments in Viet Nam – USA Bilateral Trade Agreement (VN-US BTA)and WTO Agreement as follows:

- Viet Nam allows US companies to set up joint ventures with the Vietnamese partners authorized to provide telecom services. The US companies have the right to establish joint ventures with a 50 percent cap on U.S. equity participation in the value added services (e.g., e-mail, voice mail, electronic data interchange, data processing) beginning in December 2003 and in Internet services beginning December 2004. US companies are also allowed to set up joint ventures with the maximum equity share of 49 percent in the basic telecom services (e.g., wireless services, certain data services, leased circuit) beginning December 2005 but none of the US companies has taken advantages of these liberalization initiatives yet by the end of 2006 and in basic voice telephone services (e.g., fixed local, long distance and international) beginning December 2007 (VN- US BTA).
- *Non facilities-based basic telecom services:* Upon WTO accession joint ventures with telecommunications service suppliers duly licensed in Viet Nam will be allowed. Foreign capital contribution shall not exceed 51% of legal capital of the joint ventures. Three years after accession: joint venture will be allowed without

limitation on choice of partner. Foreign capital contribution shall not exceed 65% of legal capital of the joint ventures. *Facilities-based basic telecom services*: Upon accession, joint venture with telecommunications service suppliers duly licensed in Viet Nam will be allowed. Foreign capital contribution shall not exceed 49% of legal capital of the joint ventures. 51% gives management control of the joint venture (WTO Agreement).

Non facilities-based value added services: Upon accession: business cooperation contracts or joint ventures will be allowed. Foreign capital contribution shall not exceed 51% of legal capital of the joint ventures. Three years after accession: Foreign capital contribution shall not exceed 65% of legal capital of the joint ventures. *Facilities-based value added services*: Upon accession, business cooperation contracts or joint ventures with telecommunications service suppliers duly licensed in Viet Nam will be allowed. Foreign capital contribution shall not exceed 50% of legal capital of the joint ventures. Fifty-one % gives management control of the joint venture (WTO Agreement).

According to Law on Foreign Investment in Vietnam[6], foreign investors can only invest in telecommunications sector through a Business Cooperation Contract (BCC) form. VNPT has been implementing BCCs with foreign partners such as NTT (Japan), France Telecom, Telstra (Australia), Korea Telecom (South Korea), Kinnevik, Convik (Sweden), UK Cable & Wireless since 1993. BCCs of SPTS-Telecom (South Korea) and Hanoi Telecom Hutchinson Telecom (Hong Kong) were licensed in 2003 and 2005 respectively. Total investment in telecommunications sector of these BCCs (mainly focusing on international telecom, mobile phone and local telecom networks and services) is more than US$ 2 billion. Although BCCs have been making a significant contribution to the development of the telecom sector in Viet Nam, the BCC model of investment has some structural, management and financial limitations such as restricting equity participation, management control, short tem investment for quick return, short duration, high rate of depreciation, etc. (VNCI, 2005).

Setting Tariffs

The Government of Viet Nam had applied price controls on telecommunications services for local subscription charges and tariffs for using local fixed-line (for all operators), universal service charges, and service charges imposed by operators with a dominant market share only, regardless of the mode of supply since 2003 by Prime Minister's Decision No. 217/2003/QD-TTg of 27 October 2003.

[6] This law was replaced by Law on Investment which came into effect since 1 July 2006. The new law stipulates that foreign investors can choose appropriate investment form in telecommunications sector according to Vietnam's commitments in the multilateral and bilateral agreements.

Moreover, it also had applied the system of dual pricing on telecommunications services according to which Vietnamese and foreign enterprises and individuals were charged different prices for identical goods or services. However, this system had gradually been phased out overtime since 1 October 2000. By 1 January 2005, Viet Nam had totally eliminated the dual pricing mechanism on all telecommunications services for Vietnamese and foreigners by Prime Minister's Decision No. 215/2004/QD-TTg of 29 December 2004.

The increasing trade liberalization of the ICT sector together with tariff control regulations of the Government on those operators with a dominant market share, telecommunication tariffs of VNPT were gradually reduced. As Table 2 shows, most international tariffs of VNPT were reduced by around 75% over the last five years. Other services such as cellular, Internet and leased circuits were also reduced from 10% to 30%.

Table 2: Tariffs for international service of VNPT in Viet Nam, $US/minute

Service	Dec. 2001	July 2002	Jan. 2003	April 2003	2006
Calls to other ASEAN countries	1.70 - 2.30	1.50 - 1.70	1.30 - 1.40	0.90 - 1.30	0.43 - 0.55
Calls to other ASEAN countries	2.00 - 2.30	1.80 - 2.00	1.50 - 1.70	1.00 - 1.40	0.45 - 0.58
Calls to all international destinations by VoIP			1.2	0.75	0.5

Radio and Television Services

The radio and television services are totally controlled by State-owned enterprises or institutions. There are three major radio stations and one national broadcaster, Voice of Viet Nam (VOV). VOV is the official network of the Vietnamese Government. It broadcasts on AM, FM and shortwave. VOV has 61 provincial radio stations primarily using AM while Hanoi and HCMC also have FM stations.

State-owned Viet Nam Television (VTV) has monopoly on over-the-air television. It has three nationwide channels (VTV1, VTV2, VTV3) as well as a local channel in each province. In addition there is a satellite channel, VTV4, aimed at overseas Vietnamese and carried by Thaicom 3 (Thailand), Viasat 1 (Malaysia) and Telstar 5 (United States). Multi-channel television is available through satellite reception, VTV's MMDS wireless cable service, VTV's cable service or VTV's digital service, but multi-channel television penetration is still limited.

Institutional Reform and Development

Together with increased competition in the telecom sector, the policy, regulatory and operational functions and organizational structure among state management agencies and service providers also experienced significant changes. The Prime Minister's Decision No. 91/TTg in 1994, separated the state management and business functions of the former General Department of Post and officially established VNPT as a service provider and a state general corporation under Government control. VNPT engages in both telecom and postal services as well undertaking both business and public service functions.

The substantial changes in the institutional framework actually happened when the Ordinance on Post and Telecommunications came into effect in 2002. It established the Ministry of Post and Telematics (MPT), replacing the Department General of Posts and Telecommunications which was established in 1996. The ministry has main responsibility for developing policies, laws and standards and for performing the functions of state management over telecommunications, postal and Internet services, IT, electronics, transmission and broadcast, radio frequencies and national information infrastructure; regulating tariffs and fees; and issuing licenses for all ICT services throughout the country.

Furthermore, a National IT Steering Committee was established by the Prime Minister's Decision 176/2002/ND-CP in 2002. Its functions are to provide guidlines for the implementation of the Party Directive 58-CT/TW and the National IT Master Plan and to explore policy and structural reforms, including setting up of one entity to govern ICTs in the future. In 2004, Department for IT Application under MPT was established by the Prime Minister's Decision 1120/QD-TTg to assist MPT perform the functions of State management over and organize the implementation of IT application throughout the country.

Incentives

A number of legal documents have been issued to support foreign and domestic investment in ICT sector[7]. These investment incentives include highest corporate income tax exemption and reduction, import tax and VAT exemption for imported fixed assets, access to soft loan and credit guarantee, VAT refund, land rent exemption and reduction etc. Currently, foreign and domestic investment in manufacturing computers, software products, IT and

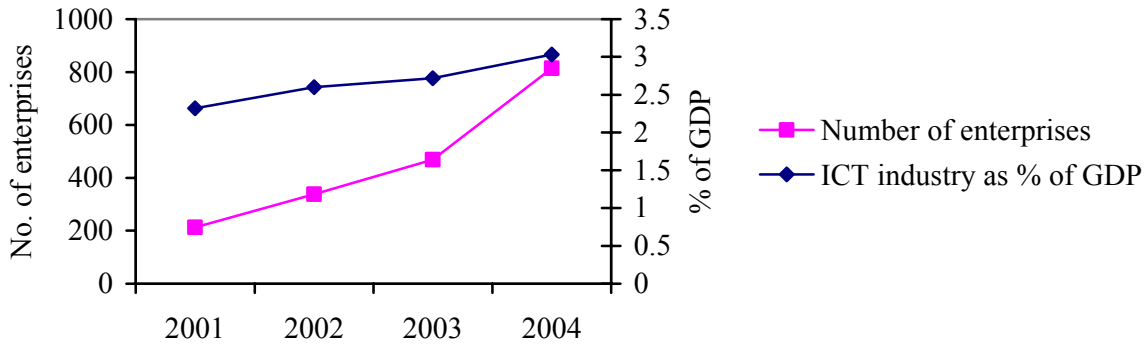
[7] Governmental Decree 10/1998/ND-CP, Governmental Resolution 07/2000/NQ-CP, Governmental Decree 51/1999/ND-CP, Prime Minister's Decision 128/2000/QD-TTg, Prime Minister's Decision 19/2001/QD-TTg, Governmental Decree 35/2002/ND-CP, Governmental Decree 164/2003/ND-CP and Governmental Decree 108/2006/ND-CP.

Internet equipment and providing services on IT research and development as well as for human resources training is eligible for these investment incentives.

2.2. Increasing Market Entries, but still Dominated by the State Sector

The number of ICT enterprises increased rapidly during 2001 – 2004 due to the openness of the sector (Figure 1). Although there was an expansion of the non-state sector, both in terms of number of ICT enterprises and employees, the industry is still dominated by the state sector in terms of huge capital and firm size. By the end of 2004, SOEs represented about 91 percent of total employees and 97.2 percent of total capital invested in the industry (Table 3).

Figure 1: ICT industry: Number of enterprises and percentage of GDP, 2001 – 2004



Source: GSO, 2005, Real Situation of Enterprises through the Results of Surveys in 2002-2003- 2004

Table 3: ICT Industry in Viet Nam by type of ownership, 2003 - 2004

	Number of enterprises (enterprise)		Number of employees (persons)		Total capital (VND bil.)	
	2003	2004	2003	2004	2003	2004
Post and telecommunication	**55**	**174**	**105,643**	**111,606**	**55,415**	**57,659**
SOEs	12	12	104,927	109,411	55,269	57,428
Non-state enterprises	41	160	517	1,935	62	134
Foreign invested enterprises	2	2	199	260	84	98
Computer & IT related services	**413**	**640**	**6,719**	**9,972**	**1,323**	**1,750**
SOEs	8	9	793	1,036	204	336
Non-state enterprises	353	540	4,538	6,592	693	764
Foreign invested enterprises	52	91	1,388	2,344	426	651
ICT	**468**	**814**	**112,362**	**121,578**	**56,738**	**59,409**
SOEs	20	21	105,720	110,447	55,473	57,764
Non-state enterprises	394	700	5,055	8,527	755	898
Foreign invested enterprises	54	93	1,587	2,604	510	748
Share of ICT	**100**	**100**	**100**	**100**	**100**	**100**
SOEs	4.3	2.6	94.1	90.8	97.8	97.2
Non-state enterprises	84.2	86.0	4.5	7.0	1.3	1.5
Foreign invested enterprises	11.5	11.4	1.4	2.1	0.9	1.3

Source: GSO, 2005, Real Situation of Enterprises through the Results of Surveys in 2002-2003- 2004

The development of the telecommunication and Internet sectors are still constrained by a legacy of heavy centralized control and limited number of operators (Table 4). Present arrangements for private participation through Business Cooperation Contracts deter foreign investment since companies have no operational control over their investments. Limited competition in fixed line and cellular telecommunications services also inhibits investment and growth of the ICT sector.

