Firm-level Competitiveness and Technology in Vietnam: Evidence from a Survey in 2010

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Preface

This report is based on a survey module incorporated into the 2009 Vietnam Enterprise Survey conducted by the General Statistics Office (GSO) of Vietnam in 2010.[1] The survey module was specifically designed by the Development Economics Research Group (DERG) of the University of Copenhagen (UoC) and the Central Institute for Economic Management (CIEM) of the Ministry of Planning and Investment (MPI) of Vietnam, to collect detailed data on issues surrounding competitiveness and technology use/adoption/adaptation at Vietnamese manufacturing firms. Approximately 8,000 non-state manufacturing enterprises in all 63 provinces of Vietnam participated in the survey module, and sampling was designed such that the data is nationally representative. The survey module focuses on building on the substantial enterprise database already being collected by the GSO (since the year 2000), with a specific focus on collecting data and gaining an understanding of competitiveness and technology issues facing Vietnamese enterprises. The survey module and report are a collaborative research effort with the explicit objective of being complementary to the on-going Vietnam Enterprise Survey.

The fieldwork behind this report consisted of interviews in the months of April-August of 2010. The Industrial Statistics Department of the GSO and the Provincial Statistics Offices (PSOs) in all 63 provinces of Vietnam carried out a wide range of tasks related to the planning and implementation of the survey in the field, as well as the survey design; and the DERG/UoC collaborated with CIEM and GSO in all aspects of survey design and data analysis. Throughout this process, capacity building activities by DERG/UoC staff were regularly conducted.

The report provides an overview of key insights from the 2010 database. It should be noted that the report is by no means exhaustive of all of the data collected, and the reader is encouraged to refer to the questionnaire (included in the Appendix to this report) that was used in the collection of data to see the comprehensive set of issues that can be addressed with the data now at hand.

Based on the data collected, further in-depth studies of selected issues on the Vietnamese private sector are underway. Furthermore, three follow-up surveys are planned for 2011 (currently on-going), 2012 and 2013 with a view to developing a panel database. Survey and sample design, as well as data analysis in this report, is conducted by the DERG/UoC and CIEM. The survey module upon which this report is based was funded specifically by the University of Copenhagen through its Development Economics Research Group (DERG). This report and all surveys and reports for the next three years are supported by Danida under the Business Sector Programme Support (BSPS).

[1] Survey conducted in 2010, with data referring to 2009.

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The team of authors is grateful to the President of the Central Institute for Economic Management (CIEM), Associate Professor Le Xuan Ba, the Vice-President of CIEM, Ms Vu Xuan Nguyet Hong, and the Director General of the Department of Industrial Statistics in the General Statistics Office (GSO) of Vietnam, Mr Pham Dinh Thuy, who have guided our work from beginning to end, and ensured effective collaboration between all partners. Thanks are also due to the Danish Ambassador in Vietnam, H.E. John Nielsen, who has supported the research effort throughout its various stages.

The core research team was led by Professor John Rand and Assistant Research Professor Juliane Brach from the DERG/UoC, and Dr Nguyen Tue Anh and Mr Le Phan from the Department for Business Environment and Competitiveness at CIEM. Professor Finn Tarp from DERG/UoC and Ms Vu Xuan Nguyet Hong, Vice-President of CIEM, coordinated and supervised the research effort through all its stages. DERG/UoC economist Mr Simon McCoy provided input, support, comments and editing throughout.

Our work would not have been possible without professional interaction, advice and encouragement from a large number of individuals and institutions. We would in particular like to highlight our thanks:

- For the productive and stimulating collaboration with the survey and data teams from GSO. They were coordinated by Mr Thuy and his staff. Without the efforts of GSO and the 63 PSOs in compiling the questionnaires, training enumerators, implementing the survey in the field and cleaning the data, all other work would have been in vain.
- For the insights and comments on the first draft of this report received from participants at a workshop in Hanoi (organised by CIEM) on 11 August 2011, in particular from Ms Pham Chi Lan.
- To the many staff at the Royal Embassy of Denmark in Vietnam who have supported us in our work, including Ms Lis Rosenholm, Deputy Ambassador, and Ms Vu Huong Mai, BSPS Programme Manager.

Moreover, the study team would like to put on record our appreciation for the time that the more than 8,000 enterprise owners/managers made available in 2010 during the interviews carried out as part of this study. It is hoped that the present report will prove useful in the search for policies geared towards improving the business environment in which they operate. Finally, while advice has been received from many colleagues and friends, the research team is responsible for any remaining errors or shortcomings in interpretation. All the usual caveats apply.

1 Introduction

Vietnam's economic growth performance since the *Doi Moi* reforms of the mid 1980s has been widely praised. A key driver of this growth has been the private sector, becoming dynamic, flexible and in many cases highly profitable in the space of just three decades. In recent years, however, it has become clear that many of the 'easy wins' that have allowed enterprises in Vietnam to grow and develop at such rates may no longer exist. For growth to continue, and for that growth to be sustainable in the long run, factor and investment led growth must give way to innovation led growth to a greater extent than in the past. In this context, issues surrounding the competitiveness of the private sector, and the economy more broadly are increasingly being seen as key priorities by the Government of Vietnam. This is reflected, for example, in the recent publication of the new annual Vietnam Competitiveness Report (CIEM et al., 2010).

In this context, technology in enterprises clearly plays a key role. This is not only in terms of the use, adoption and adaptation of technology, but also for innovation and research and development (R&D) initiatives, which are critical for sustainable and competitive economic development (Fagerberg et al, 2010). Firms can benefit from new production, process or organizational technologies in several ways. The application of new technologies allows firms to upgrade their capacities and products. Moreover, new technology often constitutes a major determinant in the development of new products, as well as in improvements to the quality of already existing products. More broadly, it can also lead to enhanced efficiency and thus a reduction in production costs.

But while such innovative and technological capacities have been a centre of attention in the context of developed countries for some time, these concepts are relatively new and underexplored in developing countries (Fu et al, 2011). In terms of measurement of innovative capacity and development, standard science and technology indicators (STIs) such as the number of patents, R&D expenditures, and the number of scientists, are widely applied by governments and international organizations for evaluation purposes (European Commission 2009, OECD 2010, World Bank 2010). Selected standard STIs are summarised in Table 1.1. These can be compared with the questions used in the survey module underlying this report (see questionnaire in Appendix to this report).

Table 1.1: Standard Science and Technology Indicators (STIs)

Variable Group	Variable	Description	Source
Input	Labour/Human Capital	Technicians in R&D (per million people)	(World Bank 2010)
		Researchers in R&D (per million people)	(World Bank 2010)
	Research and development expenditure	Research and development expenditure (% of GDP) Total R&D Expenditures	(World Bank 2010)
	Labour productivity	Adult literacy rate (% of population aged 15 years and over)	(Human Development Indicators. UNDP 2009)
		Index ranging from 0 to 1, with a higher score indicating higher education. Based on the adult literacy rate and the combined gross enrolment ratio for primary, secondary and tertiary schools.	(Human Development Indicators. UNDP 2009)
Output	Patents	Total number of patents	(World Bank 2010)
		Number of patents filed by residents	
		Patent citation	
	High-technology exports	High-technology exports (% of manufactured exports)	(World Bank 2010)

The relevance of these STIs is largely uncontested, however they do have significant limitations (Freeman and Soete, 2009), especially in the context of developing countries. Much of this is due to the narrow focus of STIs on high-technology research-based innovation and technological progress which is often not applicable in developing countries where technology and innovation often take rather different forms- something that is clearly shown by the data later in the report. As such, collecting only STIs can lead to a systematic undervaluation of the true level of innovative activity and on-going technological progress in a given country. STIs for Vietnam can be found in the World Bank's World Development Indicators (WDIs).

This report (and the on-going BSPS supported research project) is the first quantitative analysis of technology and innovation among Vietnamese enterprises that fully takes into account the measurement and methodological issues described above.

The report is organized into eight sections. In the next section (Section 2), sampling and implementation issues are outlined. Section 3 presents results surrounding the constraints and competition facing firms. Vertical technology spillovers are then analysed in Section 4. Section 5 considers research and technology development and Section 6 builds on this considering technology adaption and diffusion based innovation. Section 7 looks at future technology needs of the firms, and Section 8 provides a summary of some of the main conclusions and policy-relevant findings.

2 Survey Instrument, Sampling and Implementation

2.1 Survey Instrument

The questionnaire module (see Appendix to this report) developed by the research team of DERG/UoC and CIEM allows the collection of innovation and technology related data beyond many of the standard STIs. Drawing on innovation and growth theory (Aghion/Howitt 1998, Grossman/Helpman 1991; Romer 1990, among others), the questionnaire module includes detailed questions on technological competences and upgrading possibilities at the firm level. As such, it covers a much broader basis of innovation and technology related activities than standard innovation surveys (e.g. OECD). It is designed to be a suitable tool to help provide an in-depth understanding and evaluation of innovative and technological capacities of enterprises, in particular those that may not ordinarily invest in R&D-based innovation. This makes it particularly suitable in a developing country context such as Vietnam.

More specifically, the module includes more than 50 questions, which can broadly be grouped in five sections that directly relate to different theoretical arguments established in the literature:

i. Taking stock of technologies and technological basis (e.g. the type, age or cost of current production technologies and machinery).
ii. Channels of technology transfer that specify how technologies not developed in the firm have been acquired (e.g. vertical and horizontal spillovers, foreign direct investment or international value chain integration).
iii. Research-based development of technologies (e.g. motivation, degree of innovation, target group etc.). These R&D questions complement the STIs such as number of patents and expenditures for research and development (R&D) which are already included in the core GSO Enterprise Survey questionnaire.
iv. Diffusion-based development of technology (e.g. technology adaption activities that are related to the development of technologies that are new to the firm and/or to the country and that are based on the adaption and modification of already existing technologies, rather than original R&D.)
v. Technology planning (e.g. technology demand, reasons for and constraints to implementation).

2.2 Sampling

Since the year 2000, the GSO has implemented a nationwide survey of the private sector in Vietnam with all formally registered enterprises being interviewed. For most years, data has been gathered on the

population of all registered enterprises[2] in Vietnam with 10 employees or more, however in recent years the selection criteria in Hanoi and Ho Chi Minh City (HCMC) changed to include firms with 30 employees or more due to the significant increase in firm numbers. A representative sample of smaller firms is also collected. The survey, known as the Enterprise Survey of Vietnam, has provided analysts and policymakers in Vietnam with a rich and high quality database including many issues facing Vietnamese enterprises as they look to grow and prosper.

The sample of firms included in the survey module used here was drawn from the 2009 Vietnam Enterprise Survey (GSO, 2010)[3]. Focus is exclusively on non-state manufacturing firms. Moreover, only firms that provided consistent information regarding firm size (number of employees), total revenue and total assets are included. From a total of 44,144 non-state manufacturing enterprises interviewed in the 2009 Vietnam Enterprise Survey, 7,999 were selected to respond to the technology survey module used here. Out of these 7,999, 378 enterprises refused to answer several questions or were found to have exited (thus leaving 7,621 that were actually interviewed), and a further 482 enterprises were found, after having been interviewed, to have given inconsistent revenue and asset numbers (Table 2.1).

Table 2.1: Number of Enterprises by Region

	Sampled/ Interviewed	With consistent revenue and assets numbers (used for analysis)
Red River Delta	2,286	2,131
North East	397	364
North West	40	38
North Central Coast	384	365
South Central Coast	531	493
Central Highlands	129	113
South East	3,014	2,880
Mekong River Delta	840	755
Whole Country	7,621	7,139

Firms were selected from the population, based on a stratified (by region and sector, 2-digit ISIC) random sampling approach. The tables below show the final sample disaggregated by region and firm size (Table 2.2), sector[4] and firm size (Table 2.3), and form of legal structure and firm size (Table 2.4).

[2] Defined as enterprises that are registered with provincial authorities under the Enterprise Law of Vietnam.

[3] Survey conducted in 2010, with data referring to 2009.

[4] Particular focus was given to the rubber sector (ISIC 25). This is for several reasons: (i) Large export potential of manufactured rubber (potential technology spillovers from international customers); (ii) Complex nature of raw rubber manufacturing where production typically requires on-farm processing of latex (making both downstream and upstream technology/knowledge transfers highly relevant); (iii) Recent transformation from large state rubber plantations to private rubber farms, paving the way for an emergence of a smallholder rubber sub-sector. As a result of this focus, the weight of the rubber sector in our sample is 8.8 percent (versus 6.2 percent in the overall population of firms).

Table 2.2: Number of Enterprises by Region and Firm Size

Region	Micro	Small	Medium	Large	Total	Percent
Red River Delta	82	993	901	310	2286	(30.0)
North East	22	185	143	47	397	(5.2)
North West	0	23	14	3	40	(0.5)
North Central Coast	9	212	146	17	384	(5.0)
South Central Coast	25	215	211	80	531	(7.0)
Central Highlands	12	57	53	7	129	(1.7)
South East	87	968	1378	581	3014	(39.5)
Mekong River Delta	35	459	238	108	840	(11.0)
Total	272	3112	3084	1153	7621	
Percent	(3.6)	(40.8)	(40.5)	(15.1)		

Note: Number of firms interviewed. Percent in parenthesis

Table 2.3: Number of Enterprises by Sector and Firm Size

ISIC 2-digit	Micro	Small	Medium	Large	Total	Percent
15	71	533	409	166	1179	(15.5)
17	10	124	190	52	376	(4.9)
18	13	94	213	262	582	(7.6)
19	3	25	83	100	211	(2.8)
20	27	275	192	23	517	(6.8)
21	7	193	172	21	393	(5.2)
22	10	102	63	2	177	(2.3)
23	0	1	0	0	1	(0.0)
24	13	169	149	36	367	(4.8)
25	14	285	298	75	672	(8.8)
26	17	304	357	78	756	(9.9)
27	5	110	74	12	201	(2.6)
28	31	419	299	40	789	(10.4)
29	13	115	83	23	234	(3.1)
30	1	4	2	9	16	(0.2)
31	3	48	55	31	137	(1.8)
32	2	21	36	24	83	(1.1)
33	1	15	12	5	33	(0.4)
34	2	29	26	16	73	(1.0)
35	5	69	90	35	199	(2.6)
36	23	176	281	143	623	(8.2)
37	1	1	0	0	2	(0.0)
Total	272	3112	3084	1153	7621	
Percent	(3.6)	(40.8)	(40.5)	(15.1)		

Note: Number of firms interviewed. Percent in parenthesis

Table 2.4: Number of Enterprises by Legal Structure Form and Firm Size

Legal Ownership Form	Micro	Small	Medium	Large	Total	Percent
Collective	8	140	49	5	202	(2.7)
Private enterprise	87	860	302	30	1279	(16.8)
Limited liability company	121	1471	1244	251	3087	(40.5)
Joint stock without state	26	322	540	193	1081	(14.2)
Joint stock with state	1	14	144	106	265	(3.5)
FDI firm (100%)	24	277	701	508	1510	(19.8)
Joint venture (SOE+FDI)	0	5	43	39	87	(1.1)
Joint venture (Private+FDI)	5	23	61	21	110	(1.4)
Total	272	3112	3084	1153	7621	
Percent	(3.6)	(40.8)	(40.5)	(15.1)		

2.3 Implementation

The survey module upon which this report is based was implemented as an annexed module to the annual Enterprise Survey conducted by the GSO. Approximately 300 enumerators under the guidance of 80 supervisors located at the 63 Provincial Statistical Offices (PSOs) conducted the survey module through face-to-face interviews in the period from March to September 2010. All 63 provinces were covered by an individual team of one supervisor and up to five enumerators. Prior to the start of the fieldwork, two two-day training seminars for the supervisors took place in Nam Dinh (for Northern provinces) and Ho Chi Minh City (HCMC) (for Southern provinces).

The original questionnaire was designed in English and subsequently translated into Vietnamese. Questionnaire design and question formulation was a lengthy and careful process involving all three partners of DERG, CIEM and GSO. Once the questionnaire was agreed, independent back translations were commissioned to ensure consistency between the English and the Vietnamese versions. All interviews were conducted in Vietnamese, and each interview lasted an average of three hours, with some of this time used to introduce and explain the questions.[5]

Data collection and a first check for missing information took place at the respective PSOs. Following data entry, an electronic version of the data was sent to the GSO in Hanoi for further checking and compilation. Hard copies of the questionnaire remained with the PSO until GSO finalized the cleaning of the data and the compilation of the final dataset. The dataset was finalized in the autumn of 2010.

