FIRM - LEVEL COMPETITIVENESS AND TECHNOLOGY IN VIETNAM:

EVIDENCE FROM A SURVEY IN 2011

CIEM, DoE and GSO
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Preface

This report summarises information from the 2011 implementation of the Vietnam Technology and Competitiveness Survey, developed collaboratively between the Central Institute for Economic Management (CIEM), the General Statistics Office (GSO) and the Development Economics Research Group (DERG) in the Department of Economics (DoE) at the University of Copenhagen.

The data collected here will supplement the existing survey rounds, and further rounds of the survey will give researchers and policymakers in Vietnam a rich understanding of the dynamics and effects of technology transfer on the profitability and productivity of Vietnam's enterprise sector.

While every effort has been made to introduce readers to the main features of this data set, this is not an exhaustive description of the full range of information collected in 2011, and researchers or interested readers are encouraged to review the survey instrument and explore the data.

Acknowledgements

The study team gratefully acknowledges the guidance and support of Dr. Le Xuan Ba, President of CIEM, and Mrs. Vu Xuan Nguyet Hong, Vice-President of CIEM, who have ensured effective collaboration between the foreign researchers and their Vietnamese counterparts throughout the implementation and analysis of the 2011 survey data.

The research team involves Dr. Theodore Talbot and Professor John Rand of the University of Copenhagen, Dr. Carol Newman of Trinity College Dublin and Dr. Nguyen Tue Anh, Mr. Le Phan and Mr. Hoang Van Cuong of CIEM. Professor Finn Tarp of UNU-WIDER and University of Copenhagen coordinated the research throughout and provided valuable technical insight to the development of the survey instrument and the analysis of resulting data. The team looks forward to working with these and other researchers to produce further research using this data.

This series of on-going surveys would not be possible without the enduring professionalism and dedication of the enumerators and officials of the General Statistics Office, who have implemented this survey instrument across a substantial sub-sample of the wider Vietnamese annual Enterprise Survey.

While many commentators were responsible for improving the quality of this descriptive report, any remaining errors are the responsibility of the research team

1 Introduction

Vietnam's economy continues to expand, with an economic growth rate[1] of around 6% between 2000 and 2010 contributing to the country's rise from a position of national food insecurity, through the Doi Moi period of gradual openness and policy reform, to graduating from low income status.

While this acceleration in economic growth and the accompanying increase in per-capita income, average wages, and many human development indicators is remarkable, the Government of Vietnam (GoV) should now faces the challenge of ensuring this progress continues.

The economy faces several potentially serious challenges, including a slower growth rate and accelerating inflation, with a 18.58% year-on-year increase in the 2011 consumer price index, while the government's attempts to curb rising prices through tighter fiscal policies have created a more difficult business environment for most firms.

A nationwide business attitudes survey of 10,120 firms administered by the GSO in April, 2012 (GSO, 2012b) found bankrupt firms shut down mainly due to capital shortages while firms that were able to continue production reported facing higher costs for inputs, limiting their capacity to invest in new production methods or technologies.

28% of respondents reported high interest rates as their main constraint, and 19% said that high, volatile inflation negatively affected business. 17.5% of the over ten thousand respondents said that accessing capital was difficult, and 7% said they were affected by unstable electricity supply and unpredictable macroeconomic policies.

In line with results reported in this survey report, 90% of respondents said they were unable to get preferential access to capital, despite a raft of government programs and incentive schemes, while 42% could not get loans for production (possibly driving bankruptcies, as discussed above). About half the firms that did not take out a loan to maintain production did not need one, while the remainder cited high interest rates, complex borrowing procedures and lack of collateral as factors underlying their lack of access to credit. The GSO report on firms attitudes also reported that 71% of the sample that did take out a loan did so at an interest rate above 17%.

Future growth will be driven by Vietnam's burgeoning enterprise sector, a fact that is reflected in numerous policy and research documents undertaken by Government agencies, including the recent Vietnam Competitiveness Report,[2] a major collaboration between the GoV and international researchers. In this report, we discusses the state of technology transfer against this backdrop of serious macroeconomic challenges, and emphasise the role technology transfer can play in supporting the continued, broad-based expansion of the national economy.