Table 4: ICT operators, 2006

Services	VNPT	Viettel	ETC	SPT	FPT	Hanoi Telecom	Tienet	OCI	Netnam	Vishipel	Vietnam Airlines
Telecommunications services											
Fixed phone	✓	✓	✓	✓		✓					
Mobile phone	✓	✓	✓	✓		✓					
International telecom	✓	✓	✓								
Mobile information	✓	✓	✓	✓		✓					✓
DLD and ILD VoIP	✓	✓	✓	✓		✓				✓	
Internet services											
IXP	✓	✓	✓	✓	✓						
ISP	✓	✓	✓	✓	✓	✓	✓	✓	✓		
OSP	✓	✓	✓	✓	✓		✓	✓	✓		

Source: MPT

As a monopoly, VNPT sometimes imposes upon anti-competitive practices as follows: unfair allocation of network facilities; high prices for use of network facilities (i.e. pricing interconnection at a level that preserves monopoly rents for VNPT and/or limits use of the interconnected service); cross-subsidization among its certain subsidiaries (i.e. mobile phone services of GPC and Internet services of VDC); refusal to provide some services to its clients such as Viettel and SPT; forced use of VNPT services by maintaining a practice of forcing its subsidiaries' agents to sell only VNPT services; abuse of technical measures to block competitors' services (i.e. turning off the trunk side to block telephone calls through the 177 and 178 VoIP services of Viettel and SPT) or claim of technical problems that prevent or delay interconnection (VNCI, 2005).

VNPT still dominates the telecommunications and Internet market but its market share has been gradually declining overtime. VNPT's Internet market share was reduced from 90 percent to 42 percent between 2003 and 2006 and it retains approximately 94 percent of the overall telecom market. Currently, it is the country's largest Internet Service Provider (ISP) and operator with operations in all telecom segments (except for marine-based services) that presents a conflict of interest between VNPT's role as main supplier and competitor.

2.3. ICT Policy and Regulatory Constraints

2.3.1. Incomplete independence of government's regulator

The overlapping functions and authority shared among different government agencies obscures a transparent and objective rulemaking process. Policy development and regulatory functions under MPT have not been separated. Although MPT has been created independent of the dominant VNPT, there is still widespread concern that MPT is still "influenced" by VNPT because of the long standing close relation between staffs of VNPT with MPT and many of them being switched between each other. MPT is still handicapped by its shortage of some capabilities and expertise essential for performing its roles, especially expertise and capability to fairly intervene in areas of disputes and disagreements between the dominant players with other companies. Additionally, most regulatory decisions are made internally by MPT or by discussion with other Government agencies, with little consultation with the public and industry.

2.3.2. Restrictive licensing policies

The sector remains dominated by the state, especially for facility-based operators (FBO). Private participation is limited only to value-added services and services-based operators (SBO). According to the Ordinance, licenses for FBO services are only granted to fully state owned enterprises (SOEs) or enterprises in which the state has controlling shares. So far 6 companies have received FBO licenses.

Current licensing policies and procedures restrict competition and growth. The licensing criteria are not sufficiently clear in the relevant regulations. Therefore, it is open to interpretation and the discretionary decision of the officials in charge, as well as to potential abuse. The licensing process has been discretionary, with cumbersome procedures and a too long consideration process. The time needed to get a license is much longer than that stipulated in official regulations.

Several requirements that deter foreign investment in the IT sector include the policy that requires foreign firms use a local distributor to market their products; and restrictions on local hiring policies, which require recruitment through the State labor service. The restricted number of ISPs allowed to operate further inhibits a competitive environment and limits investment. The total number of 10 ISPs is still far below the norm in most countries.

While the government opens up the Internet sector to competition from the private sector, new licensing requirements imposed on the operation of Internet cafes will slow down

deployment and use of ICTs in the broader population. The control of content by the national firewall and the licensing requirements for ICPs also deters growth, especially in website and local content development. Restrictions on content by the national firewall also prevent the use of more advanced Internet services and business applications (e.g., Lotus notes).

2.3.3. Lack of universal service policy

Government targets to reach the global average in Internet density by 2010 lack supporting policies for equitable service delivery to underserved rural areas outside the current telecommunications backbone. Legislative measures are needed to ensure equitable and universal service delivery in underserved rural areas, which may require government subsidies and incentives. For example, widespread deployment of ICTs could be supported through incentives for network expansion in rural areas and subsidized access for rural communities and formal educational institutions. A strategic plan is needed to develop "the last mile" in connectivity and access for underserved rural areas outside the current telecommunications backbone.

2.3.4. Tax reform

Current tax structures inhibit growth of the ICT sector, especially VAT and income tax laws. Presently, hardware manufacturers pay a larger VAT tax than what they can charge buyers on components. Getting refund on the difference requires considerable paperwork and long delays. Computer peripherals are taxed unless sold on the same invoice as a computer. Computer and other telecom equipment are also subject to an import tax (considered to be the highest in the region,) although this is expected to change under the VN-US BTA. Income tax rates also undercut national goals for IT professional development. Income tax laws discriminate against senior level Vietnamese employees in favor of foreign experts, which constrain the development of Vietnamese management expertise. It is the fact that the current taxation rates for high income earners of Viet Nam are among the highest rate in the world, making the Viet Nam market less attractive and competitive for the high-skilled labor force.

3. ICT Uptake in Viet Nam

3.1. Growing Fast, but Still Lagging behind Other Countries

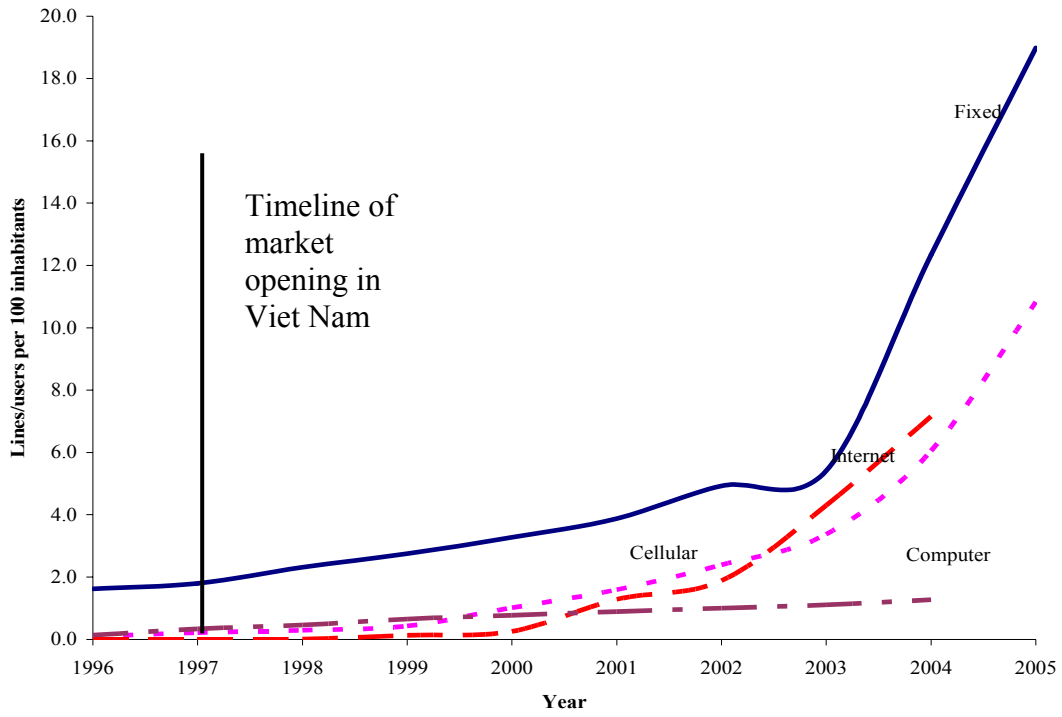
Figure 2 shows the ICT industry in Viet Nam has been growing very rapidly over the last decade.[8] The number of main telephone lines grew from 1.62 per 100 inhabitants in 1996 to 18.98 in 2005, at a compound annual growth rate (CAGR) of about 30 percent, which is one of the highest in the world. The number of mobile cellular subscribers grew from 0.09 per 100 inhabitants in 1996 to 10.83 in 2005 with a CAGR of 68.2 percent. Computer and the Internet are catching on slowly in Viet Nam as evidenced by the rise in IT users over the past few years. In 2004 there were one million computers and 1.27 percent of the population owing computers. The Internet only came to be in Viet Nam in 1997 and has steadily increased its user base from 1.28 per 100 inhabitants in 2001 to 7.16 in 2004 and 17.1 in October 2006[9]. Broadband Internet services providers also posted strong growth. By October 2006, the number of broadband Internet subscribers had been 405,721 since the first introduction of the service in mid-2003. Although home Internet connections are still slow, many more people gain access to the Internet in a different way i.e. Internet cafes or bars.

As a result of the rapid development, the contribution of ICT industry in Viet Nam to GDP increased from 2.3 percent in 2001 to 3.0 percent in 2004. The ICT industry employed 121 thousand persons in 2004. Total capital of the ICT industry increased substantially from USD 2.4 billions in 2001 to USD 3.7 billions in 2004. Total revenues of ICT industry reached nearly USD 2.2 billions in 2004 (Appendix 2). However, the Vietnamese IT sector still accounts for a relatively small proportion within ICT industry and is characterized by hardware production. More recently, thanks to strong commitments and high incentives of the Government including software parks (Appendix 3), the IT software production increased and achieved around USD 120 millions in 2003.

In spite of the recent development in the sector, Viet Nam's ICT indicators still lag behind many other countries in the region (Figure 3, Figure 4 and Figure 5).