As mentioned, the survey module will be conducted a further three times under the Danida BSPS Programme (2011, 12, 13). This first survey can thus be used as a baseline, with all sampled enterprises in

[5] The duration of the interview is expected to be less in the next rounds of 2011, 12, 13.

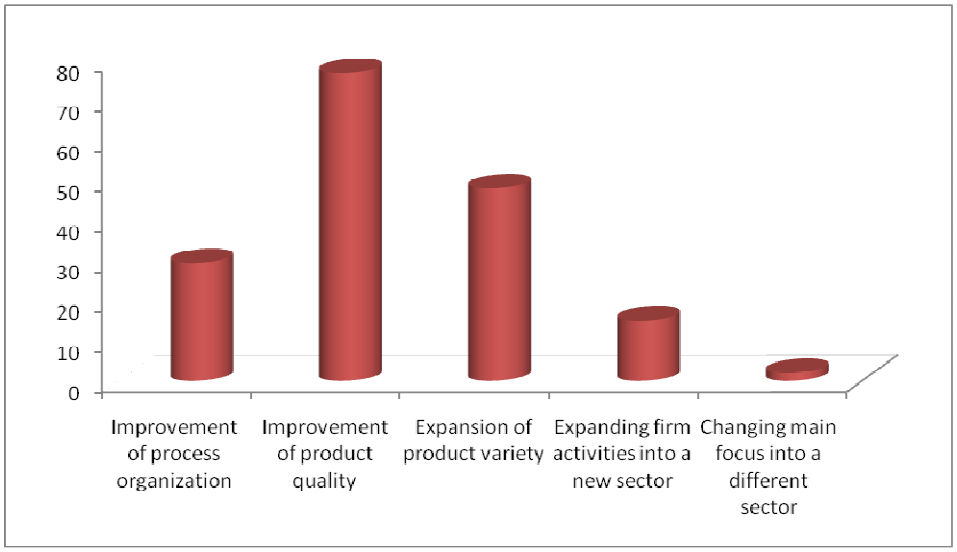
2010 to be interviewed as a panel series over the four years. In order to maintain the sample size, exiting firms will be replaced from a backup list that also meets the sample selection criteria of the stratified original sample. Wherever possible, exiting firms are replaced with firms from the same region and the same industry. The experience from the first round of the survey was reviewed and evaluated in early 2011, and the questionnaire and interviewing techniques were adjusted accordingly for the second round, for which the data collection is on-going at the time of writing.

3 Constraints and Competition

3.1 Business Strategies and Constraints

In order to improve efficiency and create/expand their competitive advantage, firms pursue different upgrading strategies. Figure 3.1 lists the five main upgrading strategies pursued by enterprises.[6]

Figure 3.1: Main Upgrading Strategies Pursued by Enterprises



The most prevalent form of upgrading, pursued by more than three quarters of enterprises, is improvements in the quality of their product. Also important, mentioned by roughly half of enterprises, is the expansion and improvement of (already existing) product varieties, as well as improvements in process organization (cited by one third of firms). Relatively few firms focus on expanding activities into new sectors, and only 2 percent of firms consider sector switching to be a part of their upgrading strategy. This indicates that firms pursue productivity enhancing strategies within the product(s) in which they have already specialized, and not much strategic focus is assigned to seeking new markets in different industries (defined 4-digit ISIC level).[7]

Several firms highlight that they face problems trying to pursue their optimal business strategy. Table 3.1 shows that 81 percent of firms face some form of constraint and/or delay obstructing their upgrading strategies. Shortage of capital/access to finance is cited as the most serious problem, followed by concerns over the level of competition. Also important are limited skill bases (lack of skilled labour and general technical know-how) and a lack of basic infrastructure.

[6] Different definitions of upgrading are offered in the literature. In this study we combine the two overlapping taxonomies established by Gereffi (1990) and Kaplinsky and Readman (2001). Brach and Kappel (2009) provide a detailed overview.

[7] Sectors are defined at the 2-digit ISIC level; Industries at the 4-digit ISIC level; Products at the 5-digit ISIC level.

Table 3.1: Constraints Delaying or Obstructing Firm Strategies

	Percent	Obs
Do you face constraints delaying or obstructing firm upgrading strategies?	81.1	6184

How Severe are these Constraints for Doing Business (0=No problem, 10=Severe problem)

	Mean	Median
Basic infrastructure (electricity, energy, land, etc.)	6,5	7
Transport infrastructure (roads, airports, etc.)	5,0	5
Communication infrastructure	4,5	5
Financing constraints	7,0	8
Labour force (availability)	5,5	5
Skilled labour, technical know-how	6,3	6

Characteristics of Constrained Enterprises

		Coeff	t-stat
Firm size	Number of employees	0.921***	4.16
Legal structure	Collective	-0.365	-0.21
	Private enterprise	1.894*	1.95
	Limited liability company	1.156	1.53
	Joint stock wo State	0.510	0.55
	Joint stock w. State	1.048	0.72
	SOE + FDI	3.673	1.46
	Private + FDI	-3.375	-1.57
Region dummies		Yes	
Sector dummies		Yes	
Total observations		7,615	
Pseudo R-sq.		0.05	

Note: Dependent variable: Index between zero (no constraints) and 60 (severe constraints) of the severity of doing business constraints. Tobit estimates, left censored (1404 censored observations).
T-stats reported in parenthesis.
Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

Table 3.1 also presents the characteristics of the most constrained enterprises. A tobit (left-censored) model approach is used, where the dependent variable is modelled as an index of the severity of doing business constraints (*zero (no constraints) to 60 (severe constraints)*). The results show that larger firms feel more constrained.[8] In addition, private enterprises are found to be more constrained, while enterprises outside the HCMC region, and firms in 'Wood Processing' (ISIC 20) and 'Furniture' (ISIC 36), are more likely to face constraints delaying or obstructing their business strategies (sector results not reported in table).

Information on the current status of the production technology, and information and communication technology (ICT) available in manufacturing firms is collected in the survey module. The data reveal that firms are relatively well upgraded with respect to production technology and ICT in use, with approximately 80 and 90 percent respectively of the main technologies possessed by firms not older than ten years of age.

[8] It is unclear from the results here whether this is due to actual constraints being higher or whether perceptions of constraints differ between differently sized firms.

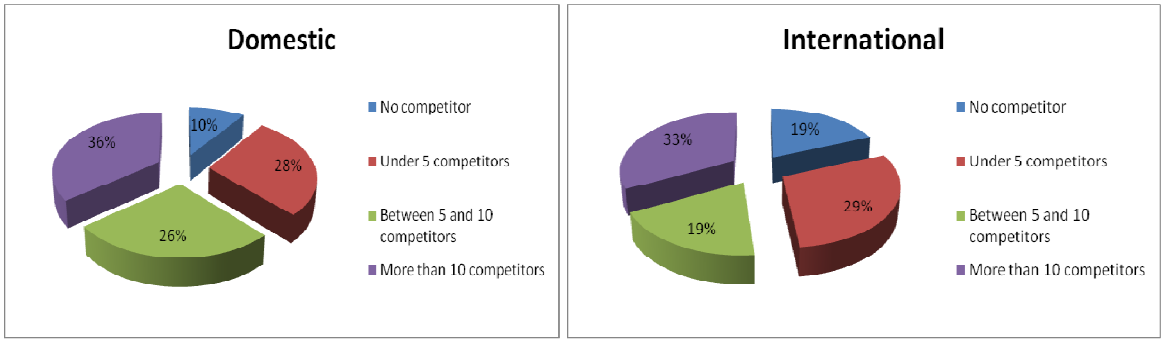
At the same time, very few enterprises (under 1 percent) pay fees for intellectual property rights to use/apply their production technology or information and communication systems.

Labour intensive production practices remain essential in Vietnamese manufacturing. 80 percent of firms use machines that are human-operated, and just eight percent use only computer operated machines (mostly enterprises in higher value-added sectors). In terms of access to relevant upgraded technologies, Vietnamese enterprises therefore perceive 'access to technology' constraints as being relatively minor.

3.2 Competition and Horizontal Spillovers

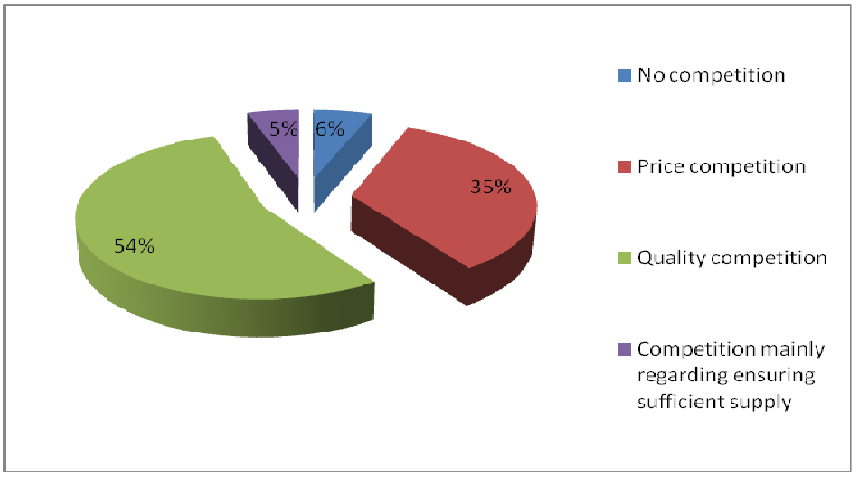
Enterprises highlight that competition in the manufacturing sector is fierce and a major contributor to the observed dynamic structure (high creation and destruction rates). Indeed, more than 30 percent of enterprises have more than ten product-related competitors, regardless of whether they are focused on the domestic or the international market (Figure 3.2). However, it is notable that more firms focused on the international market report no significant competitive pressure (19 vs 10 percent), suggesting that Vietnamese exporters are more likely to operate in niche markets.

Figure 3.2: Number of Competitors (percent)



Most of the competition faced in Vietnamese manufacturing surrounds ensuring customers a certain quality of product (Figure 3.3), and this result holds even in industries where products are considered to be quite homogenous. Also important is price, with some 35 percent of firms reporting that the price of the product is the most important form of competition. In particular, manufacturing firms in 'Publishing and Printing' (ISIC 22), 'Rubber and Plastic Products' (ISIC 25) and in 'Basic Metals' (ISIC 27) are more likely to face this type of price competition.

Figure 3.3: Type of Competition (percent)



The potential effect of technology spillovers that may occur due to competition within the same industry is important. Spillovers can occur between (i) domestic enterprises and foreign competitors (internationalization effects) and (ii) domestic enterprises and local Foreign Direct Invested (FDI) firms. These so-called horizontal spillovers may take place when locally owned firms improve their efficiency by copying technologies of foreign competitors (based locally or abroad) either through observation (demonstration/copying effect) or by hiring workers trained by the foreign firms/competitors (worker mobility effect).

However, possible negative worker mobility effects may also exist if local FDI firms successfully attract the best workers from their domestic competitors. Moreover, the increasing presence of FDI firms in the Vietnamese economy may increase competition which may force locally-owned firms to use their existing resources more efficiently or to search for new technologies.

These arguments demonstrate clearly the ambiguity of any potential productivity gains from horizontal spillovers. Indeed, evidence of positive horizontal spillovers from FDI has been difficult to find empirically in other countries. See Javorcik (2008), Moran(2008), and Smeets (2008) for excellent overviews. and it would be interesting to study this aspect further given the increasing presence of FDIs in the Vietnamese economy. Using the Enterprise Survey between 2000 and 2006 Le and Pomfret (2011) finds negative horizontal effects on labour productivity, implying that the presence and competition of foreign firms in a sector has a negative impact on the labour productivity of domestically owned enterprises.

4 Vertical Technology Spillovers

In this section potential technology spillover effects that may occur between suppliers and customers are considered. Particular focus is on the spillovers between firms with foreign capital involvement and domestic firms.

Following the recent literature on technology spillovers between multinational enterprises (MNEs) and domestic enterprises (see Javorcik (2008), Moran (2008) and Smeets (2008)), two types of vertical linkages can be defined: [9]

(i) Backward linkages: Technology spillovers take place between domestic suppliers of intermediate inputs and local FDI firms or international clients (spillovers to upstream sectors).

(ii) Forward linkages: Technology spillovers take place between domestic customers of intermediate inputs and local FDI firms or international suppliers (spillovers to downstream sectors).

Positive linkages (both forward and backward) may take place through (a) direct knowledge transfer from foreign firm customers to local enterprises, (b) higher requirements for product quality and on-time delivery introduced by FDI firms, thus providing incentives to domestic suppliers to upgrade their production management or technology, and (c) the increasing presence of FDI firms which may raise local demand for intermediate products, thus allowing local suppliers to benefit from economies of scale. Furthermore, local domestic customers may benefit from the increased competition introduced by the presence of FDI, thus making production more cost efficient.

These two possible types of linkages will be analysed in turn below, (backward linkages in Section 4.1, forward linkages in Section 4.2).

4.1 Backward Linkages

In order to analyse the presence and nature of backward linkages, a good place to start is by looking at whether firms primarily produce for final consumption or for intermediate use. Figure 4.1 shows that 61 percent of firms produce exclusively for final use, whereas 21 percent of firms exclusively manufacture intermediate products. Some 18 percent produce both for final use and intermediate production. Backward

[9] Le and Pomfret (2011) use the Vietnamese Enterprise Survey to study potential technology spillover gains through vertical backward linkages with foreign firms. They find that domestic firms supplying intermediates to sectors with a large foreign presence generally have higher levels of labour productivity, implying positive technology spillover effects from backward linkages. They are only able to analyse potential effects from backward linkages as the data does not allow them to consider (downstream) technology spillovers through forward linkages.

linkages could therefore potentially occur for around 39 percent of enterprises (those engaging in production for intermediate purposes).

Figure 4.1: Output Structure (percent)

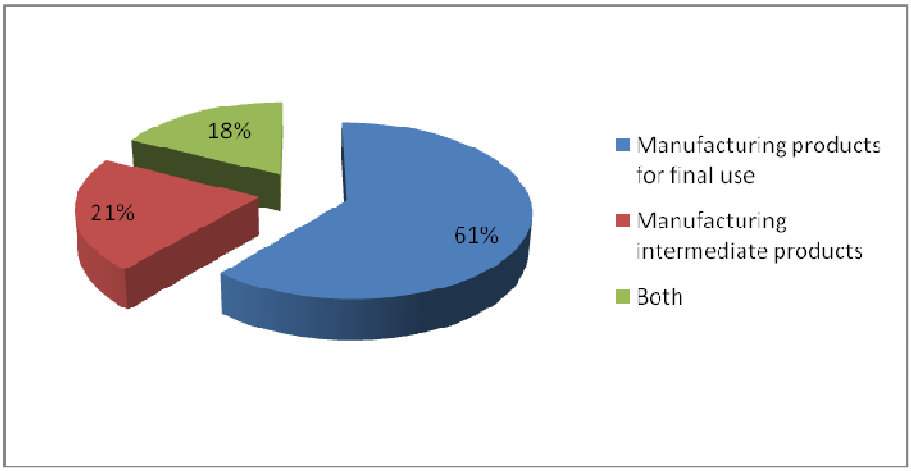


Table 4.1 presents where the enterprises sell their products. Approximately 40 percent of firms produce and sell their products within the same province. This is the case in particular for firms in the North West and North Central Coast, and there is a strong firm size effect here with micro-sized firms more likely to sell locally. Between 19 and 24 percent of produce is exported, and approximately one quarter is sold outside the province but inside the region. The remaining 16 percent is sold within the country, though outside of the region where it is produced.

Table 4.1 also shows (perhaps unsurprisingly) that the larger the firm the higher the probability of exporting both final use products and intermediates. For final use exports, principal destination countries include the US, Taiwan and Japan, while for intermediate product exports, Japan, Taiwan and China are the main destinations.