1 Calculations based on Purchasing-Power Parity adjusted GDP (2005 International USD) from World Bank, 2010

2 Vietnam Competitiveness Report 2010. Christian Ketels, Nguyen Dinh Cung, Nguyen Thi Tue Anh and Do Hong Hanh. Central Institute for Economic Management (CIEM): Ha Noi.

1.1 Technology and economic growth

Economic growth is not the only measure of well-being. It is, however, strongly correlated with the level of human development and the quantity and quality of goods and services available to consumers. While economic growth fluctuates from year to year, the long run trend of growth is the relevant measure of economic performance, and the compounding of this growth rate determines the relative wealth or poverty of nations.

If growth rates determine long-run income levels, the question is: what determines growth rates? Key elements of the answer are *capital intensity* and *technology*. Capital intensity is the amount of machines, equipment, buildings, and other capital stock in an economy, while technology is the quality of capital and the ways that capital interacts with human labour to produce output.

Through increased investment and high rates of saving, Viet Nam has been able to invest heavily in capital, including through the gradual increase in foreign investment (the inward flow of capital from other countries).

1.2 "Measuring" technology

Technology is a broad term. In this report, it refers specifically to the techniques and equipment that supplement other production inputs, particularly human labour. Developing countries' ability to absorb and adapt appropriate technology creates a virtuous cycle of increases in productivity, wages, standards of living, and national output.

Since technology is essential for economic development, researchers and policymakers are interested in evaluating countries' levels of technological innovation. This is often done using aggregate macroeconomic statistics, which are sometimes combined into an index to produce a snapshot of countries' rankings in terms of potential for economic growth. Standard Science and Technology Indicators (STI) Table 1.1.

Source	Indicators
UNIDO: *Viet Nam Industrial Competitiveness Report 2010*	Manufacturing Value Added (MVA) per capita Manufactured export capacity Share in world MVA Share in world manufactured exports Share of MVA in GDP Share of medium- and high-technology activities (MHT) in MVA Share of manufactured exports in total exports Share of medium- and high-technology products in manufactured export
European Commission: *Science and Technology Innovation in Europe 2011*	Research & Development Expenditure Science and technology workers Number & kind of innovative enterprises Number of patents Number of high-tech manufacturing / services enterprises Share of high-tech manufacturing / services exports
OECD*: Science, Technology and Industry Scoreboard 2011*	Gross domestic expenditure on R&D Researchers (headcount) Government, Enterprise, and Higher Education Expenditure on R&D Government, Enterprise, and Higher Education R&D Personnel Patents Technology Balance of Payments International trade in R&D-intensive industries

Table 1.1 Standard Sources for STIs

The consensus amongst economists is that these indicators are more appropriate for developed countries but cannot be strong predictors of economic growth in developing countries. The logic is simple: when a country is at the technological 'frontier' in any given industry or industrial classification, additional investments are required to create new gains from technology. However, when a country is far from this frontier, it is easier, cheaper, and more appropriate to *adapt* technology that *already* exists.

To generalise, while STIs focus on developing novel processes and equipment, emerging market economies can grow by combining labour with existing technology. Economic convergence between lower-income and high-income countries (as discussed in the section Technology and economic growth) may not require emerging market economies to invest in original research but to adopt and adapt technology that already exists.

In contrast to the broad macro-aggregates that are used to describe technological innovation in economies that are near the technological frontier, this survey focuses on the key channels identified in the economics literature as ways emerging market economies like Vietnam can access technology that already. Since the survey captures data on nearly 8.000 firms, it also provides a high-resolution microeconomic understanding of this effect over time.

A firm discovers new technology through research and development or diffusion, which occurs when firms improve their efficiency by copying technologies by observing foreign firms / foreign-owned domestic firms or hiring workers who have been trained by foreign firms / foreign-owned domestic firms. This is a type of spillover that occurs when production by one firm influences production decisions, including choice of technology or methods of production, of another firm.

Type of spillover	**Description**
Vertical spillover: *Forward* linkage	The firm based in Viet Nam is a customer Technology is transferred *from* suppliers that are international firms or a firm created through FDI *to* the firm based in Viet Nam
Vertical spillover: *Backward* linkage	The firm based in Viet Nam is a supplier Technology is transferred *from* customers that are international firms or a firm created through FDI *to* the firm based in Viet Nam
Horizontal spillover: Competition	The firm based in Viet Nam is a competitor Technology is transferred *from* a foreign firm / foreign-owned domestic competitor *to* the firm based in Viet Nam

Table 1.2 Taxonomy of Spillovers by Type

Foreign Direct Investment (FDI) is an important source of spillovers, because foreign firms introduce new technologies and processes to Vietnam, representing an important channel for technology transfer that promotes economic growth.