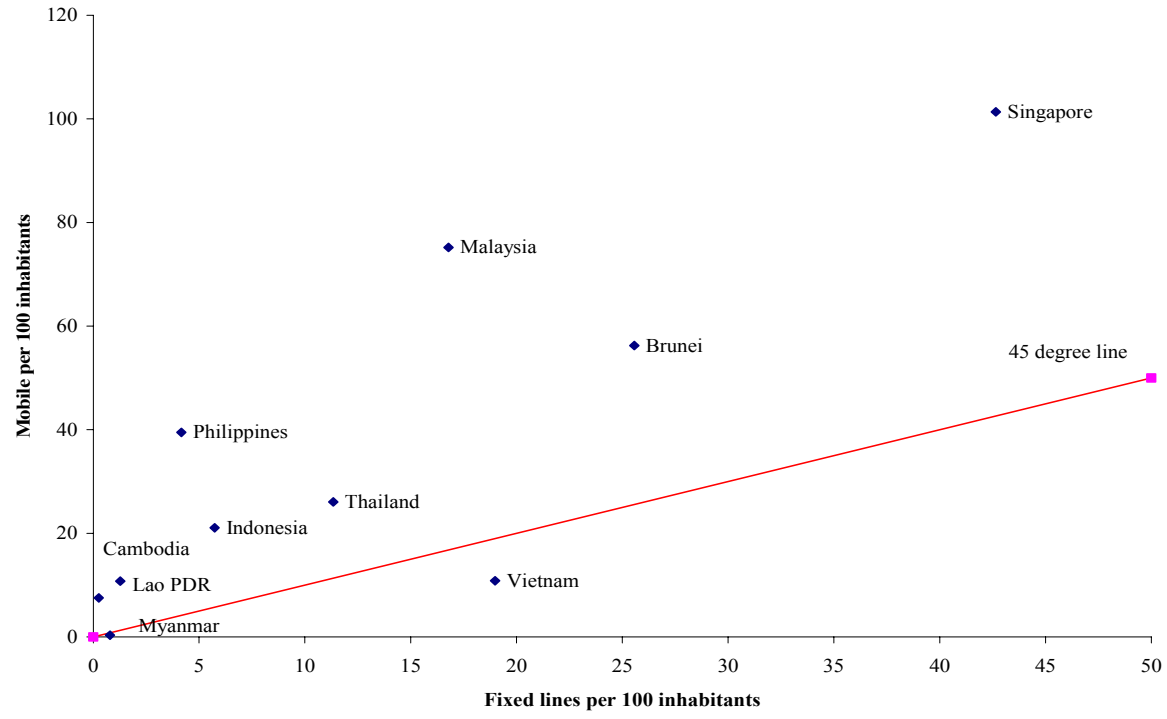
[8] Some important contribute to this development: (i) growth in average income of population by 2.5 times during 1985-2005; (ii) good physical infrastructure such as GPRS, VPN, Wi-Fi Internet; (iii) telecom tariff reduction and (iv) market entry of the private sector in value added services.
[9] There are more than 14.2 millions having access to Internet in 2006 in Vietnam

Figure 2: Selected ICT infrastructure and access indicators in Viet Nam



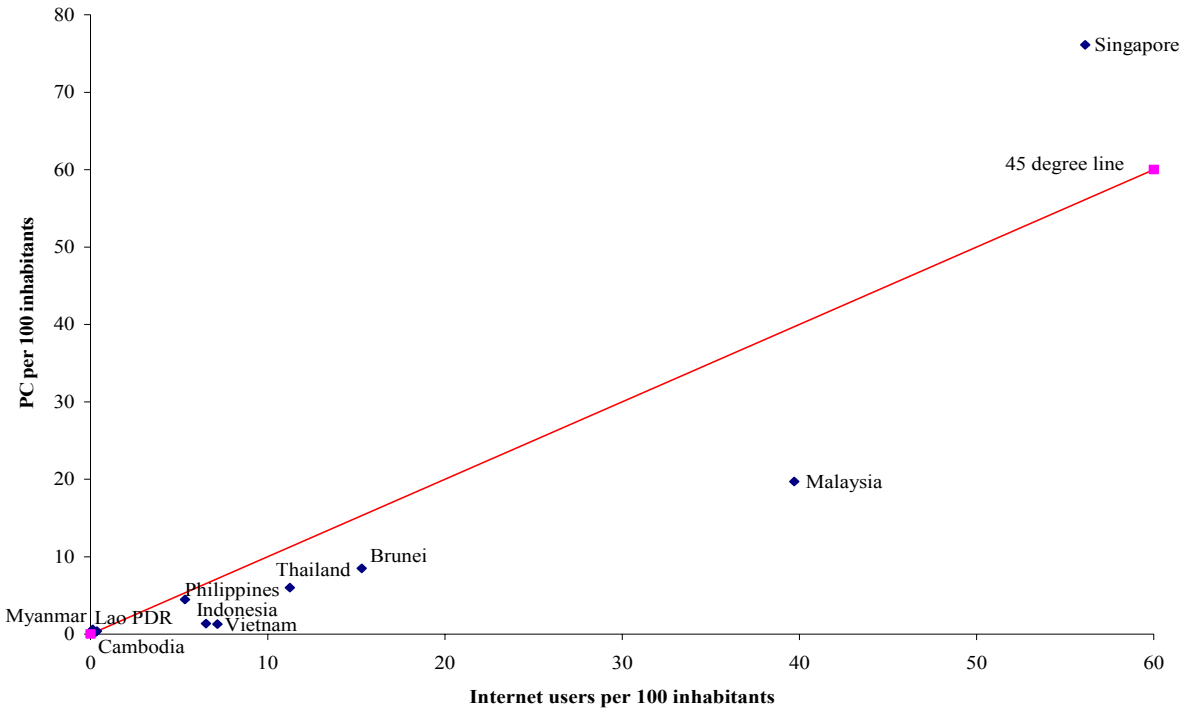
Source: http://www.itu.int/ITU-D/ict/statistics/

Figure 3: Mobile and fixed lines in ASEAN member countries in 2005



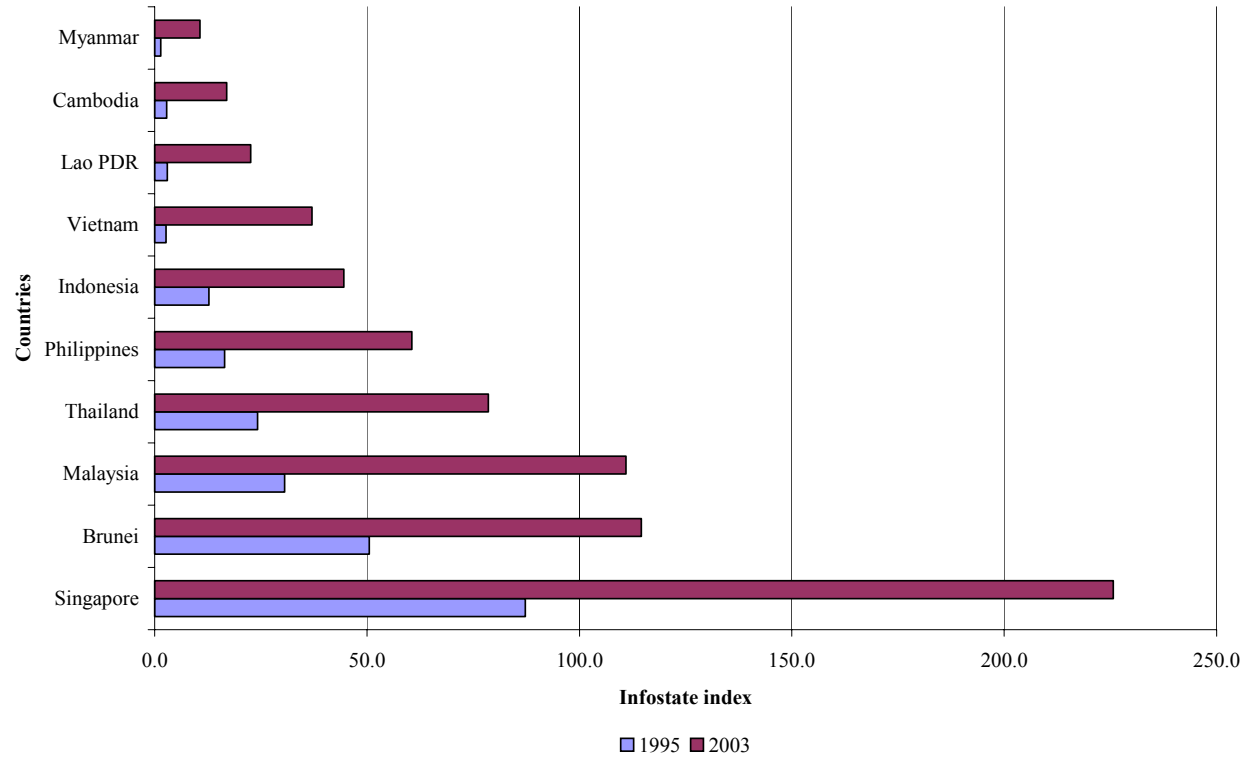
Source: http://www.itu.int/ITU-D/ict/statistics/

Figure 4: Computer and Internet in ASEAN member countries in 2005



Source: http://www.itu.int/ITU-D/ict/statistics/

Figure 5: Infostate index in ASEAN member countries, 1995 - 2003



Note: Infostate = Aggregation of Infodensity and Info-use where Infodensity = sum of all ICT stocks (capital and labour) and Info-use = consumption flows of ICTs/period.

Source: UNCTAD (2006)

A recent survey of 150 enterprises conducted by VNCI (2005) shows that service price levels were very high according to enterprises surveyed. This is particularly the case for international calls, domestic long distance calls, Internet dial-up service, cellular telephone calls and leased line. Fixed line local telephone calls, ADSL and VoIP were perceived to be more reasonably priced.

High interconnection rates for the Internet and leased lines as well as international and domestic long distance tariff structures limit the growth of telecommunications and Internet usage, which in turn constrains national goals of creating a vibrant ICT sector. High costs not only deter foreign investors from establishing offices in Viet Nam in favor of other countries within the region, but also preclude domestic industry from utilizing ICTs to improve management, realize productivity gains, and increase competitiveness (VNCI, 2005).