Table 4.1: Where does the enterprise sell its products? (percent)

A: Finished (Final Use) Products

	Total	Micro	Small	Medium	Large
Same province	38.0	53.7	50.6	33.1	15.1
Other province in the same region	21.9	23.5	25.3	22.3	11.6
Other region in the same country	16.2	13.6	15.3	17.9	14.9
ASEAN countries	3.4	1.0	1.7	4.1	6.1
Non-ASEAN countries	20.6	8.3	7.1	22.6	52.2
Total observations	[5998]	[218]	[2415]	[2403]	[962]
If enterprise exports final use products, which country is the most important customer?					
1. USA (18.0%)					
2. Taiwan (14.0%)					
3. Japan (13.8%)					

B: Intermediate Products

	Total	Micro	Small	Medium	Large
Same province	40.5	62.9	47.7	36.0	23.2
Other province in the same region	25.7	20.3	29.3	25.5	15.3
Other region in the same country	14.5	8.8	13.8	16.8	10.7
ASEAN countries	4.0	1.9	2.2	4.7	8.4
Non-ASEAN countries	15.3	6.1	7.0	16.9	42.4
Total observations	[1620]	[54]	[697]	[678]	[191]
If enterprise exports intermediate products, which country is the most important customer?					
1. Japan (21.1%)					
2. Taiwan (18.0%)					
3. China (14.2%)					

Note: Numbers in percentages. Observations in brackets.

Table 4.2 shows the characteristics of the exporting firms using a probit model approach where the dependent variable is modelled as an indicator variable taking the value 'one' if the firm exports, and 'zero' otherwise. The table shows large firms have more than a 20 percent higher probability of exporting than the smaller firms, ceteris paribus. Moreover, enterprises with foreign involvement (pure FDI firms and joint ventures between private domestic and FDI firms) are significantly more likely to export. The remaining joint venture category with FDI involvement (SOE + FDI) seems more focused on the domestic market than the other firms with FDI involvement. Finally, exporters are more likely to be found in the HCMC region (South East) and especially the lower value added sectors (ISIC 15 – ISIC 20) have a higher probability of being exporters (results not reported).

Table 4.2: Characteristics of Exporting Enterprises

		Coeff	t-stat	Coeff	t-stat
Firm size	Micro	-0.281***	-13.15	-0.259***	-11.57
	Small	-0.418***	-24.94	-0.357***	-19.82
	Medium	-0.243***	-14.94	-0.202***	-11.83
Legal structure	Collective	-0.278***	-11.23	-0.256***	-9.43
	Private enterprise	-0.329***	-22.77	-0.318***	-20.51
	Limited liability company	-0.337***	-23.88	-0.319***	-21.12
	Joint stock wo State	-0.314***	-23.98	-0.271***	-18.22
	Joint stock w. State	-0.259***	-13.65	-0.228***	-11.14
	SOE + FDI	-0.217***	-6.19	-0.162***	-4.06
	Private + FDI	-0.018	-0.41	0.010	0.21
Region dummies		No		Yes	
Sector dummies		No		Yes	
Total observations		7,618		7,615	
Pseudo R-sq.		0.26		0.31	

Note: Dependent variable: Indicator variable taking the value one if the firm exports, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

Some of the exporting firms do so through direct transactions with their customers, while others export indirectly through trading companies. For the sample of exporting firms, Table 4.3 analyses this distinction in more detail. Somewhat surprisingly, firm size does not matter, though this could be due to a selection bias given that the exporting firms are all generally quite large. Exporting private enterprises, limited liability firms and joint stock companies without state involvement are all generally less likely to export directly to their customers abroad, as they rely to a larger extent on trading companies to carry out their international transactions.

Table 4.3: Direct Trade or Intermediate Exporters?

		Coeff	t-stat	Coeff	t-stat
Firm size	Number of employees (log)	0.005	0.84	0.009	1.47
Legal structure	Collective	-0.152	-1.44	-0.135	-1.30
	Private enterprise	-0.147***	-3.95	-0.163***	-4.09
	Limited liability company	-0.069***	-3.68	-0.065***	-3.22
	Joint stock wo State	-0.091***	-3.12	-0.072**	-2.43
	Joint stock w. State	0.027	0.63	0.033	0.78
	SOE + FDI	0.017	0.26	0.010	0.14
	Private + FDI	-0.045	-0.95	-0.044	-0.92
Region dummies		No		Yes	
Sector dummies		No		Yes	
Total observations		2,371		2,360	
Pseudo R-sq.		0.02		0.03	

Note: Dependent variable: Indicator variable taking the value one if the firm exports directly to traders outside the country, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: FDI, Region 7 (HCMC area), Food processing (ISIC 15).
Some 84 percent of the transactions are done directly with traders in other countries, with only 16 percent of the transactions done through intermediate exporters in Vietnam.

Technology transfers are more likely to occur when contractual arrangements are secure between the firm and its customers. Table 4.4 shows that just under 10 percent of firms normally engage in long-term contracts (over three years) with their customers, while the vast majority of current contracts (93.5 percent) have durations of less than one year.

The table also presents the results of a probit estimation, where the dependent variable is an indicator variable taking the value of 'one' if the firm engages in long term contracts, and 'zero' otherwise. Results indicate that micro and small firms are less likely to sign longer term contracts with their customers. On the other hand, firms with FDI involvement exhibit a higher probability of having longer term contractual arrangements with customers. Firms located in the Northern regions are often more likely to engage in longer term contract arrangements. Moreover, there are no large sector differences, although firms in capital intensive sectors (e.g. ISIC 34) are more likely to engage in longer term contracting (not reported). Finally, only 17 percent of the domestic long term contracts are between local firms and FDI firms (not reported).

Table 4.4: Long-term contracting with customers?

Percent of firms normally engaging in long-term contracts (over three years) with customers	9.8
Percent of firms making additional specific investments when entering long term contracts	17.1
Percent of current contracts under one year duration	93.5

Characteristics of firms engaging in long term contracting

		Coeff	t-stat
Firm size	Micro	-0.037**	-1.96
	Small	-0.019*	-1.72
	Medium	-0.010	-0.97
Legal structure	Collective	-0.055***	-2.99
	Private enterprise	-0.041***	-3.56
	Limited liability company	-0.038***	-4.02
	Joint stock wo State	-0.032***	-2.93
	Joint stock w. State	-0.021	-1.18
	SOE + FDI	-0.024	-0.85
	Private + FDI	0.041	1.47
Region dummies		Yes	
Sector dummies		Yes	
Total observations		7,573	
Pseudo R-sq.		0.03	

Note: Dependent variable: Indicator variable taking the value one if the firm engages in long term contracts, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust.

Thus far in Section 4.1, the types and characteristics of firms that are *more likely* to be benefiting from backward linkages have been presented. With the above background in mind, Table 4.5 *directly* addresses the issue of backward technology transfer linkages. Firms were asked how many of their contracts include direct technology transfer from customers to the enterprise. Only 7.5 percent of firms report this to be the

case, and it is notable that this is comprised primarily of larger firms. It is, moreover, interesting that joint ventures between state-owned enterprises and FDI firms are more likely to have explicit technology transfer elements to their contracts from customers, while this is less likely in the case of domestic private enterprises. Finally, direct technology transfer arrangements from customers are more likely to take place in the North East and in the Red River Delta regions of Vietnam.

Table 4.5: Technology transfer from customers to the enterprise?

	Yes (percent)
Do most firm contracts include direct technology transfer from customers to the enterprise?	7.5

Characteristics of firms involved in direct technology transfer arrangements

		Coeff	t-stat	Coeff	t-stat
Firm size	Micro	-0.032**	-1.99	-0.038***	-2.66
	Small	-0.028***	-3.11	-0.037***	-3.93
	Medium	-0.011	-1.36	-0.015*	-1.85
Legal structure	Collective	-0.016	-0.83	-0.024	-1.40
	Private enterprise	-0.041***	-4.27	-0.032***	-3.11
	Limited liability company	-0.012	-1.51	-0.012	-1.46
	Joint stock wo State	0.012	1.21	-0.001	-0.06
	Joint stock w. State	0.000	0.00	-0.006	-0.40
	SOE + FDI	0.093***	3.10	0.082***	2.80
	Private + FDI	0.035	1.38	0.040	1.59
Region dummies		No		Yes	
Sector dummies		No		Yes	
Total observations		7,618		7,615	
Pseudo R-sq.		0.02		0.05	

Note: Dependent variable: Indicator variable taking the value one if firm contracts involve direct technology transfer arrangements from customers, zero otherwise. Probit estimates, marginal effects.
T-stats reported in parenthesis are heteroskedaticity robust.
Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

Specific sector effects related to the results in column 2 of Table 4.5 are shown in Table 4.6. The table shows that direct technology transfer from customers to the enterprise is more likely to occur in the sectors of '*paper and related products*' (ISIC 21), '*machinery and equipment*' (ISIC 29), and '*radio and communication equipment*' (ISIC 32). For example, firms in the '*machinery and equipment*' sector are 6.4 percent more likely to experience technology transfers from customers than food processing firms.

Table 4.6: Technology transfer from customers to the enterprise – Sector details

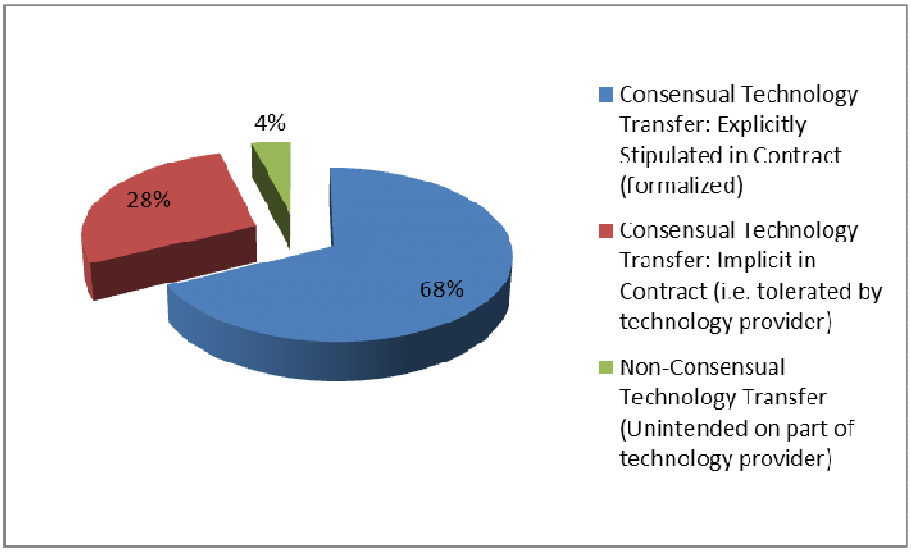
ISIC code	Sector	Coeff	t-stat
17	Textiles	-0.009	-0.63
18	Wearing apparel	-0.013	-1.01
19	Leather products	0.010	0.55
20	Wood and wood products	-0.017	-1.23
21	Paper and paper products	0.031*	1.92
22	Publishing and printing	-0.010	-0.51
24	Chemical and chemical products	0.014	0.92
25	Rubber and plastic products	0.012	0.91
26	Non-metallic mineral products	-0.015	-1.26
27	Basic metal	0.005	0.25
28	Fabricated metal products	-0.001	-0.10
29	Machinery and equipment	0.064***	3.18
30	Office and accounting machinery	0.065	1.07
31	Electrical machinery and app.	0.027	1.17
32	Radio and communication equip.	0.056*	1.84
33	Medical and optical instruments	-0.022	-0.51
34	Assembling/repairing motor vehicles	0.000	0.01
35	Repairing of oth transport eq.	0.011	0.60
36	Furniture	-0.009	-0.71
Total observations		7615	
Pseudo R-sq.		0.05	

Note: Dependent variable: Indicator variable taking the value one if firm contracts involve direct technology transfer arrangements from customers, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

The transfer of technology from source to user can occur with or without the consent of the owner of the technology. Moreover, consent can be implicit (i.e. tolerated but not openly endorsed) or explicit (i.e. included in contracts between the firm and the owner of the technology). In other words, technology transfer can be consensual and written into the contract (i.e. formalized), consensual but not formalized (perhaps just tolerated by the source), or non-consensual (thus not included in any contract and not known or tolerated by the source).

Around two thirds of the backward linkages presented above were stipulated in the contract, and around one third came through intended externality effects of the contractual arrangement (i.e. 'tolerated' by the source) (Figure 4.2). Only 4 percent of the technology transfers were non-consensual and unintended (on the part of the technology source).

Figure 4.2: Type of Technology Transfer through Customer Relations (percent)



4.2 Forward Linkages

Forward linkages occur when technology spillovers take place between domestic customers of intermediate inputs and local FDI firms or international suppliers (spillovers to downstream sectors) (see p.17). In order to analyse the presence and nature of forward linkages, we start by considering the source of raw materials and intermediate inputs used by Vietnamese enterprises (Table 4.7).

Almost half of enterprises procure raw materials (49 percent) and intermediate inputs (44 percent) from other enterprises located in the same province. The smaller the firm is, the more likely it is to obtain raw materials and intermediate inputs locally. Between 13 and 18 percent of raw materials and intermediate inputs are imported, where the main trading partners are China, India, Japan, South Korea and Taiwan. Again, the larger the firm the more likely it is to import raw materials and intermediates. For potential technology spillover effects from foreign suppliers to the firms in Vietnam, Table 4.6 is thus suggestive that direct international spillovers are more likely to occur for larger Vietnamese firms.

Table 4.7: Where does the firm procure its raw materials and intermediate inputs? (by location)

A: Raw Materials

	Total	Micro	Small	Medium	Large
Same province	49.3	63.8	55.7	46.2	33.4
Other province in the same region	22.1	19.6	24.3	21.1	18.3
Other region in the same country	15.3	13.8	14.4	16.3	16.1
ASEAN countries	4.1	0.4	2.0	5.2	7.9
Non-ASEAN countries	9.3	2.4	3.5	11.2	24.4
Total observations	[5652]	[203]	[2338]	[2178]	[750]
If enterprise imports raw materials, which one is the most important one?					
1. India (22.3%)					
2. Taiwan (13.5%)					
3. Japan (11.4%)					

B: Intermediate Inputs

	Total	Micro	Small	Medium	Large
Same province	44.1	56.4	51.6	41.3	28.3
Other province in the same region	23.9	22.2	26.5	23.4	18.4
Other region in the same country	14.0	12.7	13.4	15.3	12.8
ASEAN countries	4.4	1.0	2.1	5.5	8.3
Non-ASEAN countries	13.6	7.7	6.4	14.5	32.2
Total observations	[7286]	[256]	[2991]	[2931]	[1108]
If enterprise imports intermediate inputs, which country is the most important one?					
1. China (24.9%)					
2. Taiwan (18.2%)					
3. South Korea (12.7%)					

Note: Numbers in percentages. Observations in brackets.

Table 4.8 builds on the previous results by documenting procurement disaggregated by legal ownership form. Firms with some degree of FDI involvement are less likely to obtain raw materials and intermediate inputs locally and more likely to import inputs used in the production process. Moreover, firms with 100 percent foreign capital ownership are more likely to import intermediate inputs than joint ventures.

Table 4.8: Where does the firm procure its raw materials and intermediate inputs? (by legal)

A: Raw Materials

	Total	Collective	Private	LLC	Joint Stock wo State	Joint stock w State	FDI	Joint venture (SOE+FDI)	Joint venture (Priv+FDI)
Same province	49.3	67.4	62.8	51.2	48.0	45.1	26.8	31.7	36.4
Other province in the same region	22.1	19.2	25.7	23.3	23.1	22.6	13.7	15.5	21.3
Other region in the same country	15.3	11.7	9.2	16.5	18.1	16.2	17.1	18.7	15.7
ASEAN countries	4.1	0.1	1.1	3.2	2.5	4.3	11.6	14.0	9.1
Non-ASEAN countries	9.3	1.6	1.1	5.8	8.3	11.8	30.8	20.1	17.5
Total observations	[5652]	[162]	[1096]	[2371]	[874]	[197]	[805]	[70]	[77]

B: Intermediate Inputs

	Total	Collective	Private	LLC	Joint Stock wo State	Joint stock w State	FDI	Joint venture (SOE+FDI)	Joint venture (Priv+FDI)
Same province	44.1	63.4	59.2	47.9	45.0	41.9	22.5	29.5	31.0
Other province in the same region	23.9	21.8	27.8	26.3	25.5	20.4	16.0	15.5	22.8
Other region in the same country	14.0	11.9	9.9	16.0	17.7	16.7	10.7	14.2	12.8
ASEAN countries	4.4	0.7	0.6	2.9	3.0	5.9	10.9	14.4	7.0
Non-ASEAN countries	13.6	2.1	2.5	6.8	8.7	15.2	39.9	26.4	26.4
Total observations	[7286]	[194]	[1204]	[2976]	[1033]	[246]	[1456]	[76]	[101]

Note: Numbers in percentages.
Observations in brackets.