3.2. Growing Access to and Use of ICTs by Households, but Unequal

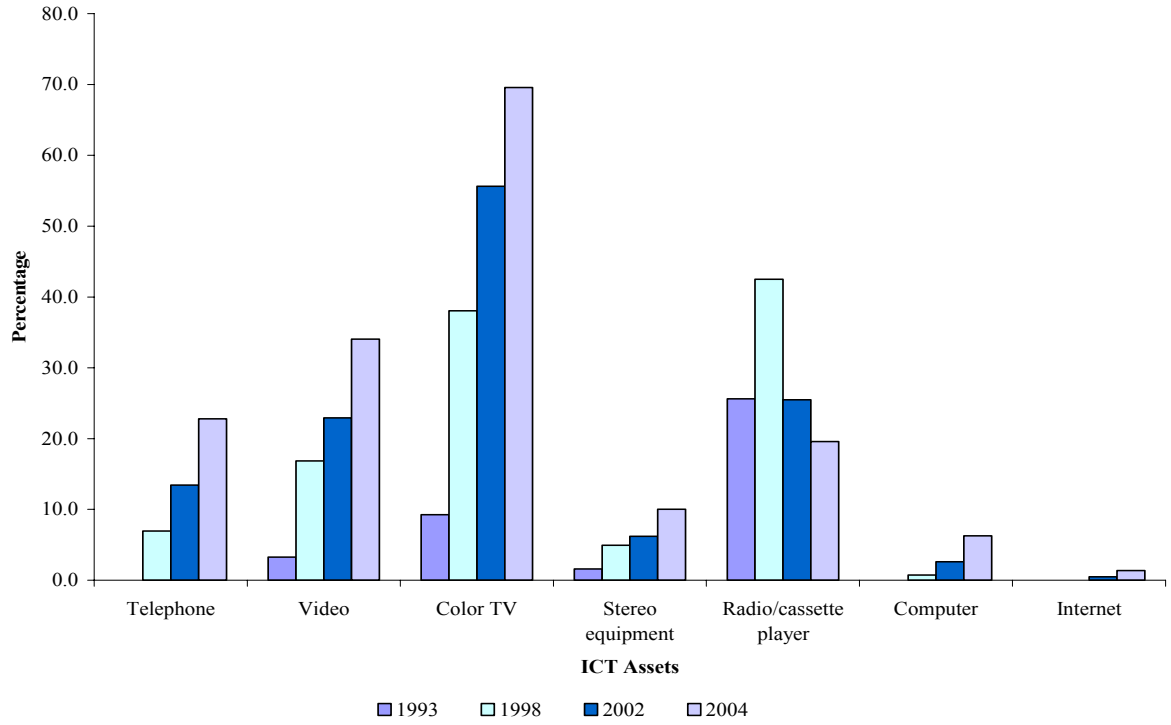
The results of VLSSs and VHLSSs conducted in 1993, 1998, 2002 and 2004 show that the proportion of households having different types of ICT assets (including telephone, video, color TV, stereo equipment, radio/cassette player and computer) has increased especially for video and color TV over the last ten years (Figure 6). This is because of the gradually reduced local subscription charges, tariffs for using local fixed-line, tariffs on and prices of ICT products, especially TV and computer and improved living standards of households overtime (Table 5).

Table 5: Telecommunication subscription charges and tariffs on ICT products, 1998-2006

	Unit	1998	2000	2002	2004	2006
Fixed line subscription charges per line:						
- Urban areas	1,000 dong	1,700	1,600	1,400	1,000	600
- Rural areas	"	1,600	1,100	800	600	200
GSM mobile phone subscription charges per phone	"	-	1,090	545	182	136
Weighted tariff imposed on imported radio, television and communication equipment	%	15	-	-	13.5	12.4

Source: MPT

Figure 6: Proportion of households with different types of ICT assets, 1993 - 2004



Source: GSO, 1993, 2000 and 2004

VHLSS 2004 indicates that, in whole country, slightly over two thirds of households have color TV sets. For telephone and computers, less than 22 percent and 6.3 percent of households own them respectively (Table 6). Only 14 of each thousand households are Internet connected.

Table 6: Proportion of households with different types of ICT assets, 2004 (%)

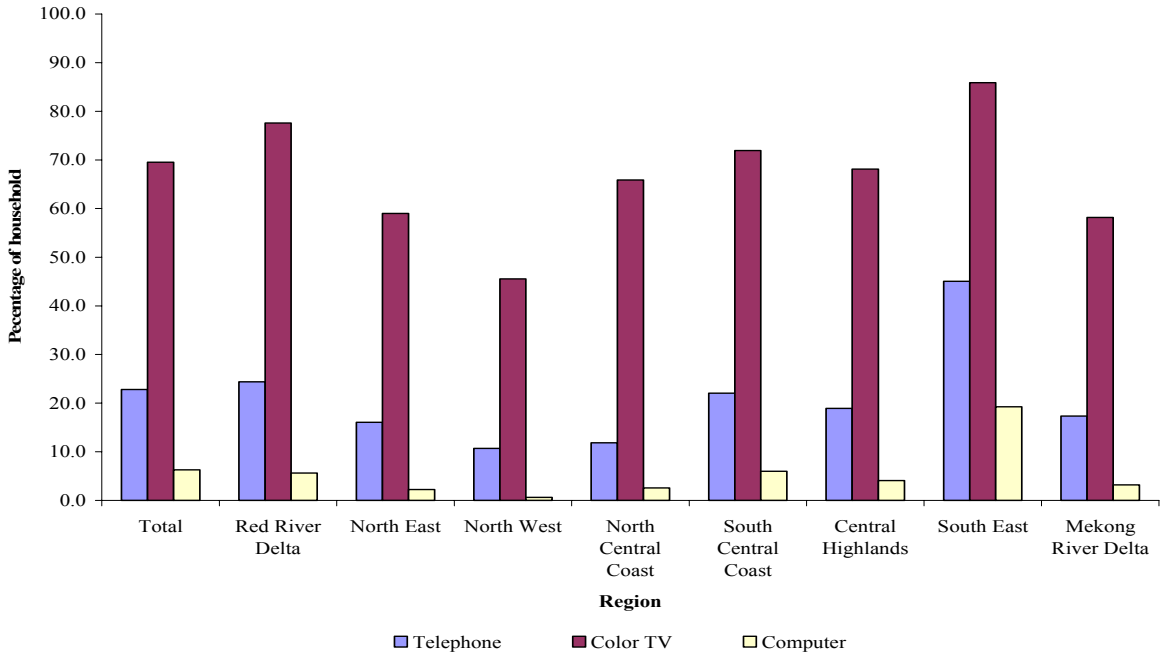
	Total	Area		Sex of household head	
		Urban	Rural	Male	Female
Telephone	22.8	55.5	11.0	20.4	29.7
Mobile phone	7.7	23.1	2.2	6.9	10.3
Video	34.0	55.0	26.5	34.1	33.9
Color TV	69.5	89.8	62.2	70.0	68.3
Stereo equipment	10.0	20.4	6.3	9.9	10.3
Radio/cassette player	19.6	19.9	19.5	20.8	16.1
Computer	6.3	18.9	1.7	5.4	8.9
Internet	1.4	4.6	0.2	1.0	2.4

Source: GSO, 2004, Result of the Survey on Households Living Standards 2004

There is a distinct regional disparity in access to and use of ICT by households. The percentage of households with different types of ICT assets in the North West, North East and North Central Coast regions is much lower than other regions of Viet Nam, with the telephone ownership of 10.7, 16, and 11.8 percent respectively (Figure 7). In 2004, for computers, less

than 6.5 percent of households own them on average, but they concentrate mostly in urban area with 19 percent of households while just 1.7 percent in rural areas. In 2004, on the household base, there are 14 from each thousand households are Internet connected. Less than 2 of each thousand of rural households are connected to Internet. The disparity in ICT access between households in rural and urban areas is still high and has not changed much throughout the period 1993-2004 (Table 7).

Figure 7: Proportion of households with different types of ICT assets by regions, 2004



Source: GSO, 2004, Result of the Survey on Households Living Standards 2004

Table 7: Inequality on access to and use of ICT of households by urban and rural, 1993 - 2004

Unit: percent

	1993		1998		2002		2004	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Telephone	-	-	23.7	1.6	39.6	5.1	55.5	11.0
Mobile phone	-	-	-	-	-	-	23.1	2.2
Video	13.7	0.7	44.5	8.1	47.7	15.0	55.0	26.5
Color TV	33.3	3.2	73.3	26.9	84.0	46.6	89.8	62.2
Stereo equipment	4.8	0.8	12.5	2.6	15.2	3.3	20.4	6.3
Radio/cassette player	43.9	21.1	47.7	40.8	26.1	25.3	19.9	19.5
Computer	-	-	2.9	0.1	8.8	0.6	18.9	1.7
Internet	-	-	-	-	1.8	0.1	4.6	0.2

Note: (-) data is not collected
Source: GSO, 1993, 2000 and 2004

ICT expenditure by quintiles (Appendix 4) also indicates unequal access to ICT products by the rich and the poor, though the consumption of different products increased in all quintiles during 1993 – 2004. Such gaps are observed wider in more luxury products like Internet, computer and video.

4. Impact of ICTs on the Improvement in Household Welfare in Viet Nam[10]

The access to and use of ICTs can improve household welfare through various channels of socio-economic development as described by Gi-Soon (2005) in the Appendix 5. They provide access to more/better information and save cost & time. These are helping:

- Accelerate economic efficiency, productivity and diversification gains to create positive effects on price and market;
- Access to better social services i.e. health, safety net or education;
- Enhance the integration/participation of the poor or poor livelihoods;
- Address barriers to poverty reduction such as natural disasters.

However, the access to and use of ICTs at household level may be determined by various factors of households such as income, education, types of economic activities, etc. The bi-directional influence creates the problem of simultaneity or causality bias if we include the access to and use of ICTs at household level in the econometric models. We therefore expect that ICT variables at household level might be endogenous and any ordinary least squares (OLS)-estimates will be inconsistent if the econometric models will be estimated by using single cross-sectional data. This may be due to some unobserved characteristics of households such as income, education, types of economic activities, etc. Therefore we can not estimate directly the impact of access to and use of ICTs at household level on household welfare.

In order to control for this endogeneity, we applied multinomial logit model using panel household data from VHLSS02 and VHLSS04 household surveys and logit/income models using cross-sectional and pooled data from VLSS98, VHLSS02 and VHLSS04 in rural areas and exclude the access to and use of ICTs at household level. This allow us to examine whether the provision of the infrastructure services and facilities (including ICT infrastructure) under Comprehensive Poverty Reduction and Growth Strategy (CPRGS)[11] has any impact on poverty reduction and household welfare improvement as measured by

[10] It is because that we can only construct panel household data between VHLSS02 and 2004. Therefore the analysis in this section just focuses on 2002 - 2004 period.
[11] In early 2002, the government approved CPRGS, in which it sets a number of objectives to provide basic infrastructure services and facilities in rural poor communes (roads, electricity, markets, post office,... etc.)

household expenditure per capita (Appendix 6) in rural areas respectively over last few years. The result shows that all infrastructure variables (except waterway index) play important roles in improving the household welfare (Appendix 7).