Table 4.9 presents the characteristics of importing firms, using a probit model approach where the dependent variable is modelled as an indicator variable taking the value 'one' if the firm procures raw materials or intermediate inputs from abroad, and 'zero' otherwise. First, micro and small firms are 15 - 20 percent less likely than large firms to import raw materials. Second, FDI firms are more likely to import raw materials than any other legal structure category considered.[10] The same conclusions are reached when analysing the characteristics of importers of intermediates. There is no prior reason, therefore, to believe that forward technology linkages to domestic firms (if present) should be different between firms with 100 percent foreign capital ownership and joint ventures.

[10] Although the coefficient estimates on the joint ventures are not well-determined when including region and sector dummies (column 2).

Table 4.9: Characteristics of Importers (of raw materials and intermediate inputs)

		A: Raw Materials				B: Intermediate Inputs			
		Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Firm size	Micro	-0,160***	-8,24	-0,147***	-8,34	-0,183***	-7,58	-0,171***	-7,23
	Small	-0,207***	-13,69	-0,182***	-12,00	-0,217***	-13,87	-0,205***	-12,30
	Medium	-0,090***	-6,56	-0,077***	-5,69	-0,111***	-7,53	-0,099***	-6,52
Legal structure	Collective	-0,170***	-8,15	-0,147***	-6,03	-0,240***	-12,00	-0,214***	-9,03
	Private enterprise	-0,228***	-18,07	-0,186***	-13,72	-0,323***	-26,04	-0,276***	-20,05
	Limited liability company	-0,219***	-16,86	-0,176***	-13,39	-0,353***	-28,51	-0,297***	-23,28
	Joint stock wo State	-0,169***	-14,87	-0,122***	-9,41	-0,257***	-22,92	-0,208***	-16,27
	Joint stock w. State	-0,142***	-9,06	-0,111***	-6,30	-0,202***	-12,02	-0,171***	-9,26
	SOE + FDI	-0,065**	-2,01	-0,012	-0,33	-0,079*	-1,94	-0,025	-0,56
	Private + FDI	-0,053	-1,59	-0,023	-0,67	-0,077**	-2,18	-0,037	-0,99
Region dummies		No		Yes		No		Yes	
Sector dummies		No		Yes		No		Yes	
Total observations		5,652		5,652		7,286		7,286	
Pseudo R-sq.		0.20		0.24		0.25		0.30	

Note: Dependent variable: Indicator variable taking the value one if the firm procures raw materials or intermediate inputs outside the country, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

Some firms trade directly with their suppliers of raw materials and intermediate inputs (76 percent), while others trade through an intermediate trading company (24 percent). The characteristics of firms in these two categories can be expected to be quite different, and Table 4.10 thus presents a probit model approach, where the dependent variable is modelled as an indicator variable taking the value 'one' if the firm procures raw materials or intermediate inputs directly outside the country, and 'zero' otherwise. It is clear from the results that larger firms are more likely to import directly. Also, joint ventures and firms with 100 percent FDI ownership are significantly more likely to import directly as compared to other firms without foreign involvement.

Table 4.10: Direct Trade or Intermediate Importers?

		Coeff	t-stat	Coeff	t-stat
Firm size	Number of employees (log)	0.022***	3.18	0.020***	2.68
Legal structure	Collective	-0.403**	-2.45	-0.330*	-1.87
	Private enterprise	-0.383***	-6.39	-0.361***	-5.65
	Limited liability company	-0.266***	-10.36	-0.250***	-9.56
	Joint stock wo State	-0.257***	-7.05	-0.192***	-5.25
	Joint stock w. State	-0.384***	-7.01	-0.332***	-5.75
	SOE + FDI	-0.041	-0.54	-0.001	-0.01
	Private + FDI	-0.099	-1.53	-0.082	-1.26
Region dummies		No		Yes	
Sector dummies		No		Yes	
Total observations		1,974		1,974	
Pseudo R-sq.		0.09		0.12	

Note: Dependent variable: Indicator variable taking the value one if the firm procures raw materials or intermediate inputs directly outside the country, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: FDI, Region 7 (HCMC area), Food processing (ISIC 15).
Some 76 percent of the transactions are done directly with traders in other countries, with only 24 percent of the transactions done through intermediate importers in Vietnam.

Table 4.11 documents whether firms engage in long-term contracts with their raw material and intermediate input suppliers. Fewer than nine percent of firms procuring inputs domestically sign contracts with a duration of three years or more. This figure is even lower for firms involved in international transactions (3.6 percent). Almost all (93 percent) current contracts have durations shorter than one year. Controlling for region and sector firm size is not a particularly good predictor of engagement in long-term contracting (although micro firms are significantly less likely to have long-term contracts than small, medium and large firms). As compared to pure FDI firms, domestic firms are less likely to engage in long-term contracting. There is a small indication that joint ventures between private and FDI firms are more likely to have long-term contracts with their suppliers. Finally, we find (consistent with the backward linkages results) that only 13 percent of the domestic long term contracts are between local firms and FDI firms.

Table 4.11: Long Term Contracting with Suppliers

	Domestic	International
Firm normally engages in LT contracts (> 3 years) with intermediate input and raw material suppliers.	8.7	3.6
Percent of firms making additional specific investments when entering long term contracts	18.4	
Percent of current contracts under one year duration	93.8	92.3

Characteristics of firms engaging in long term contracting

		Coeff	t-stat
Firm size	Micro	-0.045**	-2.27
	Small	-0.017	-1.46
	Medium	-0.005	-0.45
Legal structure	Collective	-0.025	-1.22
	Private enterprise	-0.034***	-2.72
	Limited liability company	-0.039***	-4.06
	Joint stock wo State	-0.038***	-3.35
	Joint stock w. State	0.012	0.62
	SOE + FDI	0.000	0.01
	Private + FDI	0.051*	1.72
Region dummies		Yes	
Sector dummies		Yes	
Total observations		7,599	
Pseudo R-sq.		0.04	

Note: Dependent variable: Indicator variable taking the value one if the firm engages in long term contracts, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

Although indicative of the presence of possible forward linkages, the previous results do not directly address the technology spillover issue to downstream sectors. With this in mind, Table 4.12 documents the number of firms experiencing direct technology transfer from suppliers to the enterprise. Around 10 percent of firms report that they have observed technology transfers taking place between their suppliers and the firm. Larger firms are more likely to experience technology transfers from suppliers than their smaller counterparts. Controlling for region and sector, only private enterprises and limited liability companies are less likely than pure FDI firms to experience direct technology transfers from their suppliers.

Table 4.12: Technology Transfer from Suppliers to the Enterprise

	Yes (percent)
Do most firm contracts include direct technology transfer from suppliers to the enterprise?	10.5

Characteristics of firms involved in direct technology transfer arrangements

		Coeff	t-stat	Coeff	t-stat
Firm size	Micro	-0.068***	-3.85	-0.074***	-4.69
	Small	-0.056***	-5.33	-0.073***	-6.65
	Medium	-0.027***	-2.85	-0.038***	-3.87
Legal structure	Collective	0.000	-0.01	-0.015	-0.66
	Private enterprise	-0.035***	-2.92	-0.024*	-1.81
	Limited liability company	-0.012	-1.27	-0.017*	-1.70
	Joint stock wo State	0.030**	2.44	0.009	0.73
	Joint stock w. State	0.034*	1.74	0.012	0.63
	SOE + FDI	0.064*	1.93	0.041	1.28
	Private + FDI	0.036	1.22	0.038	1.30
Region dummies		No		Yes	
Sector dummies		No		Yes	
Total observations		7,618		7,615	
Pseudo R-sq.		0.02		0.04	

Note: Dependent variable: Indicator variable taking the value one if firm contracts involve direct technology transfer arrangements from suppliers, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

Sector details based on the above results are presented in Table 4.13. As compared to the base (Food Processing – ISIC 15), firms in apparel (ISIC 18), wood processing (ISIC 20) and furniture (ISIC 36) are less likely to experience technology transfers from suppliers, whereas firms producing paper (ISIC 21) and medical and optical instruments (ISIC 33) are more likely to have technology transfers from suppliers.

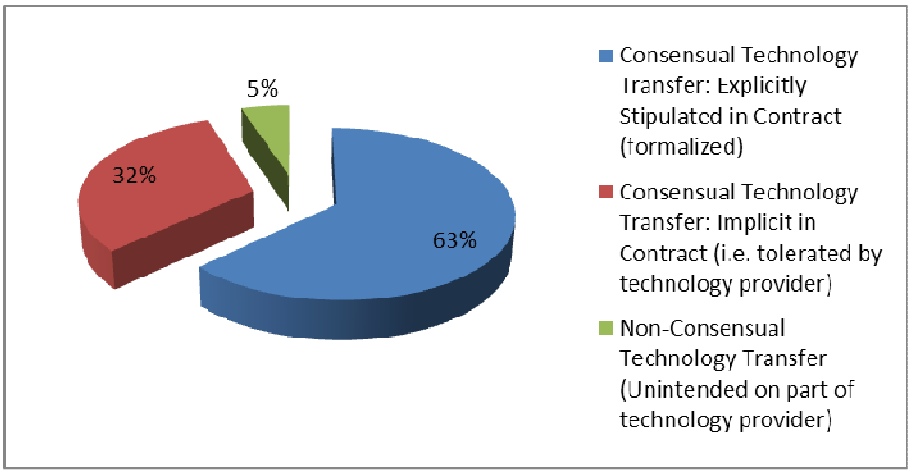
Table 4.13a: Technology Transfer from Suppliers to the Enterprise – Sector details

ISIC code	Sector	Coeff	t-stat
17	Textiles	-0.018	-1.03
18	Wearing apparel	-0.037**	-2.54
19	Leather products	-0.015	-0.69
20	Wood and wood products	-0.028*	-1.78
21	Paper and paper products	0.032*	1.73
22	Publishing and printing	0.036	1.44
24	Chemical and chemical products	0.029	1.54
25	Rubber and plastic products	0.006	0.39
26	Non-metallic mineral products	-0.009	-0.64
27	Basic metal	-0.005	-0.23
28	Fabricated metal products	-0.007	-0.48
29	Machinery and equipment	0.036	1.62
30	Office and accounting machinery	0.022	0.32
31	Electrical machinery and app.	0.035	1.28
32	Radio and communication equip.	0.000	0.01
33	Medical and optical instruments	0.113*	1.92
34	Assembling/repairing motor vehicles	0.001	0.03
35	Repairing of oth transport eq.	-0.021	-1.00
36	Furniture	-0.029**	-2.06
Total observations		7615	
Pseudo R-sq.		0.04	

Note: Dependent variable: Indicator variable taking the value one if firm contracts involve direct technology transfer arrangements from suppliers, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

As in the case of backward linkages (Section 4.1), Figure 4.3 considers whether the transfer of technology occurred with or without the (implicit and explicit) consent of the owner of the technology. Results are very similar to the case of backward linkages, with around two thirds of forward linkages stipulated in the contract and around one third coming through intended externality effects of the contractual arrangement (i.e. 'tolerated' by the source) (Figure 4.3). Only five percent of the technology transfers were non-consensual and unintended (on the part of the technology source).

Figure 4.3: Kind of Technology Transfer through Supplier Relations (percent)



5 Research and Technology Development

Technology, technological progress and innovation are key drivers for sustainable economic development in both developed and developing countries. Once a country has reached a certain level of physical and human capital accumulation, fostering the development and accumulation of innovation and technological capacities becomes increasingly important, both at the firm and national level. Two types of capacities for innovation and technological progress are considered in this report:

i. Research-based innovation: Innovation based on original research and (technology) development activities. This type of innovation is very capital (physical and human) intensive.

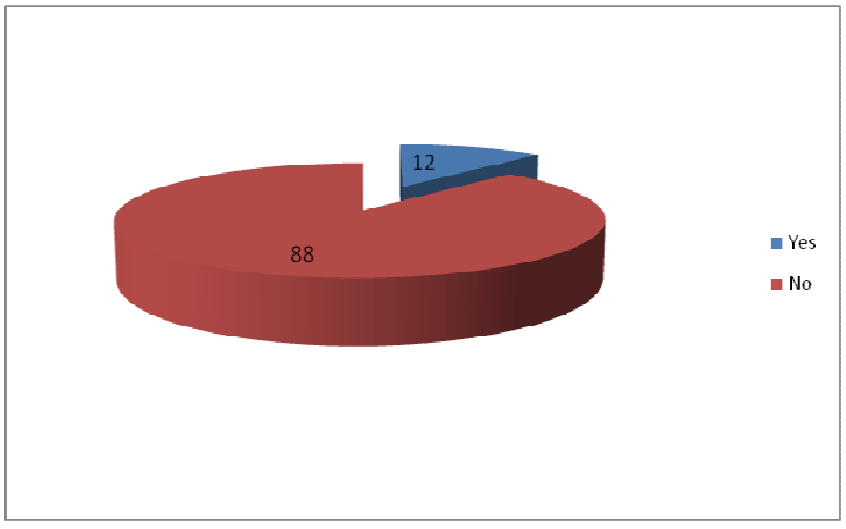
ii. Diffusion-based innovation: Innovation based on technology adoption and adaption, making use of techniques and technologies that already exist outside of the firm in question.

In this section, we focus on the first of these, looking first at research based innovation and development (Section 5.1) and secondly at the area of research collaboration (Section 5.2). Diffusion based innovation is analysed in Section 6 of the report.

5.1 Research-Based Innovation and Development

Figure 5.1 shows that a relatively small number of firms, 12 percent, actively engage in research and development (R&D).

Figure 5.1: R&D Activities of Vietnamese Manufacturing Firms (percent)



Based on probit estimations, the characteristics of those firms undertaking R&D activities are summarized in Table 5.1. The findings suggest that there is a significant size effect related to R&D: micro, small and medium sized enterprises are statistically significantly less likely to undertake R&D than large firms. This is in-line with the established literature in this area, which emphasizes the uncertain payoff and risky nature of R&D.

With respect to legal structure, the result is more surprising. The normally positive impact of foreign owned firms as a major channel for R&D cannot be confirmed. Indeed the data shows that all other legal forms are more likely to engage in R&D as compared to firms with 100 percent foreign ownership.[11] This finding has important implications vis-à-vis policies aimed at attracting FDI and foreign investment on the assumption that it will lead to technology transfer to local firms. Indeed the findings are suggestive that the importance of FDI as a vector for technology transfer and technological upgrading may at present well be overestimated (see also Section 4).

Table 5.1: Characteristics of Enterprises engaging in R&D

		Characteristics of firms involved in R&D
		C
Firm size	Micro	-0.0
	Small	-0.0
	Medium	-0.0
Legal structure	Collective	0
	Private enterprise	0
	Limited liability company	0.0
	Joint stock wo. State	0.1
	Joint stock w. State	0.2
	SOE + FDI	0.2
	Private + FDI	0.1
Region dummies		
Sector dummies		
Total observations		
Pseudo R-sq.		

Note: Dependent variable: Indicator variable taking the value one if firm undertakes research and development activities, zero otherwise. P
Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

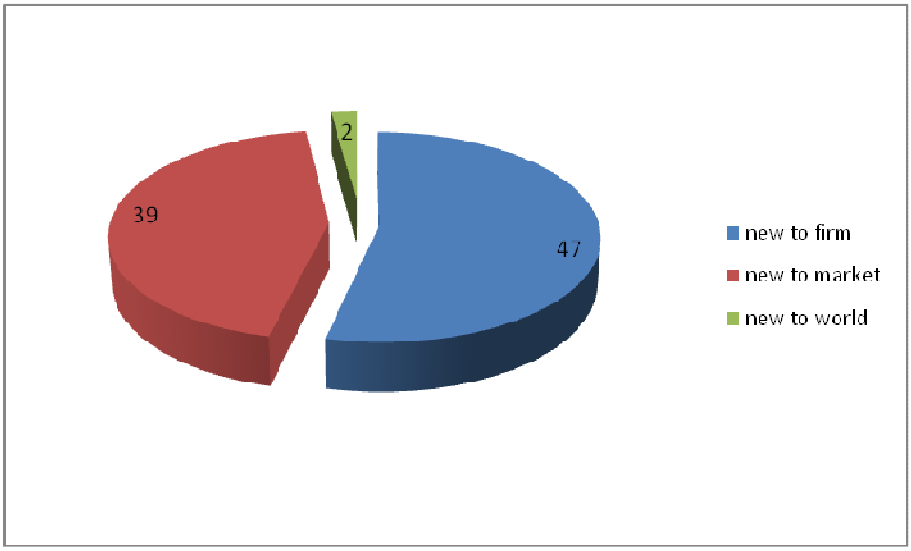
Innovation refers to the creation of better or more effective products, processes, technologies, or ideas. This can occur at many different levels, for example by creating products that are new just to the innovating firm, to the market, to the country, or completely new at the international level.[12] As shown in Figure 5.2, most of the innovation taking place among Vietnamese enterprises can best be described as relatively modest in nature, leading to new products or processes at the level of the firm (47 percent of

[11] Only in the case of 100 percent privately owned Vietnamese firms is this positive effect not statistically significant (when not including region and sector dummies). Both effects are robust across different model specifications regardless of whether sector and regional dummies are included or not.

[12] Innovation leading to a completely new product/process/technology at the international level is generally referred to a new-to-world innovation

firms undertaking R&D) and local market (39 percent), and rarely resulting in anything new internationally (under 2 percent).[13]

Figure 5.2: Degree of Innovation Targeted by R&D Performing Firms (percent)



These results show that very few firms in Vietnam innovate, and they are thus likely to use technology developed outside of the firm. For those that do innovate, they are in general not creating entirely new products or processes. An interesting question for further investigation is therefore why these firms chose to innovate at all, rather than simply copying from their neighbours.

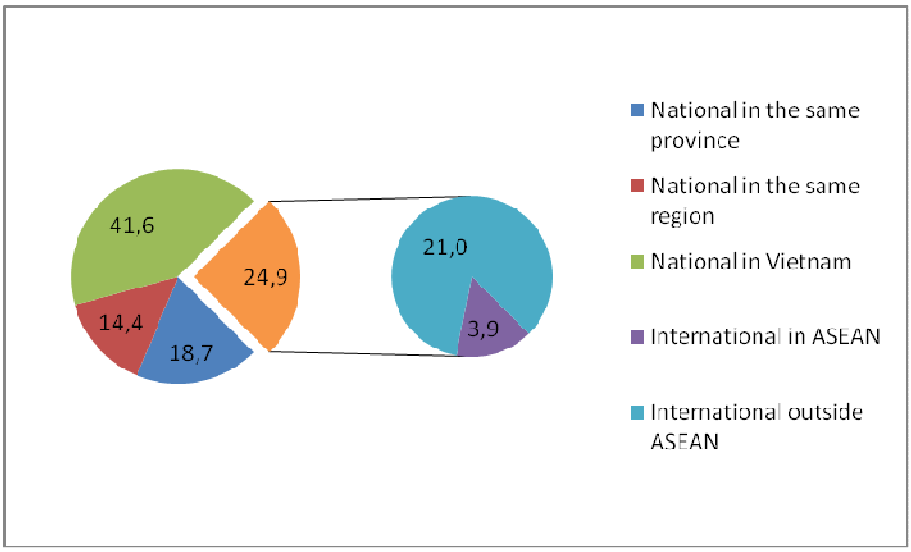
5.2 Research Collaboration

Research cooperation is known to be an important feature of research-based innovation. Research cooperation lowers the risk and cost of large research projects, but also reduces time requirements. In addition, collaboration enables firms to learn about new and different technologies at a relatively low cost (De Man and Duysters 2005). In other words, firms are able to broaden their own (technological) horizons.

Figure 5.3 shows that almost one in three (28 percent) of the firms involved in R&D have external cooperation partners. Of these, 75 percent involve collaboration between national actors, while 25 percent takes place with partners outside of Vietnam.

Figure 5.3: Location of Main External R&D Partners (percent)

[13] In the standard (international) literature on R&D, focus tends to be on new-to-world innovations, in particular research and development activities leading to new patents.



National research cooperation appears to be fairly evenly spread, with partners just as likely to come from outside of the firm's region as from the same province. This is indicative of well-developed research and communication networks, and such ties should be further encouraged and fostered. In contrast, international research cooperation takes place primarily with partners outside of ASEAN. This is an interesting result, and merits further investigation as to why it is the case.

With respect to the different sectors, R&D activities are concentrated in the food-processing, chemical and non-metallic mineral product industries (ISIC 15, 24 and 26, respectively) (results not shown).

6 Technology Adaption: Diffusion-Based Innovation

Innovative activities are not limited to research and development (R&D). Indeed, as highlighted earlier, the survey module (see Appendix) upon which this report is based allows for a much broader definition of innovation than is normally used when applying the standard science and technology indicators (STIs). Instead of investing in R&D, it is likely, especially in a developing country context, that adaption, modification and refinement of existing technologies will represent sensible strategies for a firm in order to further expand and upgrade products and production processes

Technology adaption - in contrast to technology development - generally comprises of all activities that are based on (internationally) diffused technologies, centred on the application, modification and refinement of such already existing technologies.

When an enterprise looks to acquire and apply a technology, there are broadly two possible routes. First, the enterprise can purchase a technology that does not involve or require further investments to learn how to use and apply. Such technologies are commonly referred to as 'off-the-shelf' technologies. Typical examples are the purchase of standard software or simple production tools and equipment. Often, however, specialized and complex production processes require technologies that are more specifically tailored to the particular needs of a firm. It is frequently the case that no 'perfect fit' is available, either because it simply does not exist in the market, or is too expensive. In such cases the best and often also most sustainable solutions for the enterprise is to take what is available and invest in learning this technology and making itself the necessary refinements and changes. This is commonly referred to as 'adapted technology'.

Particular attention in this report is given to this latter type of technology adoption: the modification or adaptation of (purchased or transferred) technologies that involve active learning and capacity building with respect to similar existing technologies on the side of the firm.

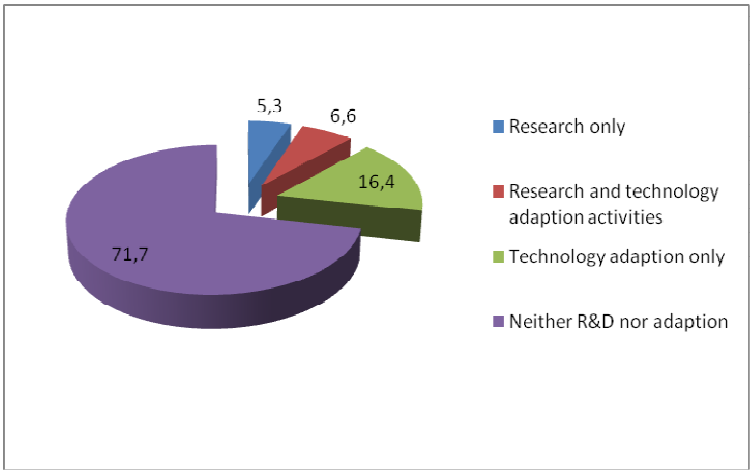
6.1 Technology Adaption

Technology adaption includes, as mentioned above, all activities that are related to the development of technologies that are based on the modification and refinement of already existing technologies, rather than original research and development by the firm in question. The technology will be new to the firm, but not necessarily to the market, country or world. It can take the form, for instance, of adapting a machine

such that it is suitable for differently skilled labour, cultural norms, different environmental conditions such as climate, infrastructure or energy supply.

In the preceding section, we saw that a relatively small number of firms, around 12 percent, engage in R&D activities themselves (Figure 5.1). However, a far greater number of firms, 23 percent, adapt, modify, refine and improve existing technologies (Figure 6.1). Over 5 percent of enterprises engage exclusively in R&D, while 6.6 percent undertake research and technology adaption activities.[14] In addition, 16.4 percent of the firms, while not involved in R&D, do undertake technology adaption. It is the innovation that occurs in this latter group of firms that is rarely included in standard innovation surveys using the STIs.

Figure 6.1: Innovation and Technology Adaption Activities (percent)



The true extent of innovative activities taking place in Vietnamese firms is therefore much greater and broader than would initially be implied and in the past estimated. Even though the adaptation activities cannot be defined as research-based or new-to-world, they are certainly innovative and directed at the development of appropriate technologies for the firms in question. This is important as these firms will likely have different but equally important needs for policy support. The simple fact that these firms are generally smaller is relevant in this regard (see Table 6.1). These findings stress the importance of measuring and monitoring innovative and technological capacities in a broad manner. The remainder of this section is dedicated to analyse and highlight such similarities and differences.

The characteristics of firms involved in technology adaption activities are analysed using a simple probit specification (Table 6.1). It is immediately clear that there are considerable differences between those firms

[14] Combining the 5.3 percent of enterprises with the 6.6 percent gives the 11.8 percent (with some rounding) seen in Figure 5.1.

engaged in R&D (see Table 5.1) and those that adapt technology. First, the size effect is less strong, with not just the large firms undertaking technology adaption. Second, legal structure plays an important role for technology adaption, yet in a way that was not necessarily to be expected: 100 percent foreign invested firms are less likely than other legal ownership types to engage in technology adaption. Another very interesting aspect is that, once R&D activities are controlled for, foreign firms with state involvement are the most likely type of firm to engage in technology adaption.

Table 6.1: Characteristics of Firms Involved in Technology Adaption

		(I)		(II)		(III)	
		Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Firm size	Micro	-0.109***	-4.05	-0.128***	-4.87	-0.107***	-3.89
	Small	-0.051***	-3.26	-0.074***	-4.48	-0.042**	-2.50
	Medium	-0.007	-0.51	-0.024	-1.56	-0.006	-0.36
Legal structure	Collective	0.031	0.92	0.024	0.69	0.001	0.03
	Private enterprise	0.052***	2.84	0.032	1.63	0.016	0.84
	Limited liability company	0.036**	2.52	0.026*	1.76	-0.004	-0.25
	Joint stock wo State	0.087***	4.88	0.061***	3.22	0.011	0.61
	Joint stock w. State	0.202***	6.66	0.163***	5.28	0.089***	2.94
	SOE + FDI	0.131***	2.68	0.102**	2.09	0.035	0.74
	Private + FDI	0.035	0.80	0.024	0.58	-0.020	-0.49
R&D	(Yes=1, No=0)					0.360***	21.47
Region dummies		No		Yes		Yes	
Sector dummies		No		Yes		Yes	
Total observations		7,621		7,618		7,618	
Pseudo R-sq.		0.01		0.03		0.08	

Note: Dependent variable: Indicator variable taking the value one if firm is involved in technology adaption, zero otherwise. Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedaticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15).

These findings underline the innovative and economic potential that lies within the local Vietnamese firms. However, it should be noted that Table 6.1 reports results for all firms involved in technology adaption, and thus also firms that undertake R&D, thereby biasing the results towards R&D performers. In order to learn more about firms that engage exclusively in technology adaption (and not R&D), the results are rerun controlling for firms that undertake R&D. These results are shown in Tables 6.2 and 6.3.

Once sector and regional differences are controlled for, only micro-sized firms are statistically less likely to be involved in technology adaption (and not R&D) as compared to large firms (Table 6.2). In other words, the size effect is even less strong. Both small and medium sized firms display no significant effect. These findings underline the importance of technology adaption versus R&D for small and medium firms. Such firms account for the majority of firms in the Vietnamese manufacturing sector but are not traditionally a focus of national innovation policy.

Table 6.2: Technology Adaption Only, No R&D

	Coeff	t-stat
	-0.065***	-2.62
	-0.002	-0.14
	0.015	1.14
	-0.001	-0.05
erprise	0.029*	1.88
ility company	-0.012	-0.99
wo State	-0.005	-0.31
w. State	0.039	1.55
	0.016	0.40
l	-0.011	-0.30
	No	
	No	
	7,621	
	0.00	

olved in technology adaption only, zero otherwise (also R&D or no adaption). Probit estimates, marginal effects. t-stats reported in parenthesis are heteroskedat

The firm size (in terms of employees) findings suggest that support directed towards facilitating technology adaption and diffusion-based innovation (rather than pure R&D based innovation) may be especially beneficial for small and medium sized enterprises. High-technology and research-based innovation, on the other hand, should be more directed towards the needs of larger firms. Furthermore, firms with foreign involvement should not, on the basis of these results, be given special treatment in relation to technology adaption activities.

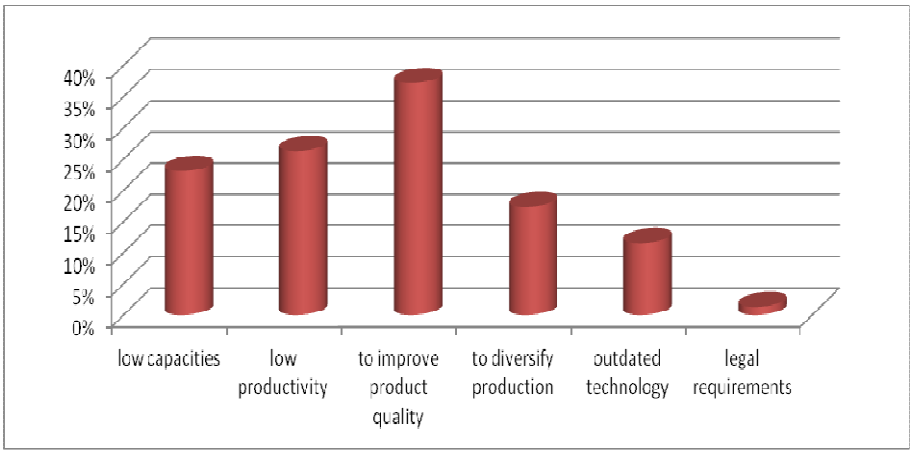
Table 6.3 presents characteristics (sector and location) of firms who are found to adapt technology but do not also engage in R&D activities themselves. Being located in the North West has a strong negative effect on firm technology adaption. This effect is robust even when legal structure and firm size effects are controlled for. At the same time, most sector coefficients are negative (and often significant) indicating that firms in the 'food processing' sector (ISIC 15) are generally more likely to engage only in technology adaption in relation to firms in other sectors.

Table 6.3: Technology Adaption Only, No R&D – Sector and Regional Effects

		Coeff	t-stat	Coeff	t-stat
Region	Red River Delta	0.009	0.83	0.017	1.48
	North East	0.023	1.12	0.031	1.47
	North West	-0.141**	-2.47	-0.139**	-2.41
	North Central Coast	-0.006	-0.31	0.001	0.03
	South Central Coast	-0.011	-0.63	-0.004	-0.22
	Central Highlands	-0.026	-0.82	-0.025	-0.77
	Mekong River Delta	0.011	0.77	0.012	0.80
Sector	Textiles	-0.097***	-5.24	-0.099***	-5.41
	Wearing apparel	-0.097***	-6.09	-0.101***	-6.24
	Leather processing	-0.090***	-3.86	-0.094***	-4.08
	Wood and wood products	-0.061***	-3.56	-0.061***	-3.58
	Paper and paper products	-0.036*	-1.86	-0.037*	-1.90
	Publishing and Printing	-0.059**	-2.28	-0.057**	-2.18
	Chemical products	-0.075***	-4.01	-0.078***	-4.16
	Rubber and plastic products	-0.033**	-2.08	-0.037**	-2.29
	Non-metallic mineral products	-0.038**	-2.48	-0.043***	-2.78
	Basic metal	-0.079***	-3.30	-0.079***	-3.33
	Fabricated metal	-0.064***	-4.31	-0.064***	-4.30
	Machinery and equipment	-0.057**	-2.49	-0.056	-2.43
	Office machinery	0.119	1.27	0.102	1.12
	Electrical machinery	-0.044	-1.50	-0.048	-1.64
	Radio, TV etc.	-0.067*	-1.85	-0.074**	-2.08
	Medical equipment	-0.084	-1.53	-0.089*	-1.65
	Vehicles	-0.083**	-2.21	-0.087**	-2.40
	Transport equipment	-0.098***	-4.14	-0.101***	-4.32
	Furniture	-0.052***	-3.18	-0.056***	-3.38
Size dummies		No		Yes	
Legal dummies		No		Yes	
Total observations		7,619		7,618	
Pseudo R-sq.		0.02		0.02	

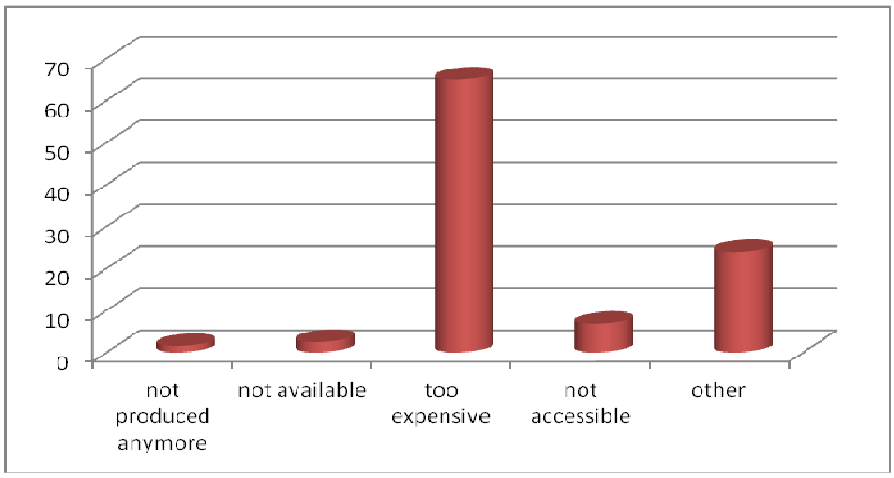
The survey data also provides information about the motivation for, and constraints to, technology adaption. In-line with the stated upgrading strategy presented in Section 3 (Figure 3.1), the main motivation for firms to undertake technology adaption is to improve product quality, followed by the wish to overcome low productivity and low capacities (Figure 6.2). Interestingly, legal requirements (for instance in connection with more environmentally friendly production or safety and quality certificates) play a negligible role (1.3 percent).