In order to control for the endogeneity when we include ICT variables at household level in the econometric model and to estimate the impact of ICTs on household welfare, the change in household welfare between 2002 and 2004 will be used as the dependent variable in the following model with a liner specification assumption:

$$(1)\ \Delta Y_i = \beta_0 + \beta_1 ICT_{io} + \beta_2 HHC_{io} + \beta_3 HC_{io} + \beta_4 \Delta HC_i + \beta_5 HA_{io} + \beta_6 \Delta HA_i + \beta_7 C_{io} + \beta_8 Y_{io} + u_i$$

where the dependent variable (ΔY_i) is the change in household welfare as measured by the difference in real household expenditure per capita of household *i* between 2002 and 2004. ICT_{io} is a set of ICT variables of household *i* in 2002 (telephone, color TV, radio/cassette player, computer, access to Internet). HHC_{io}, HC_{io}, HA_{io}, C_{io}, ΔHC_i, ΔHA_i and Y_{io} are vectors of the characteristics of household head, household size, household assets, ICT index of commune (all in 2002), changes in household size and household assets between 2002 and 2004, and the real household expenditure per capita in 2002 respectively.

Equation (1), developed by Gi-Soon (2005), is estimated using panel household data from VHLSS02 and VHLSS04 household surveys in both urban and rural areas and OLS technique. The panel data set allows us to control for certain unobserved differences among households such as income, education, types of economic activities, and therefore we can eliminate the key source of endogeneity bias. Moreover, as Wooldridge (2003) suggested that panel data can be seen to provide a good sample for evaluating policy implementation over time.

The OLS regressions in Table 8 show that color TV and telephone use have positive and significant impacts on the growth of household expenditures per capita between 2002 and 2004 in both rural and urban areas. For example, household ownership of a color TV may increase household expenditures per capita between 2002 and 2004 by 380 thousand of dong in rural areas (representing 13.8% of the average expenditures of rural households in 2002) and by 417 thousand of dong in urban areas (representing 21.8% of the average expenditures of urban households in 2002). Computer use in the urban area is an important determinant of the improvement of household welfare. Radio cassette use of the poor in the rural areas is an important determinant of the improvement of household welfare. This can be explained that ICT variables, especially color TV and radio cassette may be competing with each other in the urban areas and in the rich located in rural areas (Table 9). All infrastructure variables (except

waterway index and post office index) appear to be strongly and significantly associated with the growth of household expenditures per capita in the rural areas.

As Table 9 shows in the rural areas the impact of ICTs on household welfare improvement tends to be significantly higher among the poor than the rich (except fixed telephone) while in the urban areas it tends to be significantly lower. This implies that the access to and use of ICTs by households contribute to widen the gap between the rich and the poor in the urban areas but not in rural areas, especially traditional ICTs (color TV and radio).

The OLS regressions show that among different ICT variables with significant impact, computer use appears to have the biggest effect on the increase of real household expenditures per capita between 2002 and 2004 then telephone and finally color TV in the rural and urban areas.

Table 8: Impact of ICTs on household welfare in rural and urban areas between 2002 and 2004

OLS and Panel data: 2002 - 2004

	Rural		Urban	
	Number of obs.	3143	Number of obs.	860
	R-squared	0.1575	R-squared	0.2333
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Dependent variable: Changes in real household expenditures per capita between 2002 and 2004 (a)				
Color TV*	**380.45*** **	64.91	**1239.43*** **	250.44
Radio cassette*	27.47	46.85	117.37	358.73
Computer* (c)	1706.40	1162.81	**1130.35***	605.08
Fixed telephone* (c)	**1026.55*** **	145.36	**1144.09*** **	372.09
Female HH*	-65.81	71.56	-65.66	173.69
Age of HH	**50.19*** **	11.03	4.95	43.85
Age squared of HH	**-0.40*** **	0.10	0.06	0.41
Primary education of HH*	66.07	63.98	99.97	308.25
Secondary education of HH*	**179.62****	85.14	**758.35****	300.82
Technical school of HH*	**303.76****	150.87	260.91	317.05
College and university of HH*	**-225.88*** **	69.10	933.14	607.61
Ln (household size)	**-530.42*** **	105.08	**-1746.97*** **	332.52
Cultivated land per capita	**0.06*** **	0.02	**-0.17*** **	0.03
Change in Ln (household size)	**-1077.97*** **	143.02	**-2557.75*** **	682.89
Change in cultivated land per capita	**0.06*** **	0.02	0.04	0.09
Electricity*	**151.63***	79.70		
Road index	**221.12***	118.06		
Waterway index	106.67	96.48		
Local market index	**139.16****	68.77		
Post office index	0.48	111.96		
Factory*	**66.63***	40.20		
Real household expenditures per capita in 2002	**-0.42*** **	0.04	**-0.45*** **	0.09
Intercept	80.49	373.73	**3575.70*** **	1356.57

*Note: Coefficients in bold are *: significant at 10% level; **: significant at 5% level and ***: significant at 1% level;*

(*) Dummy variables.

(a) Household expenditures per capita are adjusted by monthly CPI and regional CPI and expressed in January 2002 prices (1,000 dong).

(b) Access to Internet variable was excluded from the regression because of the correlation with telephone and computer varialbes.

Source: Calculations based on VHLSS02 and VHLSS04.

Table 9: Impact of ICTs on household welfare by the poor and the rich between 2002 and 2004

OLS and Panel data: 2002 - 2004

	In rural areas			
Number of obs.	1481		1662	
R-squared	0.6667		0.2234	
	Poor household (c)		**Rich household** (c)	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Dependent variable: Changes in real household expenditures per capita between 2002 and 2004 (a)				
Color TV*	**117.88*****	23.92	102.21	118.06
Radio cassette*	**44.16***	28.71	-2.14	80.70
Computer* (b)	(dropped)		1751.57	1225.26
Fixed telephone* (b)	79.07	100.75	**1062.96*****	183.92
	In urban areas			
Number of obs.	91		769	
R-squared	0.7959		0.249	
Color TV*	**128.14*****	40.10	**1046.37*****	304.99
Radio cassette*	-85.37	138.08	83.30	384.16
Computer* (b)	(dropped)		**1154.66***	611.25
Fixed telephone* (b)	**-809.22*****	273.57	**1102.40*****	340.37

*Note: Coefficients in bold are *: significant at 10% level; **: significant at 5% level and ***: significant at 1% level;*

(*) Dummy variables.

(a) Household expenditures per capita are adjusted by monthly CPI and regional CPI and expressed in January 2002 prices.

(b) Access to Internet variable was excluded from the regression because of the correlation with telephone and computer varialbes

(c) Households in the first two quintiles are poor and households in the last three quintiles are rich.

Source: Calculations based on VHLSS02 and VHLSS04.

5. Conclusions and Policy Implications

Starting from very low levels until the late 1980s, the government of Viet Nam has made strong commitments to upgrade the nation's ICT capability and implemented significant institutional reorganization of key ICT stakeholders, gradually opening the ICT market over the last decade. However, it took at least 5 years since the first market opening in 1997 to affect on the ICT market and create significant changes in ICT uptake in the society in Viet Nam.

These reform and trade liberalization efforts together with the achievement of high economic growth would be probably the most important factors which significantly contribute

for improving Viet Nam's ICT uptake and catching up Viet Nam's ICT infrastructure with other countries in the region.

The findings for Viet Nam strongly confirm the common observations of Flor (2001), Swaminathan (2005) Harris (2002), Greenberg (2005), UNCTAD (2002), Gi-Soon (2005) and Joseph (2005) in other developing countries that the access to and use of ICTs positively impact on poverty alleviation and improve household welfare over time. Road, electricity and local market appear to be prerequisite to post office for the poverty alleviation in rural areas of Vietnam. We also find that computer use of households which currently are only common in the richest households appear to have had significant effects on the increase of household welfare over time in Viet Nam. This raises the concern mentioned by Gi-Soon (2005) that one of the potential risks in introducing ICTs to developing countries is that ICTs may widen the gaps between the rich and the poor. Therefore, the government should invest substantially more in provision of computers and Internet access in schools and in rural areas. Moreover, the tariff and VAT imposed on ICTs should be reduced to 0 percent from 12.4% and 10% respectively currently implemented.

In spite of the recent development in the sector, Viet Nam's ICT indicators still lag behind many other ASEAN countries. The telecommunications and Internet cost is still high and the unequal access to and use of ICT products of households by regions, especially in Northern Uplands and North Central Coast and between rural and urban areas is widespread. Moreover, the rural infrastructure indices are underdeveloped in the Northern Uplands and Central Highlands. These imply the need to do much more reform efforts to achieve a fair and transparent ICT market and catching up with other countries in the region as mentioned in the strategic policy papers.

Therefore we strongly recommend that it is necessary to reform regulatory system for safeguard a freer and more competitive enabling environment and require the effective state intervention in underdeveloped rural areas.

The number of service providers should be increased by simplifying the restrictive licensing policies and procedures for both foreign and private investors; the discrimination among foreign investors, private domestic investors and SOEs involved in providing ICT services, especially FBO, SBO, IXP, radio and television services needs, especially in rural areas also to be addressed as a priority in order to create a more leveled playing field and attract more foreign and private investment in the sector; restrictions on content through ICP licenses and the national firewall should be replaced by general guidelines based on self-regulation; licensing for Internet cafes should be liberalized and legal status clarified; and official support should be considered for franchising schemes.

The provision of ICT infrastructure to the vast underdeveloped rural areas, even if can be expensive, is necessary and urgent purchase for the Government of Viet Nam. The lack of and inequality access to information is an important part of the poverty, which exists mostly in rural areas. This could be considered as the effective way to assist the rural poor.

References

An, D. V. *et al.* (2005), *Competitiveness and Impact of Trade Liberalization in Viet Nam: The Case of Telecommunications,* Final Report for VIE/02/009 Project.

Butler R. (2005), *Cell Phones may help "Save" Africa*, http://news.mongabay.com/2005/0712-rhett_butler.html.

David S. (2004), *ICTs and Economic Growth in Developing Countries*, document submitted to the POVNET for INFORMATION, OECD Development Co-operation Directorate.

Doanh L. D. *et al*. (2002), "Catching up ICT in the Transitional Economies in ASEAN: the Case of Viet Nam", *Working Paper Series No. 3/2002,* Central Institute for Economic Management. Hanoi.

Duc L.T, T.Q Trung and N.T. Ha (2006), *Gendered Impacts of the Development of Information and Communications Technologies in Viet Nam*, MIMAP- Gender Network (Phase III).

Elmer, L. (2002), *Viet Nam's ICT Enabling Environment: Policy, Infrastructure and Applications*, USAID, Hanoi.

Flor A. G. (2001), *ICT and Poverty: The undisputable link*, Paper presented at the 3rd Asia Development Forum on Regional Economic Cooperation in Asia and the Pacific, 11-14 June 2001, Bangkok.