Figure 6.2: Reasons for Technology Adaption (percent)



In contrast to R&D, technology adaption is not considered by firms in Vietnam as so much an investment, but rather a way to reduce production costs. A clear majority of firms involved in technology adaption activities (65 percent) state that an appropriate technology is generally available, but is too expensive to be purchased in its present form (Figure 6.3).

Figure 6.3: Technology Adaption vs. Purchase of Technology (percent)

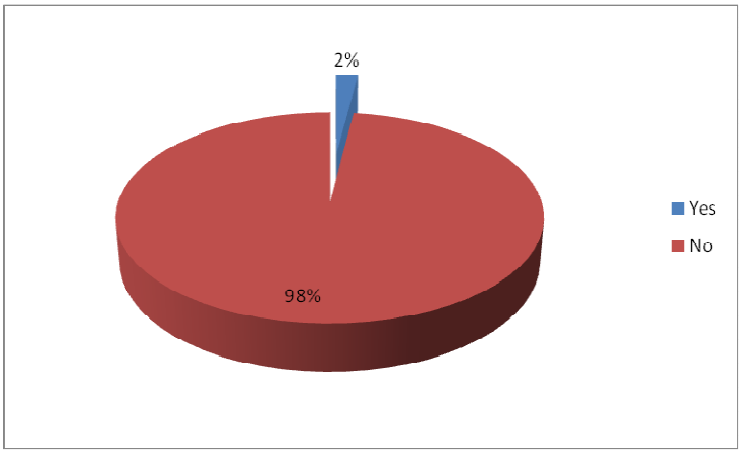


It is clear that straightforward technology adoption (without any adaptation) of 'off-the-shelf' technologies can be expected to be productivity enhancing at the firm-level. However, the modification and adaptation of existing technologies has the potential to (significantly) contribute to value added at the firm-level, generating technological competence through learning-by-doing effects. The next section examines in more detail these effects.

6.2 Technological Learning-by-Doing

Thus far we have concentrated on all firms involved in technology adaption, with and without R&D activities, and not differentiated between successful and failed technology adaption efforts. This is however important to fully understand existing constraints and to design effective policy measures. Given the uncertain nature of the process of technology adaption, it is remarkable that 98 percent of the firms involved in technology adaption activities report never having experienced a project failure (Figure 6.4).

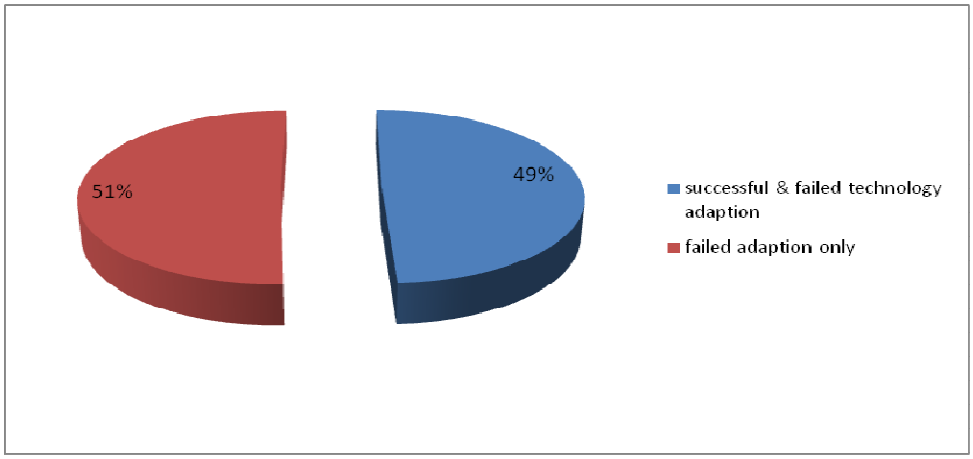
Figure 6.4: Experienced Technology Adaption Failures (percent)



We do not expect firms to shy away from reporting failure, so the results in Figure 6.4 highlight that once a firm engages in technology adaption, it is almost certain to succeed. A possible interpretation of this is that firms may be highly risk averse and only willing to invest resources if they are certain of success. Such a low failure rate may appear as good news and should act as an encouragement to other firms to target similar initiatives. At the same time, however, the results could be indicative of a lack of support and safety nets encouraging firms to engage in innovative activities more 'trial and error' in nature. Learning through experimentation is an area in which policy could be more adequately provided.

Of the two percent citing failed projects, the proportion *never* experiencing a successful project (as compared to those who have witnessed both failed and successful initiatives) is almost equally distributed (Figure 6.5)

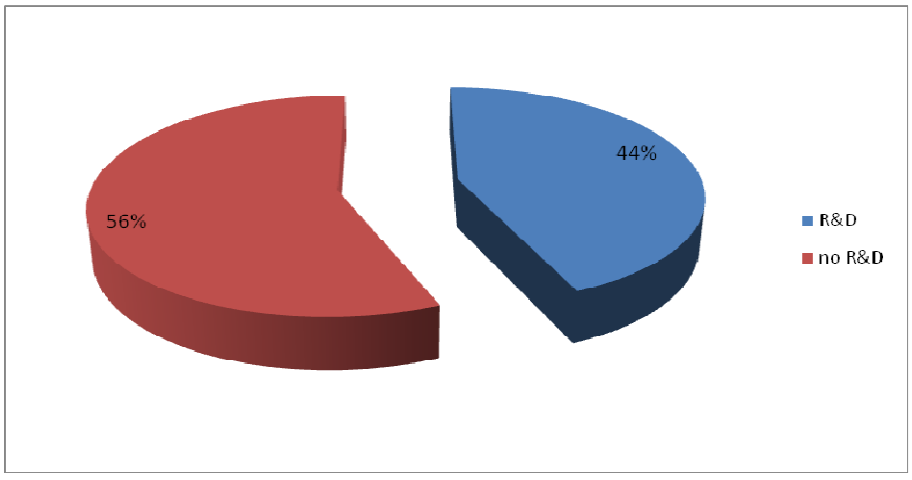
Figure 6.5: Mixed Adaption Successes vs. Failure Only (percent)



The results possibly indicate that learning through failure is not very common, and once again the reason behind this may be a lack of incentives to report and admit failure and/or lacking resources or capacities to re-engage after a failure. In any case, tailored policy measures targeting technology adaptors are likely to have a significant impact on innovative and technology adaption activities at the firm-level.

Considering differences between firms that do and do not perform R&D simultaneously to technology adaption projects, the picture is similar, but with a slight majority of failure among firms who do not undertake R&D (Figure 6.6).

Figure 6.6: Failed Technology Adaption and R&D (percent)



Focussing on the motivation and constraints of failed activities, Figures 6.7 and 6.8 show that 37 percent of the technology adaption projects that failed were targeted to improving product quality while over 20 percent were directed at overcoming low productivity and low capacities. In 63 percent of the cases suitable technology would be available, but is judged to be too expensive to be purchased (see Figure 6.7 and 6.8).

Figure 6.7: Motivation for Technology Adaption that Failed (percent)

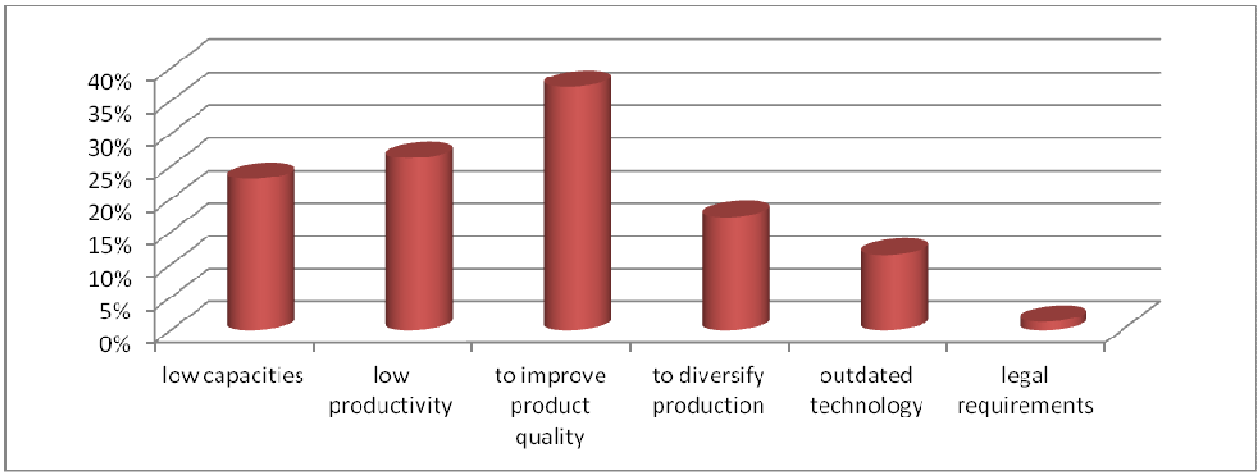
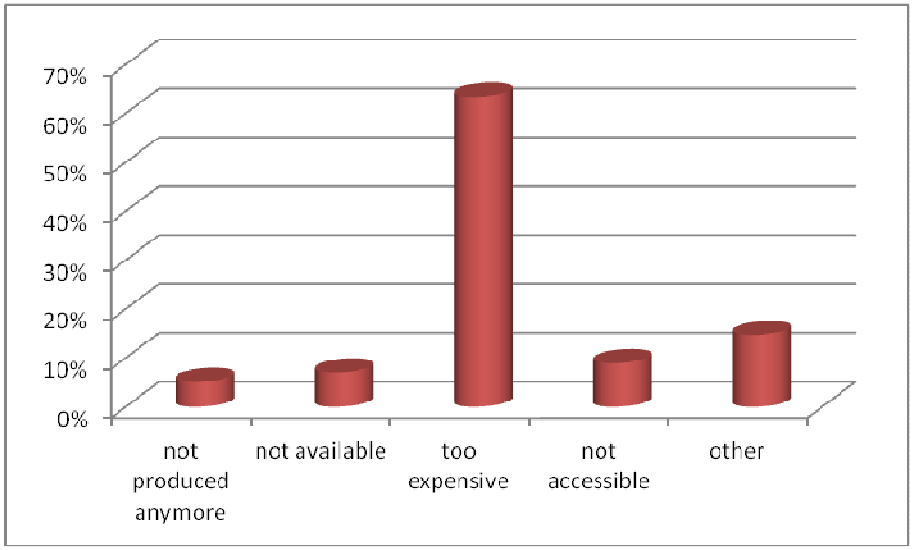


Figure 6.8: Failed Technology Adaption vs. Purchase of Technology (in percent)



7 Technology Needs

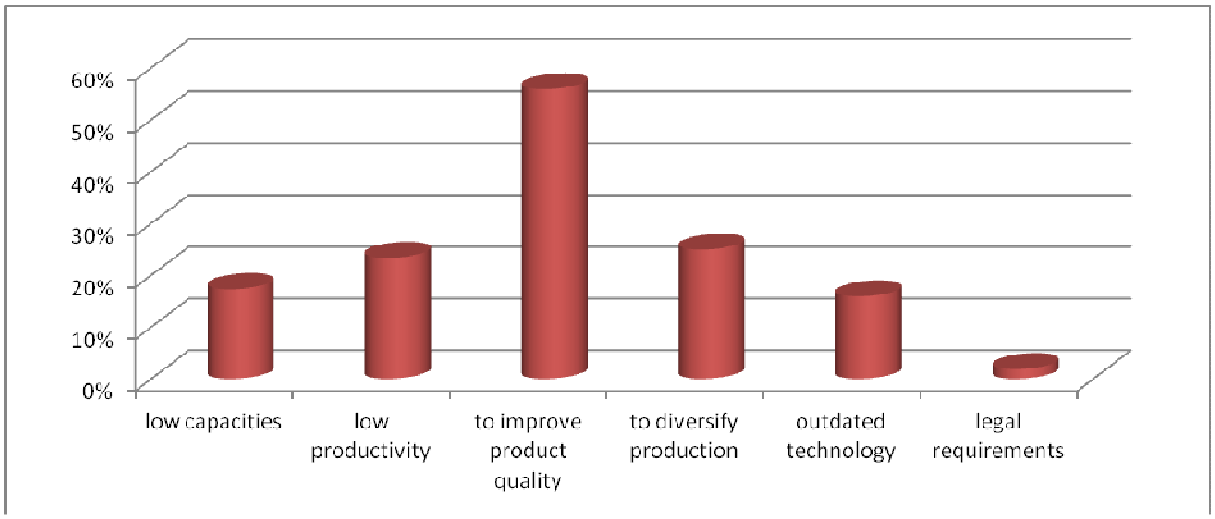
This section concerns future technology (upgrading) needs and demands of firms. Technology demand is considered to be any modification, replacement or change to technology that is desired by the firm to upgrade its technological and innovative capabilities.

7.1 Technology demand

Fifteen percent of firms are currently planning (further) changes in technologies (result not shown). This number includes both firms that have and have not yet upgraded their technology. This relatively low percentage corresponds to the finding in Section 1 that the level of technology is already quite high.

Figure 7.1 presents the origin of existing technology demand. Consistent with their business strategy, 55 percent of the firms place a clear emphasis on improving product quality. Accounting for 25 and 23 percent respectively, expanding product variety and production capacities also represent important reasons for technology upgrading plans. As in previous results, technology upgrading due to legal requirements is cited by just a few firms. These results seem to suggest that those firms focusing on product quality improvement are also those with the highest need for further technology upgrading.

Figure 7.1: Reasons for Technology Demand



Of all firms planning changes to their stock of technologies, 8 percent plan to develop the needed technologies by themselves, either through R&D or technology adaption activities. In contrast, the large majority of firms plans to purchase the technologies 'off the shelf' without immediate plans or needs for modifications. The main reason why these firms did not already purchase the needed technologies is price (Table 7.1). These results indicate that a much smaller proportion of firms need specialized technologies,

instead requiring rather basic standard solutions. This pattern is likely to change in the process of structural change towards a more knowledge-based economy.

Table 7.1: Technology

	Percent	Obs
Do you consider purchasing ready-for-use technology?	82,1	1,140

What is the main reason that this upgrading was not yet undertaken?	Mean	Median
is not produced anymore	5,5	5
do not know where to buy	4,0	5
too expensive	7,3	8
not accessible	4,7	5
Other	6,0	6

With respect to the realization of such technology demands, a large number (74 percent) of firms face constraints that are either obstructing or at least delaying upgrading plans. These constraints are summarized in Figure 7.2 and Table 7.2. On an index (*0 (not relevant) to 10 (very relevant)*), financing constraints and the lack of skilled labour were judged to be the most severe.