Gi-Soon Song (2005), The Impact of Information and Communication Technologies (ICTs) on Rural Households: A Holistic Approach Applied to the Case of Lao People's Democratic Republic, UNV/UNDP Jakarta.

Greenberg A. (2005), ICTs for Poverty Alleviation: Basic Tool and Enabling Sector, SIDA4937en, http://www.sida.se/publications.

Greenwald, B. and J. E. Stiglitz (1986) "Externalities in economies with imperfect information and incomplete markets," *Quarterly Journal of Economics* 101: 229-64.

Hamelink, C. J. (1997) "New Information and Communication Technologies, Social Development and Cultural Change," *UNRISD Discussion Paper 86*. Geneva: UNRISD.

Harris R. (2002), *A Framework for Poverty Alleviation with ICTs*, http://www.communities.org.ru/ci-text/harris.doc.

International Telecommunication Union - ITU (2002), *Viet Nam Internet Case Study*, Geneva, Switzerland.

Joseph K. S. (2005), *The Role of ICT in Poverty Alleviation in Uganda*, Makerere University Business School.

McDonald, M. (1999), *Vietnamese Women and the Computer Industry*, Viet Nam-Canada Information Technology Project, Hanoi.

Mekong Project Development Facility - MPDF (1999), *Information Technology Capacity in Vietnamese Private Firms*, Hanoi.

National Institute of Post and Telematics Strategy (2004), *Telecommunication and Internet Master Plan of Viet Nam to 2010*. Hanoi.

Niimi, Y., P. Vasudeva-Dutta and L. A. Winters (2003), "Trade Liberalisation and Poverty Dynamics in Viet Nam", *PRUS Working Paper No. 17.* Brighton: University of Sussex.

Remco H. O., T.Q. Trung and N.T. Tung (2006), *The Changing Role of Non-Farm Household Enterprises in Viet Nam,* VERN Project.

Stiglitz, J. E. (1988) "Economic Organization, Information, and Development," in H. Chenery and T. N. Srinivasan ed., *Handbook of Development Economics*, Vol. 1, Amsterdam: North Holland.

Stiglitz, J. E. (1989) "Markets, Market Failures and Development," *American Economic Review* 79 (2): 197-203.

Swaminathan (2005), *How can ICTs play a role?* http://www.14donline.net/feb05/introduction.asp.

UNCTAD (2002) *United Nations Conference on Trade and Development E-commerce and Development Report*, http://r0.unctad.org/ecommerce/ecommerce_en/edr02_en.htm.

UNCTAD (2006) *Information Economy Report 2006: The Development Perspective,* United Nations: New York and Geneva

UNDP (2003), *Achieving MDGs through ICT: Experiences and Challenges in Viet Nam*, Hanoi.

VCIT (2001), *Assessing Information Technology Master Plan*, Hanoi.

Viet Nam Competitiveness Initiative - VNCI (2005), *Competition Review of the Vietnamese Telecom Sector*, Vietbit and USAID.

Wooldridge, J. (2003), *Introductory Econometric – An Modern Approach*, Thomson South-Western Press.

World Bank (1998) *World Development Report 1998-1999: Knowledge for Development*, New York: Oxford University Press.

Appendix 1: IT key policies and legislations

- Prime Minister's Decision No. 54/1998/QD-TTg dated 3 March 1998: Establishes Techno-Economic Program on IT in Ministry of Science and Technology (MOSTE);
- E-ASEAN Framework Agreement (April 2000): Establishes policy to promote Harmonization of e-commerce and e-governance goals to support regional trade;
- Resolution of the Government No. 07/2000/NQ-CP dated 5 June 2000: Establishes policy to preferentially support the software industry as a major contributor to GNP for period 2000-2005;
- Communist Party Policy Directive No. 58-CT/TW in October 2000: Establishes policy on the use and development of IT to promote modernization for period 2001-2010;
- Prime Minister's Decision No. 128/2000/QD-TTg dated 20 November 2000: Specifies incentives and tax benefits to support investment in the software industry;
- Prime Minister's Decision No. 19/2001/QD-TTg dated 20 February 2001: Specifies incentives and tax benefits to support investment in the hardware industry (PCs and peripherals);
- Prime Minister's Decision 81/2001/TTg dated 24 May 2001: Ratifies the action plan for realization of the Policy Directive over the period of 2001-2010. It establishes national IT targets for deploying and applying ICTs in four program areas for 2001-2010 to implement the Party Directive 58-CT/TW;
- Prime Minister's Decision No. 112/2001/QD-TTg dated 25 July 2001: Guidelines and targets for the computerization and automation of government management and administration to improve public service delivery for 2001-2005 period;
- Prime Minister's Decision No. 136/2001/QD-TTg dated 17 September 2001: Establishes policy for Public Administrative Reform to modernize state administrative management; includes IT component;
- Prime Minister's Decision 176/2002/QD-TTg dated 3 December 2002: Establishes National IT Steering Committee and Secretariat based in MOSTE. Its functions are to provide guidlines for implementation of the Party Directive 58-CT/TW and the National IT Master Plan and to explore policy and structural reforms, including one entity to govern ICTs in the future;
- Prime Minister's Decision 33/2002/QD-TTg dated 8 February 2002: Approves Internet Development Plan for 2001-2005 and provides budget byline;
- Prime Minister's Decision 95/2002/QD-TTg dated 17 July 2002: Approves National IT Development and Application Master Plan for the Period 2002- 2005;
- Prime Minister's Decision 331/TTg dated 6 April 2004: Approves Program on IT Human Resource Development to 2010 for IT professionals, IT management officials, students, civil servants and pupils;
- Prime Minister's Decision 1120/QD-TTg dated 20 October 2004: Establishes Department for IT Application under Ministry of Post and Telecommunications to assist Minister of Post and Telecommunications perform the functions of State management over and organize the implementation of IT application throughout the country;
- National Assembly approves Law on IT No. 67/2006/QH11 dated 29 June 2006.

Appendix 2: Selected indicators of ICT industry in Viet Nam, 2001 - 2004

	Unit	2001	2002	2003	2004
ICT industry as % of GDP	%	2.32	2.60	2.72	3.03
Number of enterprises	Enterprise	212	338	468	814
Number of employees	Persons	101,493	105,648	112,362	121,578
Total capital	VND bill.	36,111	43,085	56,738	59,409
Total turnover	"	18,924	22,728	30,541	35,852
Profit before taxes	"	6,085	8,332	9,457	13,676
Taxes and fees	"	3,590	4,244	5,281	1,715

Source: GSO, 2005, Real Situation of Enterprises through the Results of Surveys in 2002-2003- 2004

Appendix 3: Ho Chi Minh City software park

Software development has been identified as one of the four key areas in Viet Nam's IT Master Plan (along with infrastructure, hardware development and human resources). The logic is compelling. Computer programming is basically brainpower and thus requires relatively little investment. Funds that are needed could come from local private companies as well as foreign ones. A software development industry would also build up Vietnamese expertise in computing, helping to make ICT sustainable and driving the country into a knowledge-based economy.

The strategy of the government is to promote software development sites around the country rather than one specific zone. The Ministry of Science and Technology has been charged with spearheading software development. A number of incentives are provided to companies locating at the sites such as tax breaks, low rent, etc. So far, a few so-called "Software Parks" have been established in Ho Chi Minh City and Hanoi.

One of the first was Ho Chi Min City Software Park (SSP) where is actually located in a new building albeit in a relatively quiet residential district of HCMC. It opened for business in July 2000 with 30 companies. SSP has around two dozen management staff and over 600 people are working there. This includes established companies as well as new ones. Most are Vietnamese but there are also a few foreign ones. SSP is fully occupied and has been looking for another building close by.

SSP has a two Mbps Internet connection, strong server systems of IBN, SUN, HP and network equipments of CISCO, NORTEL and provides all Internet services (optical cable, xDSL), web hosting, mail-offline.… The price for Internet connection here is discounted 50 per cent as part of a government policy to promote software development. Companies in SSP typically do one portion of software coding in Viet Nam; this is usually part of a larger project. Accounting, management, and education applications are among those being developed for the local market. Softwares that have been developed include a job market application and an electronic catalogue for a business.

Viet Nam's main advantage appears to be labour costs with the average programmer earning about US$ 200/month. SSP has a training and education centre to instruct software engineers on following international standards. It is also working with the University of Ho Chi Minh City to train software engineers. SSP also hosts the first Cisco Networking Academy in Viet Nam. Nonetheless Viet Nam currently only churns out around 2'000 graduates in IT a year and it will need to accelerate this if it is to meet the target of IT Master Plan. The country is also working with overseas partners to develop training programs. India appears to be a model for the Vietnamese with several agreements made with that country for human resource development.

Source: ITU (2002) and http://www.ssp.com.vn/

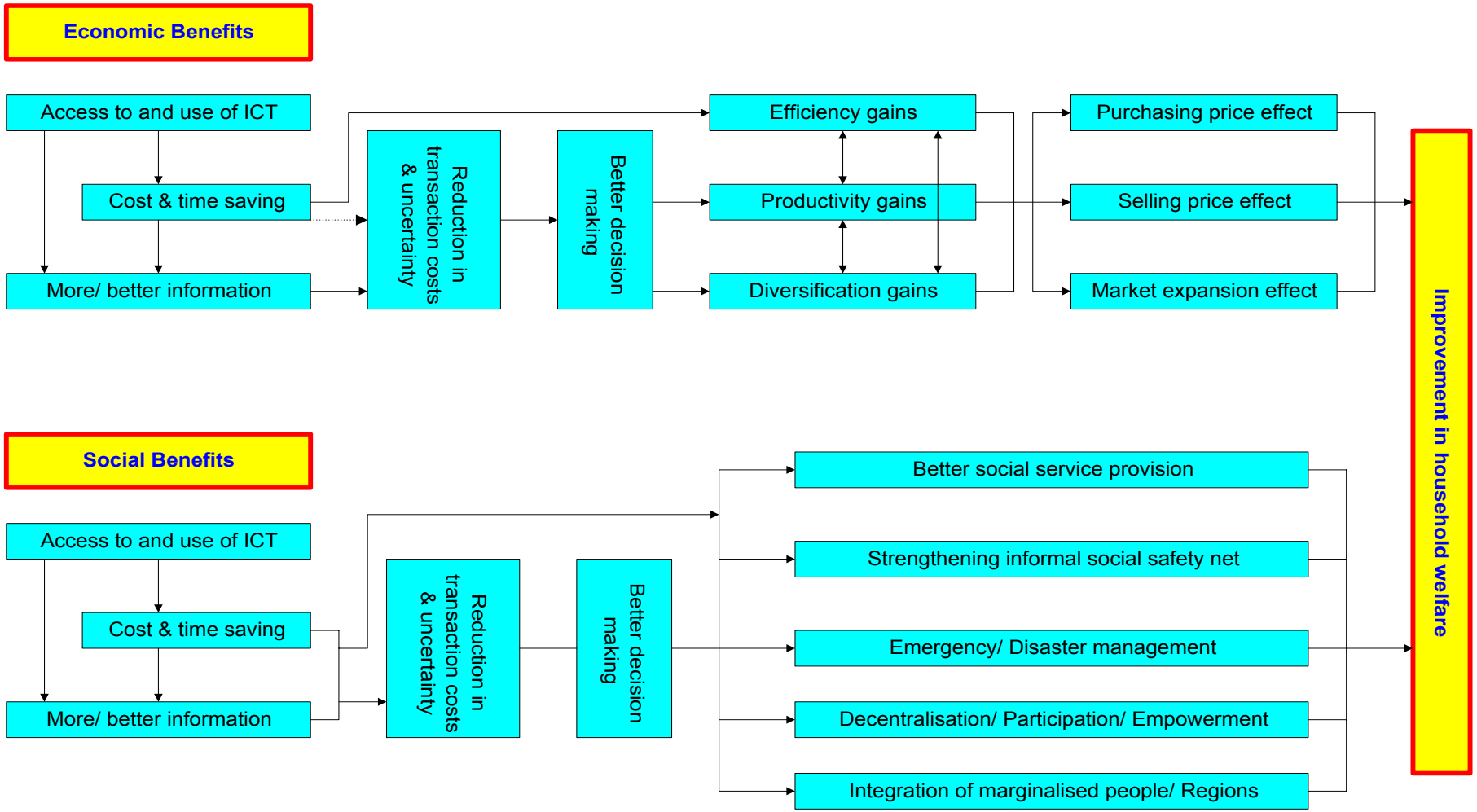
Appendix 4: ICT access of households by expenditure quintile, 1993 - 2004

Unit: percent

	Total	Expenditure Quintile				
		1	2	3	4	5
		1993				
Video	3.3	0.0	0.1	0.2	1.3	13.2
Color TV	9.2	0.5	1.3	3.1	7.2	30.7
Stereo equipment	1.6	0.1	0.3	0.9	1.0	5.1
Radio/cassette player	25.6	8.6	12.1	23.5	32.3	47.3
		1998				
Telephone	6.9	0.0	0.3	0.3	2.9	26.8
Video	16.9	0.8	3.1	6.0	15.4	50.3
Color TV	38.0	6.5	18.7	29.3	46.0	76.4
Stereo equipment	5.0	0.8	1.3	2.3	3.8	14.3
Radio/cassette player	42.5	26.9	32.9	41.4	47.5	57.6
Computer	0.7	0.0	0.0	0.1	0.0	3.1
		2002				
Telephone	13.4	0.1	0.5	1.8	10.2	46.9
Video	22.9	3.0	8.0	14.3	27.0	53.4
Color TV	55.6	17.0	38.7	51.5	68.9	88.8
Stereo equipment	6.2	1.0	1.3	2.7	4.6	18.5
Radio/cassette player	25.5	19.4	21.9	24.1	28.6	31.2
Computer	2.6	0.2	0.0	0.1	0.7	10.5
Internet	0.5	0.0	0.0	0.0	0.1	2.1
		2004				
Telephone	22.8	0.5	3.0	7.9	26.0	66.7
Mobile phone	7.7	0.0	0.1	0.8	4.0	29.8
Video	34.0	7.6	18.2	29.7	43.9	61.8
Color TV	69.5	31.6	57.1	71.1	83.1	94.1
Stereo equipment	10.0	1.3	2.9	5.4	12.5	24.3
Radio/cassette player	19.6	15.0	18.5	19.7	21.2	22.3
Computer	6.3	0.0	0.6	0.6	2.9	24.1
Internet	1.4	0.0	0.0	0.0	0.1	5.9

Source: Own calculation based on VLSS survey 1993, 1998, 2002, 2004.

Appendix 5: Potential economic and social benefits of ICTs



Source: Gi-Soon Song (2005)

Appendix 6: Measuring household welfare

There are two proxies that stand for household welfare - income and expenditure. Both are frequently used in empirical studies across the world. However, expenditure is preferable as a measure of a household wellbeing since expenditure is a good proxy for permanent income and thus also long-term average well-being (Balisacan *et al.* 2003). Information on expenditure also tends to be less difficult to acquire than income, especially for rural households whose income comes largely form self-employment in agriculture (Deaton 2001). Thus, we use real household expenditure per capita as an approximation for household welfare and it is calculated based on data from VLSSs. Total annual expenditure of household consists of five components:

- Consumption expenditure on food and nonfood (nondurable goods);
- Value of home-product food consumed;
- Value of goods in-kind received (such as food, house etc) beside wages;
- Estimated used value of durable goods owned by the household; and
- Rental value of the dwelling occupied by the household.

Total nominal consumption expenditure of household is adjusted by the regional prices and monthly prices deflators and then is divided by household size to obtain real household expenditure per capita.

Appendix 7: Impact of Infrastructure on Poverty Reduction and Household Welfare in Rural Areas of Viet Nam

1. Impact of Infrastructure on Poverty

The impact of infrastructure on poverty dynamics between 2002 and 2004 can be analyzed by applying a multinomial logit model. The model analyses the probability of being in a particular state out of several unordered alternatives. The model examines the probability of poor or non-poor being in one of the four possible outcomes between 2002 and 2004: (1) being poor in both periods, (2) being non-poor in the first period and becoming poor in the second period, (3) being poor in the first period and becoming non-poor in the second period, and (4) being non-poor in both periods in order to investigate poverty transition during the period (Niimi *et al*., 2003). The probability that household *i* experiences outcome *j* is expressed as:

(2)
$$\Pr ob(Y_i = j) = \frac{e^{\beta_j' x_i}}{\sum_{k=1}^{4} e^{\beta_k' x_i}}, j = 1,2,3,4$$

where Y_i is the outcome experienced by household i, x_i is the (n x 1) vector of characteristics for household i, and β_j is the (n x 1) vector of coefficients on x_i applicable to household in state *j*. The model is identified only up to an additive vector since adding, say, vector *m* to each β_k leads to the same probabilities of *Y = 1*, *Y = 2*, *Y = 3* and *Y = 4*. Thus, one β_k must be chosen as the base category and set to zero. All other sets are then estimated in relation to this benchmark.

Equation (2) is a multinomial logit model we will estimate using panel household data from VHLSS02 and VHLSS04 household surveys in rural areas. The dependent variable in the model is a dummy variable representing whether one of these four possible outcomes. The household and farm characteristics, local employment conditions, local infrastructure (as explained and measured in Appendix 8), the migration status of relatives of the household and eight regions of Viet Nam at different levels of aggregation are explanatory variables in the model. These variables refer to conditions in 2004, so the regression attempts to find determinants of the probability of each outcome relative to the probability of the base category in the past.

Panel A of Table 10 shows that better infrastructures are important determinants of increasing the probability of being non-poor relative to being non-poor in both periods.[12]

[12] It gives the impacts of each explanatory variable on the relative risk ratios (RRR) rather than the actual coefficients. The relative risk ratios are the ratio of the probability of each outcome relative to the probability of the base category. If we set *Y = 1* as our base category, the relative risk ratio for *Y = 2* for a change in each variable *x* is given by:

However, households locating in the commune with better infrastructures (except the local market index) do not significantly increase the probability of escaping out of the poverty or being non-poor between 2002 and 2004 relative to being non-poor in both periods.

It is important to note that the multinomial logit regression results only refer to households that were surveyed in both the VHLSS 2002 and VLHLSS 2004 (panel household data). This does not reflect the experience of all households either in VHLSS 2002 or VLHLSS 2004. Therefore we applied a logit model which measures the association between poverty and a wide range of explanatory variables to examine whether infrastructure has any effect on the incidence of poverty of all households surveyed in 1998 - 2002 - 2004. A logit model is defined as follows:

$$\Pr(y_j \neq 0 \mid x_j) = \frac{\exp(x_j\beta)}{1+\exp(x_j\beta)} \quad (3)$$

where y_j takes on two unique values, 0 and 1 experienced by household j. The value 0 denotes a non-poor household and 1 denotes poor household. x_j might contain various characteristics for household j such as household and farm characteristics, local employment conditions, the migration status of relatives of the household, local infrastructure and eight regions as used in the multinomial logit model.

The logit model was estimated by using cross-sectional household data from VLSS98, VHLSS02 and VHLSS04 household surveys in rural areas. Although the result shows that the significance level for coefficients on different local infrastructure variables varies over time, better access to infrastructures in the commune appears to be strongly and significantly reducing the probability that a household residing in the commune is poor in 1998, 2002 and 2004 (panel B of Table 10).

$$\frac{\Pr ob(Y=2)}{\Pr ob(Y=1)} = e^{\beta' 2x}$$

where $e^{\beta(2)}$ is the relative risk ratio for a unit change in the variable *x*. Since all continuous variables have been standardized, the coefficients represent the impact of a one standard deviation change in each explanatory variable on the relative risk ratios of the household being in each outcome. Any coefficient less than one implies that the variable reduces the probability of the household being in the nominated category. The percentage change in the probability is given by the coefficient minus one, multiplied by one hundred. This rule applies to both dummy and continuous variables (Niimi, *et. al.*, 2003).

2. *Impact of Infrastructure on Household Welfare*

The analysis of the multinomial logit/logit models is too dependent on the choice of poverty line to distinguish between the poor and non-poor while the analysis of the income model uses all the information on the range of income rather than reducing this to an arbitrary/binary variable that does not distinguish the rich from the marginally non-poor nor the marginally poor from the very poor in both periods. Therefore we constructed and applied an income model to measure the impacts of infrastructures on household welfare in 1998, 2002 and 2004. In practice, the income model regression is usually preferred to the multinomial logit/logit model regression in the poverty analysis.

Total income (Y_i) of household *i* is the sum of four income components, namely income from wage employment (W_i), income from farm (F_i), income from NFHE (NF_i) and income transfers (R_i) such as remittances. We assume that the income components W_i, F_i, NF_i and R_i are not only a function of household and farm characteristics (H_i), local employment conditions (E_i), the migration status of relatives of the household (M_i), other regional determinants of income activities (such as availability of natural resources) (R_i), and a number of unobservable factors that vary across households (u_i), but also of local infrastructure (I_i) because access to and use of infrastructure services and facilities can have powerful impacts on household production (Remco *et al.,* 2006). We assume a liner specification as follows:

$$Y_i = \beta_0 + \beta_1 H_i + \beta_2 E_i + \beta_3 I_i + \beta_4 M_i + \beta_5 R_i + u_i \quad (4)$$

Equation (4) is the income model we will estimate using cross-sectional data from VLSS98 and VHLSS02 and VHLSS04 household surveys in rural areas and OLS technique. For the dependent variable we choose the per capita expenditure level of the household as a proxy for the income of the household. The actual household income level is a poor measure of the true income level of the household because it does not take into account transitory changes in income due to investment, dissavings and changes in inventories.