Figure 7.2: Constraints Obstructing Technology Upgrading

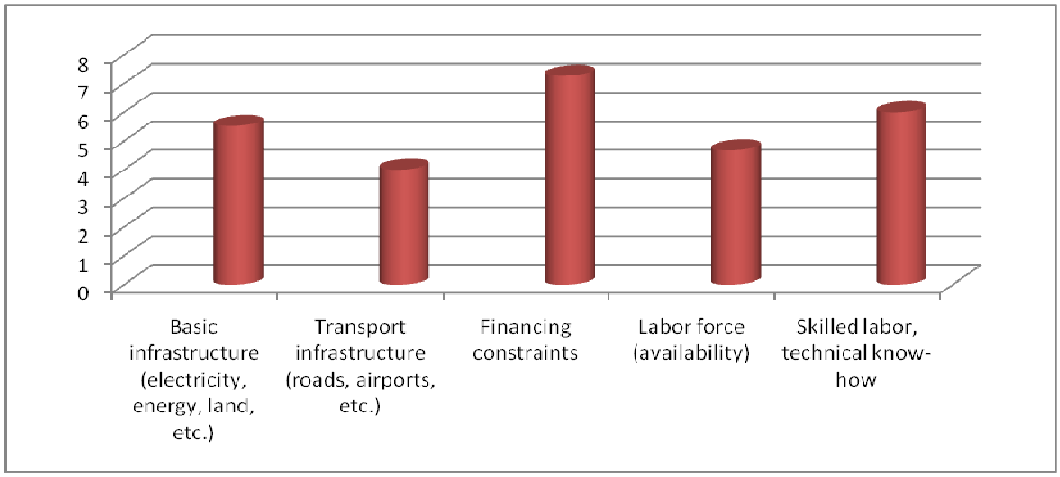


Table 7.2: Severity of Constraints

How Severe are these constraints for technology upgrading (0=No problem, 10=Severe problem)		
	Mean	Median
Basic infrastructure (electricity, energy, land, etc.)	5,5	5
Transport infrastructure (roads, airports, etc.)	4,0	5
Financing constraints	7,3	8
Labour force (availability)	4,7	5
Skilled labour, technical know-how	6,0	6

8 Conclusion

This report has documented the findings from a survey module added to the national Vietnam Enterprise Survey conducted by the GSO in 2010. A further three surveys are planned in 2011, 12, 13, and as such this report will act as a baseline report for what comes in subsequent years. The database arising from the survey is comprehensive, and the aim of this report is to provide a selective and concise overview of some of the key and pertinent results. There is much more that could come from the database, and as such further more in-depth studies are planned which, it is hoped, will lead to firm conclusions and the drawing up of policy relevant implications.

Key conclusions emerging from the results and analysis in this report are summarised below:

- Innovation and technology policies that are based purely on the evaluation of STIs will potentially lead to a systematic undervaluation of innovative activity and on-going technological progress in Vietnam. A broader definition of innovation and R&D is necessary to capture the full extent of technological activity taking place among Vietnamese manufacturing firms.
- In general, most firms in the Vietnamese manufacturing sector perceive themselves to have a satisfactory level of technology. Most see 'access to technology' constraints as being of relatively minor importance.
- Firms have a tendency to pursue productivity enhancing strategies within the product(s) in which they already specialize. Very little strategic focus is assigned to seeking new markets in different industries.
- Technology transfers are more likely to occur the more secure contractual arrangements are. However, only one in 10 firms normally engage in long-term contracts.
- Fewer than 10 percent of firms engage in contracts explicitly stipulating direct technology transfers from customers to the enterprise (backward linkages) - although more transfers of technology occur outside of formal contractual agreements. Joint ventures between state-owned enterprises and foreign invested enterprises are more likely to experience customer technology transfers.
- Approximately 10 percent of firms report that technology transfers have taken place between them and their suppliers (forward linkages). Only private enterprises and limited liability companies are less likely than firms with 100 percent foreign capital to experience forward linkages.
- Approximately two thirds of the backward and forward linkages are stipulated in formal contracts. Only around five percent of the technology transfers occurring are non-consensual, coming through unintended/unexpected spillover effects.
- Just under one third of Vietnamese manufacturing firms undertake technology upgrading related initiatives. These can take the form of explicitly developing new technologies through research-

based activities (R&D), or implicitly through modification and refinement of already existing technologies (technology adaption).

- The majority of innovative activity is directed to solve very concrete problems and (technology) limitations. As such, innovative activities are often considered to be cost-reducing rather than an investment in the future (e.g. through improving the product quality).
- Technology adaption of already existing technologies to be directly suitable for the firm in question (as opposed to pure R&D) is especially relevant to micro and small enterprises.
- Foreign-ownership is not a guarantee for technology transfer. In fact, ownership-form matters much less for technological level and technology upgrading success of firms than other determinants, such as the location and the size of the firm.
- A significant share of Vietnamese firms is not yet engaged in technology adaption or technology upgrading activities. In order to broaden the technological and innovative capacity in Vietnam, it would be important for this number to be further increased. There is vast unexploited potential here.
- While selected high-technology and research based innovation programmes should be pursued, in the short to medium term, it is important to raise the awareness for technological learning and innovative capacities at large. Technical and financial support for technological upgrading at the firm level would seem particularly important.

Appendix: Survey Module Questionnaire

Questionnaire No.: 3-ĐTDN-KHCN

GENERAL STATISTICS OFFICE

Enterprise No.: ☐☐☐☐☐☐

(Filled by statistics agency – coincides with enterprise code in Questionnaire 1A)

SURVEY QUESTIONNAIRE
TECHNOLOGY USE IN PRODUCTION

(ISSUED IN ACCORDANCE WITH THE LAW OF STATISTICS)

(Applied for sampled enterprises operating in processing and manufacturing industries)

Province/City code

Name of enterprise: . . . . . (Filled by statistics agency)

Address (province/city): . . . . . ☐☐

Status of enterprise's utilization of technology/production machinery and equipment

		First technology/production machine/equipment	Second technology/production machine/equipment
1	Please name two technologies or production machines/equipments that are being used most in enterprise *(by order of importance)*	……...……. ……...……..	……...…… ……...……
1.1	Country of origin	Country . . . . . … Country code (Filled by statistics agency): …….....	Country . . . . . … Country code (Filled by statistics agency): …….....
1.2	Trademark	……...……..	……...……..
1.3	Year of manufacture	Year . . . . . ……	Year . . . . . ……
1.4	Modernity of production technology/ machines: *(Circle the most appropriate answer)*	1. Mechanical hand tools 2. Power-driven hand tools 3. Human-operated machines 4. Computer-operated machines 5. Other, specify: ……	. Mechanical hand tools 2. Power-driven hand tools 3. Human-operated machines 4. Computer-operated machines 5. Other, specify: ……
1.5	Year of use	Year……..	Year……..
1.6	Cost of acquiring technology/machine	…… million dongs	…….…….. …… million dongs
1.7	a. Does enterpise have to pay fees for intellectual property rights to use or apply production technology?	1. Yes 2. No	1. Yes 2. No
	b. If yes, how much is on average spent annually (or in 2009)?	……million dongs	……million dongs

Information and communication technology

	First information and communication technology/machinery ↓	Second information and communication technology/machinery

2.1	Please name two information and communication technologies or machines/equipments that are being used most in enterprise *(by order of importance)*	……..……. ……..……..	Country……..Code……..….
2.2	Country of origin	Country……..Code……..….	Country……..Code……..….
2.3	Trademark	…….	……..
2.4	Year of manufacture	Year……..	Year……..
2.5	Modernity of the technologies/ machines: *(Circle the most appropriate answer)*	1. Telephone 2. Mobile phone 3. Fax machine 4. Personal computer (without internet) 5. Internet 6. Oher, please specify:……	1. Telephone 2. Mobile phone 3. Fax machine 4. Personal computer (without internet) 5. Internet 6. Oher, please specify:……
2.6	Year of use	Year……..	Year……..
2.7	Cost of acquiring technology/machine	…….……million dongs	…….……million dongs
2.8	a. Does enterpise have to pay fees for intellectual property rights to use or apply these technologies/ machines?	1. Yes 2. No	1. Yes 2. No
	b. If yes, how much is on average spent annually (or in 2009)?	…….……million dongs	…….……million dongs

3. Input-use technology and output structure

3.1	a. Where does enterprise procure raw materials (including unprocessed materials used to produce intermediate products or final products) from (in percentage)? Same province ……. Other provinces in the same region …… Other region in the same country …… ASEAN countries …… Non-ASEAN countries …….. Total (equal to 100%)			
	b. If choose option 4 or 5 in question 3.1a: →	List three most important countries that enterprise procure raw materials from: → 1. Country…… . . . .Code: . . . . 2. Country…… . . . .Code: . . . . 3.Country…… . . . .Code:	In percentage of total raw materials that enterprise uses: ……% ……% ……%	Year of starting to import raw materials: …… … …… … …… …
3.2.	a. Where does enterprise procure intermediate inputs (including those are final products or intermediate processed/manufactured products used to produce enterprise's final products) from (in percentage)? Same province ……. Other provinces in the same region …… Other region in the same country …… ASEAN countries …… Non-ASEAN countries …….. Total (equal to 100%):			
	b. If choose option 4 or 5 in question 3.2a: →	List three most important countries that enterprise procure intemediate inputs from: 1. Country…… . . . .Code:	In percentage of total intemediate inpurts that enterprise uses: ……%	Year of starting to import intermediate inputs:

		2. Country…… . . . .Code: . . . . 3.Country…… . . . .Code:	……% ……%	…… … …… … …… …
	c) Please name three kinds of raw materials or intermediate inputs that enterprise imports	1.……...…….. 2.……...…….. 3.……...……..		
	d) *If ansswer 4) or 5) to 3.2:* The enterprise directly transact with traders in exporting country or through an intermediate importer in Vietnam *(circle one suitable option)?* 1. Directly transact with traders in other countries ⟶ 2. Through intermediate importer in Vietnam		List three (3) most important countries exporting intermediate inputs for the enterprise: 1.Country…… Code : . . . . 2. Country…… Code : . . . 3. Country…… Code : . . .	
3.2.1	1. Does the enterprise sign long-term contracts (from 3 years and over) with domestic or international suppliers of raw material or intermediate input?	a) Domestic 1. Yes ⟶ *Number of suppliers is:* 1.1. State enterprise: ……. 1.2. Foreign invested enterprise: ……. 1.3. Private enterprise: …….. 1.4. Other, specify: …… 2. No	b) International 1. Yes ⟶ list three most important countries (in the order of importance): 1.1.Country…… Code : . . . . 1.2. Country…… Code : . . . 1.3. Country…… Code : . . . 2. No	
	2. In which: Which type do the domestic main suppliers?	Number of main suppliers in each type: 1. State enterprise: …….. 2. Foreign invested enterprise: ……..... 3. Private enterprise: …… 4. Other: ……		
	3. How long is the average contract term ?	1 Domestic:…… month 2 International:……month		
3.2.2	Does the enterprise make specific investment (for production techology/ machine/ equipment or information and communication technology, frastinstructure or skill training for staffs) relating to a long-term contractor if having contract?		1. Yes 2. No	
3.2.3	Do most of contracts include technology transfer from suppliers to the enterprise?		1. Yes 2. No ⟶ *Skip to 3.2.5*	
3.2.4	Most of technology tranfer from suppliers to the enterprise is? *(Circile the most suitable option)*		1. An article indicated in the contract 2. Enclosed Cautions without indicated in the contract 3. Without cautions and not indicated in the contract	
3.2.5	The useful support type helping the enterprise to integrate with international suppliers or supplying network is? *(Circle one or more suitable options)*		1. Finance/ Credit 2. Technical supports through Enterprise center/associate or Technology innovation center 3. Other support, specify …….	
3.3	The main output product structure of the enterprise belongs to which type? *(Circile the most suitable option)*		1. Manufacturing products (goods) for use 2. Manufacturing intermediate products (goods) 3. Both	
3.3.1	1. If answer 3.3: 1 (the finished product) or 3 (both of finished and intermediate products) ⟶ Percentage rate of all finished products are sold in: In the same province ……% Outside the province, but in the same region ……..% Outside the rigion, but in the same country …… % Outside the country, but in ASEAN ……..% Overseas, outside ASEAN ……..% Total (equally 100%)			
	2. If answer d) or e) to 1: ⟶	List three (3) main countries where the enterprise exports to? 1.Country…… Code : . . . . 2. Country…… Code : . . .	Percentage rate in the total export value of the enterprise: ……..…%	1st year of export: ……..…… …

		3. Country…… Code :	……% ……..…%	……..…… … ……..…… …
3.3.2	1. If answer 2 to 3.3 (intermediate products): → Percentage rate of total intermediate goods are sold in: In the same province ……% Outside the province, but in the same region ……....% Outside the rigion, but in the same country …… % Outside the country, but in ASEAN ……....% Overseas, outside ASEAN ……....% Total (equally 100%)			
	2. If answer d) or e) to 1: →	List three (3) main countries where the enterprise exports goods to? 1.Country…… Code : . . . . 2. Country…… Code : . . . 3. Country…… Code : . . .	Percentage rate in the total export value of the enterprise: ……..…% ……% ……..…%	1st year of export: ……..…… … ……..…… … ……..…… …
3.3.3	a. Export products of the enterprise? → *(Surveyor record by the current Industrial products list)*	Intermediate product List three most important products: 1. Product……Code…….. 2. Product……Code…….. 3. Product……Code……..	Finished product List three most important products: 1. Product……Code…….. 2. Product……Code…….. 3. Product……Code……..	
	b. *If the enterprise export products:* The enterprise directly transact with traders in exporting country or through an intermediate importer in Vietnam? 1. Directly import 2. Import through intermediator (*skip to 3.3.4*)		If export directly (code 1), List three countries to which the enterprise export the most 1.Country…… Code : . . . . 2. Country…… Code : . . . 3. Country…… Code : . . .	
3.3.4	1. Does the enterprise have long-term contract (over 3 years) with customers? →	a) Domestic 1. Yes 2. No ↓	b) International 1. Yes 2. No ↓	
	2. If Yes to 1: →	Type of customers: (circle suitable options) 1. State enterprise: …… 2. Foreign invested enterprise: ……..……. 3. Private enterprise: …… 4. Other: …… ↓	List three the most countries: 1.Country…… Code : . . . . 2. Country…… Code : . . . 3. Country…… Code : . . .	
	3. Number of main customers?	1. State enterprise: …… ↓ 2. Foreign invested enterprise: ……..……. 3. Private enterprise: …… 4. Other: …… ↓	List three the most countries: 1.Country…… Code : . . . .Customer code..... 2. Country…… Code : . . . Customer code..... 3. Country…… Code : . . . Customer code.....	
	4. Percentage (%) of product value (total outputs) of the enterprise providing for all customers in 2009?	1. State enterprise: …… 2. Foreign invested enterprise: ……..……. 3. Private enterprise: …… 4. Other: …… ↓ (Total 100%)	List three the most countries: 1. Country…… Code : . . . . . . Rate:…. .% 2. Country…… Code : . . . . . . Rate:…. .% 3. Country…… Code : . . . . . . Rate:…. .%	
	5. The average term of goods supply contract:	……..…… month	…… month	
	Does the enterprise make specific investment (for production techology/ machine/ equipment or information and communication technology, frastinstructure or skill training for staffs) relating to a long-term contracted supplier if having contract?			1. Yes 2. No
	Do most of contracts include technology transfer from suppliers to the enterprise?			1. Yes 2. No
	Most of technology tranfer from suppliers to the enterprise is? *(Circile the most suitable option)*			1. An article indicated in the contract 2. Enclosed Cautions without indicated in the contract

		3. Without cautions and not indicated in the contract

4. Enterprise's development potential

4.1	The current developing stategy of the enterprise through *(circle one or more suitable options):* 1. Improving organisational structure 2. Improving product quality 3. Developing many types of products 4. Extending enterprise's activities in a new field of production - business 5. Change enterprise's activities in a different fields of production – business	
4.2	Does the enterprise face difficulties (listed below) leading to postpone or obstructing upgrading, improving technology or machine and equipment? If yes, assessing level *(circle one (01) most suitable number for each item below):* *0=no related, 1=little important, 5=Normal, 10= Very important*	1. Yes 2. No
	1) Infrastructure (power, enegy, soil)	0 1 2 3 4 5 6 7 8 9 10
	2) Traffic facilities (road, airport, etc.)	0 1 2 3 4 5 6 7 8 9 10
	3) Communication facilities	0 1 2 3 4 5 6 7 8 9 10
	4) Finance (credit, loan,…)	0 1 2 3 4 5 6 7 8 9 10
	5) Labour size	0 1 2 3 4 5 6 7 8 9 10
	6) Skilled, hi-tech labor	0 1 2 3 4 5 6 7 8 9 10
	7) Other (specify)	0 1 2 3 4 5 6 7 8 9 10

5. Competition

5.1	What is the main competition method of the enterprise? (*Circle one most suitable option*)	1. No competition 2. Competition in price 3. Competition mainly in quality 4. Competition mainly in product number, supplying services	
5.2	Estimate number of main competitors	National 1. No competitor 2. Under 5 competitors 3. Between 5 and 10 competitors 4. More than 10 competitors	b) Internationa 1. No competitor 2. Under 5 competitors 3. Between 5 and 10 competitors 4. More than 10 competitors

6. Developing technology/ Machine and equipment

		Production technology/ machine and equipment	Information, communication technology/ machine and equipment
6.1	a. Most of technologies/machines and equipments currently used in the enterprise are? If answer 3, skip to 6.5	1. Purchase 2. Other enterprise provide 3. Self-develop 4. Other (*Specify*):……	1. Purchase 2. Other enterprise provide 3. Self-develop 4. Other (*Specify*):……
	b. if answer 1 or 2 to a: The main supplier of technology/ machine and equipment for the enterprise is? (*Circle one most suitable option*)	1. Vietnam enterprise in the same region 2. Vietnam enterprise in different region 3. International enterprise in ASEAN 4. International enterprise outside ASEAN	1. Vietnam enterprise in the same region 2. Vietnam enterprise in different region 3. International enterprise in ASEAN 4. International enterprise outside ASEAN
	c. If answer 2 to b, which region the supplier belong to?	Region .....Region code.....	Region .....Region code.....
	d. If answer 3 or 4 to b, which country the supplier belongs to?	Country .....Country code.....	Country .....Country code.....
	e. The technology/ machine and equipment supplier for the enterprise is?	1. State enterprise 2. Non-state enterprise in the same group, company 3. Non-state enterprise outside your group, company	1. State enterprise 2. Non-state enterprise in the same group, company 3. Non-state enterprise outside your group, company

		Production technology/ machine and equipment ↓	Information, communication technology/ machine and equipment
		4. Foreign invested enterprise 5. Other (specify): ……..	4. Foreign invested enterprise 5. Other (specify): ……..
6.2	a. Does the enterprise pay for intellectual property (expenses related to utilization or application of production technology or information technology)?	1. Yes 2. No	1. Yes 2. No
	b. If Yes to a) how much is the average expense in one year ?	……..……. million dong	……..……. million dong
6.3 .	How is the maintainance of production technology performed?	1 Self-maintain 2 Hire others 3 Both → estimated rate: - Self-maintain: …… % - Hire others: ……. % (Total 100%)	1 Self-maintain 2 Hire others 3 Both → estimated rate: - Self-maintain: …… % - Hire others: ……. % (Total 100%)
6.4	a. Does the number of employees in the enterprise change thanks to develping and applying production/information technology?	1. Yes 2. No	1. Yes 2. No
	b. If answer Yes to 6.4.a, how many employees changed due to applying this production/information technology?	1. Number of employee increases: ……..…. person 2. Number of employee decreases: ……..…. person	1. Number of employee increases: ……..…. person 2. Number of employee decreases: ……..…. person
6.5.	a. Does the enterprise have reseachs and development of technology?	1. Yes 2. No	1. Yes 2. No
	b. *If Yes to a,* when did the research start?	Year: . . . . . . …….	Year: . . . . . . …….
6.6.	1. Research and development activities are self-performed by the enterprise or hired others?	1. The enterprise self-performs 2. Hire 3. Both ⟶ estimated rate: - Self-perform: ……..…. % - Hire: ……. ……. % (Total 100%)	1. The enterprise self-performs 2. Hire 3. Both ⟶ estimated rate: - Self-perform: ……..…. % - Hire: ……. ……. % (Total 100%)
	2. The purpose of research and development is to innovate each part or all technology/machine and equipment?	1. All 2. Each part	1. All 2. Each part
	3. *If innovation in each part (answer 2*) the purpose of technology/ machine and equipment innovation is?	1. New to the enterprise 2. New to the market 3. New to the world	1. New to the enterprise 2. New to the market 3. New to the world
6.7	1. The number of projects, initiatives ò researching and developing technology/ machine and equipment of the enterprise in 2009 is ?	Proceeding…….. Finished …… Cancelled …….....	Proceeding…….. Finished …… Cancelled …….....
	2. Is the enterprise cooperating with outside partners to research?	1. Yes 2. No	1. Yes 2. No

		Production technology/ machine and equipment ↓	Information, communication technology/ machine and equipment
	3. If Yes to 6.7.2, the main partner is?	1. In the same province, city 2. In the same region 3. In the same country 4. In ASEAN 5. International, outside ASEAN *If answer 4 or 5:* ↓ List three most important country: 1.Country…… Code : . . . . 2. Country…… Code : . . . 3. Country…… Code :	1. In the same province, city 2. In the same region 3. In the same country 4. In ASEAN 5. International, outside ASEAN *If answer 4 or 5:* ↓ List three most important country: 1.Country…… Code : . . . . 2. Country…… Code : . . . 3. Country…… Code : . . ..
	4. Where is the main expense source for technology research and development from? (*Circle one or more suitable option*)	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other

6.8	How many National Inventory Lisense does the enterprise have? a) In 2009: …….. ……. b) Total (till the end of 2009): …….
6.9	How many International Inventory Lisense does the enterprise have? a) In 2009: …….. ……. b) Total (till the end of 2009): …….

7. Technology/machine and equipment transfer

7.1	Does the enterprise think that the following receipt channels of technology transfer relating to production technology/ machine and equipment of the enterprise? (*Circle one most suitable option for each item*): *Relating level: From 0= unimportant to 10= very important*										
	a) Purchasing technology presented in goods (e.g. machine, equipment)	0	1	2	3	4	5	6	7	8	9	10
	b) Purchasing technology/ machine and equipment from Research Institutes and other enterprises	0	1	2	3	4	5	6	7	8	9	10
	c) Utilizing technology/ machine and equipment from *other enterprises in the same group/corporation*	0	1	2	3	4	5	6	7	8	9	10
	d) Utilizing technology/ machine and equipment provided by *supplier or main customer under long-term contract* (3 years and over)	0	1	2	3	4	5	6	7	8	9	10
	If answer c) or d) to 7.1 with high relating level (between 6 and 10) technology transfer is?	1. An article indicated in the contract 2. Enclosed Cautions without indicated in the contract 3. Without cautions and not indicated in the contract										
7.2	Percentage (%) of technology/ machine and equipment currently used by the enterprise relate to recruitment of new employees: ……..…%											
7.3	The most important human resource for technology transfer is	1. Mainly foreigners 2. Mainly Vietnamese 3. Overseas compatriots										

8. Successful changes/adjustments of technology/ machine and equipment

8	Does the enterprise <u>succeed</u> in adjusting/changing technical procedure or production machine and equipment in order to applying technology more effectively? (E.g.: repair, overhaul machine and equipment, production line or replace parts, etc. but excluding purchase entire the new technology/ machine and equipment)	1. Yes 2. No ⟶ *Skip to 9*
8.1	Number of adjusting/changing procedure of production technology/machine and equipment are successful: …….time	

		1st time:	2nd time:
8.2	1. List and describe 2 most successful times of adjusting/changing production technology/ machine and equipment	…… ……	…… ……
	2. Start year	Year ……	Year ……
	3. Expense for the successful adjustment/change	……..……million dong	……..……million dong
	4. Reason for adjustment/change of production technology/machine and equipment (*Circle one or more suitable option*)	1 Due to low capacity 2 Due to low productivity 3 To improve quality 4 To diverdify production technology 5 Due to out-of-date technology 6 Due to legal requirements 7 Other (*specify)*……	1 Due to low capacity 2 Due to low productivity 3 To improve quality 4 To diverdify production technology 5 Due to out-of-date technology 6 Due to legal requirements 7 Other (*specify)*……
	5. Why the enterprise does not purchase new technology/machine and equipment to replace? (*Circle one or more suitable option*)	1 No longer produce 2 Don't know where to buy 3 Too expensive 4 Unable to access 5 Other (*specify)* ……	1 No longer produce 2 Don't know where to buy 3 Too expensive 4 Unable to access 5 Other (*specify)* ……
	6. Where does the main expense source for adjustment/change of technology/machine and equipment from? (*Circle one or more suitable option*)	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other
8.3	Success of adjustments/changes of production technology/machine and equipment is the planned result or by random? (*Circle the most suitable option*)		Levels between 0 = planned in advance and 10 = by random 0 1 2 3 4 5 6 7 8 9 10

9. Unsuccessful adjustments/changes of technology/machine and equipment

9	Have you ever been unsuccessful in adjustments/changes of production technology/machine and equipment ?		1. Yes 2. No ⟶ *Skip to 10*
9.1	Times of unsuccessful adjustments/changes of production technology/machine and equipment: ……time		
		1st time:	2nd time:
9.2.	1. List and describe 2 unsuccessful times of adjusting/changing production technology/ machine and equipment	…… ……	…… ……
	2. Start year	Year ……	Year ……
	3. Expense for the unsuccessful adjustment/change	……..……million dong	……..……million dong
	4. Reason for adjustment/change of production technology/machine and equipment (*Circle one or more suitable option*)	1 Due to low capacity 2 Due to low productivity 3 To improve quality 4 To diverdify production technology 5 Due to out-of-date technology 6 Due to legal requirements 7 Other (*specify)*……	1 Due to low capacity 2 Due to low productivity 3 To improve quality 4 To diverdify production technology 5 Due to out-of-date technology 6 Due to legal requirements 7 Other (*specify)*……
	5. Why the enterprise does not purchase new technology/machine and	1 No longer produce 2 Don't know where to buy 3 Too expensive	1 No longer produce 2 Don't know where to buy 3 Too expensive

	equipment to replace? (*Circle one or more suitable option*)	4 Unable to access 5 Other (*specify)* ……	4 Unable to access 5 Other (*specify)* ……
	6. Where does the main expense source for adjustment/change of technology/machine and equipment from? (*Circle one or more suitable option*)	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other

10. Expectation/plan for development of technology/machine and equipment

10	At present, does the enterprise have demand for adjustments/changes of production technology/machine and equipment?		1. Yes 2. No ⟶ *Skip to 11*
		1st technology/machine and equipment:	2nd technology/machine and equipment:
10.1	1. List two technologies/machines and equipments the enterprise plans to adjust/change in the future	…… ……	…… ……
	2. Planned year	Year ……	Year……
	3. Reason for adjustments/changes of technology/machine and equipment ?	1 Due to low capacity 2 Due to low productivity 3 To improve quality 4 To diverdify production technology 5 Due to out-of-date technology 6 Due to legal requirements 7 Other (*specify)*……	1 Due to low capacity 2 Due to low productivity 3 To improve quality 4 To diverdify production technology 5 Due to out-of-date technology 6 Due to legal requirements 7 Other (*specify)*……
	4. Does the enterprise plan to replace by purchasing available perfect technology/machine and equipment to use? 1. Yes 2. No ⟶	Reason for no replacement: 1 No longer produce 2 Don't know where to buy 3 Too expensive 4 Unable to access 5 Other (*specify)* ……	Reason for no replacement: 1 No longer produce 2 Don't know where to buy 3 Too expensive 4 Unable to access 5 Other (*specify)* ……
	6. Where does the main expense source for planned adjustment/change of technology/machine and equipment from?	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other	1. State budget 2. Available fund 3. Credit loan 4. Venture 5. Other
10.2	Does the enterprise face to difficulties in the expectation/plan of adjusting/changing technology or machine and equipment? If yes, assessing level *(circle one (01) most suitable number for each item below):* *0=no related, 1=little important, 5=Normal, 10= Very important*		1. Yes 2. No ⟶ *Skip to 11*
	1) Basic infrastructure (power, enegy, soil)		0 1 2 3 4 5 6 7 8 9 10
	2) Traffic facilities (road, airport, etc.)		0 1 2 3 4 5 6 7 8 9 10
	3) Communication facilities		0 1 2 3 4 5 6 7 8 9 10
	4) Finance (credit, loan,…)		0 1 2 3 4 5 6 7 8 9 10
	5) General labor number		0 1 2 3 4 5 6 7 8 9 10
	6) Skilled, hi-tech labor		0 1 2 3 4 5 6 7 8 9 10
	7) Other (specify)		

11. Disseminating technology/machine and equipment of the enterprise to the outside

11	Does the enterprise have improvement initiative, technology/ machine and equipment or new product (generally called initiative, technology/machine and equipment/product) transfered/sold to the outside for utilization? 1. Yes 2. No *(If No, skip the following questions)*		
11.1	a. List 2 newest initiatives, technologies/machines and equipments/products) have just been transfered/sold to the outside	1st new initiative, technology/machine and equipment/product …….....	2nd new initiative, technology/machine and equipment/product …….....

		……	……
	b. Has the initiative, technology/ machine and equipment/ product of the enterprise been used outside?	1. Yes 2. No	1. Yes 2. No
	c. If Yes to b), does the enterprise receive award or payment from the outside for the new initiative, technology/ machine and equipment/product?	1. Yes 2. No	1. Yes 2. No
11.2	Describe the partner receiving tranference of the new initiative, technology/machine and equipment/product of the enterprise: a. Field of business: 1 = In the same production line with the enterprise b. Directly under (branch,..) management of the enterprise ? 1 = Yes, 2 = No c. Does the partner receiving tranference have relationship with anyone else in the enterprise? 1 = Yes, 2 = No		
11.3	How is the transference of the new initiative, technology/machine and equipment/product? (*Circle one or more suitable options*)	1 According to the plan and indicated as an article of the contract 2 According to the plan, but a voluntary commitment 3 Not according to the plan, but the enterprise allows to use 4 Copyright stolen and resembled 5 Other (specify):	

Suveyor:

Full name: . . . .……... . . . . . Phone no: . . . .……... . .

.

Date:

The enterprise's owner

(Sign and stamp)

References

- De Man, A., Duysters, G.M., 2005. *Collaboration and innovation: a review of the effects of mergers, acquisitions and alliances on innovation*. Technovation 25,1377–1387.

- Javorcik (2004). "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages, *American Economic Review*, 94(3), 605-627.

- Javorcik (2008). "Can Survey Evidence Shed Light on Spillovers from Foreign Direct Investment?", *World Bank Research Observer*, 23, 139-159.

- Moran (2008). "How to Investigate the Impact of Foreign Direct Investment on Development and Use the Results to Guide Policy", *Brookings Papers on Economic Activity*.

- Smeets (2008). "Collecting the Pieces of the FDI Knowledge Spillovers Puzzle", *World Bank Research Observer*, 23, 107-138.

- Aghion, P. and P. Howitt (1998): Endogenous Growth Theory. Cambridge, Mass.: MIT Press.

- Basu, S. and D. N. Weil (1998): Appropriate Technology and Growth, in: Quarterly Journal of Economics, Vol. 113, No. 4, pp. 1025-1054.

- Fagerberg, J., Srholec, M., Verspangen, B. (2010). "Innovation and Economic Development," in: Hall, B. and N. Rosenberg, Handbook of the Economics of Innovation. North Holland: Elsevier, 2010, pp. 833-872.

- Freeman, C., Soete, L. (2009): "Developing Science, Technology and Innovation Indicators: What We Can Learn From the Past." Research Policy, 2009, 38 (4), 583-589.

- Fu, X., C. Pietrobelli and L. Soete (2011): "The Role of Foreign Technology and Indigenous Innovation in the Emerging Economies: Technological Change and Catching-up", World Development, doi: 10.1016/j.worlddev.2010.05.009

- Gereffi. G. 1999. International Trade and Industrial Upgrading in the Apparel Commodity Chain, in: Journal of International Economics 48: 37-70.

- Grossman, G.M. and E. Helpman (1991): Innovation and Growth in the Global Economy. Cambridge, Mass.: MIT Press.

- Hausmann, R. and D. Rodrik (2003): Economic Development as a self-discovery, in: Journal of Development Economics, Vol. 72, No. 2, pp. 603-633.

- Kaplinsky, R. and Readman, J. (2001): Globalization and Upgrading, in: Industrial and Corporate Change 14,4: 679-703.

- Le, H.Q. and Pomfret, R. (2011): Technology spillovers from foreign direct investment in Vietnam: horizontal or vertical spillovers?, in: Journal of Asia Pacific Economy, Vol. 16, No. 2, pp. 183-201.

- Romer, P. (1990): Endogenous Technological Change, in: Journal of Political Economy, Vol. 98, No. 5, pp. 71-102.

- Schumpeter, J.A. (1950): "The Process of Creative Destruction", in J. Schumpeter (ed.): Capitalism, Socialism, and Democracy, 3rd edn. London: Allen and Unwin.