Panel C of Table 10 reports the estimated impact of infrastructures on household welfare in 1998, 2002 and 2004 for rural areas in Viet Nam. The OLS estimates of the income model show that all infrastructure variables (except waterway index) appear to be strongly and significantly associated with higher household welfare over 1998 and 2002 period. The role of post office in the commune for improving the household welfare located nearby was increasingly significant over time. However, the result also shows that the significance level for coefficients on different local infrastructure variables varies over time. This can be explained that the regression of cross-sectional data can only report the

estimated impact of infrastructures on household welfare in a single year. Wooldridge (2003) suggested that by pooling samples collected from the same population at different periods, we can get more accurate estimators and test statistics with more power when compared to those of single cross-sectional data because of the advantage of large sample size at different points in time.

Therefore we estimated equation (4) by using pooled data from VLSS98, VHLSS02 and VHLSS04 household surveys in rural areas using OLS. The household expenditures per capita in three surveys are adjusted by monthly CPI and measured in January 2002 prices. Table 11 shows that the pooled regression is consistent with the cross-sectional regression and all coefficients on local infrastructure variables (except waterway index) are significant at 1% level.

The cross-sectional and pooled regressions show that among different infrastructure variables with significant impact, road and electricity appear to have the biggest effect on the household welfare then the presence of factory and local market and finally post office.

Table 10: Impact of infrastructure on poverty and household welfare in rural areas, 1998 - 2004

Panel A: Multinomial logistic regression and panel data: 2002 - 2004

(Outcome poor==1 is the comparison group)

	Outcome poor: 2		Outcome poor: 3		Outcome poor: 4	
	RRR	Robust Std. Err.	RRR	Robust Std. Err.	RRR	Robust Std. Err.
Dependent variable: Outcome of being poor or non-poor between 2002 and 2004 - 1, 2, 3, 4 (**)						
Electricity*	1.00	0.57	0.73	0.172	0.79	0.29
Road index	1.04	0.42	0.77	0.293	1.36	0.44
Waterway index	1.39	0.38	1.40	0.358	1.16	0.31
Local market index	**1.46****	0.26	**1.63****	0.370	**2.44*****	0.38
Post office index	1.14	0.42	1.24	0.376	1.52	0.46
Factory*	0.98	0.17	**0.78****	0.091	1.15	0.17

Panel B: Logistic regression and cross-sectional data: 1998 - 2002 - 2004

	1998		2002		2004	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Dependent variable: Outcome of being poor or non-poor						
Electricity*	**-1.25*****	0.16	**-0.45*****	0.13	-0.14	0.14
Road index	-0.03	0.39	**-0.83*****	0.12	**-0.42****	0.17
Waterway index	-0.19	0.28	-0.03	0.09	**-0.28***	0.16
Local market index	**-0.66*****	0.25	**-0.14****	0.07	**-0.73*****	0.11
Post office index	0.09	0.25	**-0.24****	0.11	-0.04	0.14
Factory*	**-0.37****	0.17	**-0.31*****	0.06	**-0.22*****	0.07

Panel C: OLS regression and cross-sectional data: 1998 - 2002 - 2004

	1998		2002		2004	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Dependent variable: household expenditures per capita						
Electricity*	**585.81*****	68.15	82.64	85.27	-23.66	119.65
Road index	-37.61	181.00	**517.65*****	93.38	**382.35*****	149.03
Waterway index	13.13	133.29	61.37	60.55	38.78	72.57
Local market index	**181.05***	105.64	**142.34*****	42.25	**334.94*****	47.11
Post office index	95.70	118.97	47.91	64.59	**132.46****	66.52
Factory*	79.06	78.71	**242.94*****	44.07	**173.52*****	39.95

*Note: Coefficients in bold are *: significant at 10% level; **: significant at 5% level and ***: significant at 1% level;*

(*) Dummy variables.

(**) Outcome of being poor or non-poor between 2002 and 2004: Poor in 2002 and 2004: 1; Non-poor in 2002 and poor in 2004: 2; Poor in 2002 and non-poor in 2004: 3; Non-poor in 2002 and 2004: 4

Source: Calculations based on VHLSS98, VHLSS02 and VHLSS04

Table 11: Impact of infrastructure on household welfare in rural areas, 1998 - 2004

Number of observations	33030	R-squared	0.2334
F(23, 2401)	112.93	Root MSE	1519.8
Prob > F	0.0000	Number of clusters	2402

OLS regression and pooling data: 1998 - 2002 - 2004

	Coef.	Robust Std. Err.	t	P>t
Dependent variable: household expenditures per capita				
Female HH*	-51.70	27.22	-1.90	0.058
Age of HH	84.10	4.74	17.74	0.000
Age squared of HH	-0.72	0.05	-15.54	0.000
Primary education of HH*	342.53	27.13	12.62	0.000
Secondary education of HH*	705.19	31.18	22.61	0.000
Technical school of HH*	1510.32	61.86	24.42	0.000
College and university of HH*	93.55	48.79	1.92	0.055
Ln (household size)	-894.64	31.41	-28.49	0.000
Cultivated land per capita	0.07	0.01	10.26	0.000
Electricity*	317.74	54.28	5.85	0.000
Road index	496.32	75.77	6.55	0.000
Waterway index	36.12	46.00	0.79	0.432
Local market index	108.71	35.01	3.11	0.002
Post office index	132.53	52.12	2.54	0.011
Factory*	248.00	34.33	7.22	0.000
Migration status*	421.90	23.03	18.32	0.000
North East*	92.35	49.61	1.86	0.063
North West*	120.66	89.13	1.35	0.176
North Central Coast*	-155.32	50.36	-3.08	0.002
South Central Coast*	312.61	56.23	5.56	0.000
Central Highlands*	288.76	78.99	3.66	0.000
South East*	1171.98	78.62	14.91	0.000
Mekong Delta*	985.02	59.99	16.42	0.000
Intercept	-323.94	137.90	-2.35	0.019

Note: (*) Dummy variables.
Source: Calculations based on VHLSS98, VHLSS02 and VHLSS04

Table 12: Variable Definitions in Tables 8, 9, 10 and 11

Variable	Definition
Dependent variable in Table 8 and Table 9	Changes in real household expenditures per capita between 2002 and 2004 (in 1,000 dong of January 2002 prices)
Dependent variable in Panel A of Table 10	Outcome of being poor or non-poor between 2002 and 2004: poor in 2002 and 2004 (1); non-poor in 2002 and poor in 2004 (2); poor in 2002 and non-poor in 2004 (3); non-poor in 2002 and 2004 (4)
Dependent variable in Panel B of Table 10	Outcome of being poor or non-poor in 1998, 2002 or 2004: poor (1) and non-poor (2)
Dependent variable in Panel C of Table 10	Comparable monthly price adjusted household expenditures per capita (in 1,000 dong of 1998, 2002 or 2004)
Dependent variable in Table 11	Comparable monthly price adjusted household expenditures per capita (in 1,000 dong of January 2002 prices)
Color TV	Dummy variable, =1 if Household has color TV
Radio cassette	Dummy variable, =1 if Household has radio cassette
Computer	Dummy Variable, =1 if Household has computer
Fixed telephone	Dummy variable, =1 if Household has fixed telephone line
Female HH*	Dummy variable, =1 if Female household head
Age of HH	Years of age of household head
Primary education of HH*	Dummy variable, =1 if HH has primary education
Secondary education of HH*	Dummy variable, =1 if HH has secondary education
Technical school of HH*	Dummy variable, =1 if HH has technical school
College and university of HH*	Dummy variable, =1 if HH has college, university and higher
Ln (household size)	Log of household size
Cultivated land per capita	Total area of cultivated land per capita of household
Electricity*	Dummy variable, =1 if Household has access to electricity
Road index	Value of road index
Waterway index	Value of waterway index
Local market index	Value of local market index
Post office index	Value of post office index
Factory*	Dummy variable, =1 if HH locates in commune with factory nearby
Migration status*	Dummy variable, =1 if HH has migrant
North East*	Dummy variable, =1 if Household resides in North East
North West*	Dummy variable, =1 if Household resides in North West
North Central Coast*	Dummy variable, =1 if HH resides in North Central Coast
South Central Coast*	Dummy variable, =1 if HH resides in South Central Coast
Central Highlands*	Dummy variable, =1 if HH resides in Central Highlands
South East*	Dummy variable, =1 if Household resides in South East
Mekong Delta*	Dummy variable, =1 if Household resides in Mekong Delta

Source: Calculations based on VHLSS98, VHLSS02 and VHLSS04

Appendix 8: Measuring rural infrastructure indices

In the models we construct and use a number of rural infrastructure indices according to the methodology developed by Vijverberg and Houghton (2004) as follows:

$$\text{ICI Index} = \left(1 - \frac{\text{Km.to nearest post office}}{10}\right)$$

This measures the availability of telecommunication and Internet services in the commune. Distances greater than 10 are truncated at 10. The index declines if the nearest post office to the commune is further away.

$$\text{Road Index} = \left(1 - \frac{\text{Km. to nearest road}}{10}\right)\left(1 - \frac{\text{Months with impassable road}}{12}\right) \text{x Quality of road}$$

where quality of road is 1 for cement/asphalt/tar on gravel road, 0.8 for gravel road and 0.6 for dirt/other road.

This measures the availability of a viable road system. Distances greater than 10 are truncated at 10. The index declines if the nearest road that a car can travel on is further away, or impassable for longer periods.

$$\text{Waterways Index} = \left(1 - \frac{\text{Km. to nearest waterway}}{10}\right)$$

This measure is only computed if the respondent indicated that waterways were an important means of transportation for the community. Whenever the distance exceeds 10 km or waterways are not deemed important, the index takes on a value of 0.

$$\text{Daily Market Index} = \left(1 - \frac{\text{Distance to nearest daily market}}{72}\right)$$

$$\text{Periodic Market Index} = \left(1 - \frac{\text{Distance to nearest periodic market}}{50}\right) \times \text{Daily Frequency}$$

$$\text{Local Market Index} = \text{Daily Market Index} + \text{Periodic Market Index}$$

For market indexes, the truncation points are chosen according to values indicated in the survey. The daily frequency is a proportion, so a market that operates once a week has a daily frequency of 1/7. Local market index is the combination of the daily market index and the periodic market index in the commune.