With new regional and international competition, firms will begin to invest in technologies that increase productivity and quality. This report emphasises the potential for FDI to deliver both the direct benefit of more investment and the indirect benefit of technology transfer through spillovers.

1.3 Survey instrument

The survey instrument was developed collaboratively by the Development Economics Research Group (DERG) of the University of Copenhagen, the GSO, and the Central Institute of Economic Management (CIEM) within the Ministry of Planning and Investment (MPI). With over 100 full-time research staff across 7 research departments, CIEM is a leading producer of economic analysis and policy evaluation for the Government of Vietnam.

While the final questionnaire was mutually agreed between all three parties in an English version, the survey was implemented in Vietnamese, and a back translation from the final Vietnamese version to English was performed to ensure consistency.

The survey studies technology development and adaptation along 6 dimensions:

Topic (Section Title)	Description	Question numbers
Taking stock of technologies and technological basis	Capturing the status-quo of the firm's level of technological investment and sophistication through questions about the age, cost, and type of current production technologies, processes, and capital equipment.	1.1 – 3.4
Input and supplier relations	The details of major suppliers' locations and the value of inputs obtained, differentiated across domestic and international suppliers.	4.1 – 6.1
Output and customer relations	The details of major customers' locations and value of outputs sold, differentiated between domestic and international customers.	7.1 – 9.2
Innovation and technology capacities	A series of diagnostic questions targeting the constraints affecting technology adaptation and level of the firms' investment in technology transfers or research and development, differentiated between successful and unsuccessful adaptation of existing technology, desired technology improvements and novel research & development.	10.1 – 15.4
Competitors	Information about the number and location of competitors, and the dimension (cost / quality) along which competition occurs	16.1 – 16.6
Corporate Social Responsibility (CSR)	Questions relating to formal and informal commitment to CSR practices	17.1 – 20.8

Table 1.3 Survey Instrument Section Descriptions

1.4 Implementation

The survey is being implemented as an additional module attached to the Government Statistics Office (GSO)'s annual enterprise survey, a short-form census of registered firms of ten employees or larger (the minimum cut-off is 30 in the urban centres of Ha Noi and Ho Chi Minh City) implemented by the Government of Vietnam.

In 2011, the survey was carried out by approximately 300 enumerators under the guidance of 75 supervisors through face-to-face interviews. The survey results were recorded in survey booklets, and follow-up interviews were not conducted. The data were digitised in Ha Noi, and

were then extensively cleaned.

The Danida Business Sector Support Program (Danida BSPS) has generously committed funds to enable the GSO to implement the survey as a module attached to the annual Enterprise Census in 2011, 2012, and 2013. Since the survey questions are "backwards looking," the 2011 survey refers to firm data from 2010. This report presents cross-sectional evidence generated by the 2011 survey round, which is the second of the four planned survey rounds to be implemented (the 2010 survey was funded from other sources). The survey questionnaire has been adjusted to reflect feedback from partners and to introduce new research themes.

Most importantly, the survey is implemented in the same cross-section of firms in each survey round, generating a panel data set that enables economists or analysts to understand changes within individual firms over time, making this survey a rare resource internationally and nearly unique within lower- and middle-income countries.

1.5 Sampling and data cleaning conventions

The Technology and Competitiveness survey is implemented as part of the GSO's larger national enterprise survey of all firms registered under the Enterprise Law of Vietnam that are have 10 or more employees (the cut-off is 30 in the urban and peri-urban areas of Ha Noi and Ho Chi Minh City because of the density of large firms).

8,178 responses were recorded in the 2011 cross-section, and combining the survey module responses with data from the Vietnam Enterprise Survey and removing duplicate entries and those firms with inconsistent asset or revenue figures delivers a cross-section of 7,938 surveyed firms. In addition to the standard tests for duplicate entries and missing data, the data were cleaned to exclude those firms whose figures for assets and / or revenue were recorded as zero or missing. In addition, if the ratio of assets, revenue, and / or number of employees at the end of 2010 to the beginning of 2010 was lower than 20% or greater than 500%, then the firm was excluded from the analysis. Finally, the ratio of firm revenue to firm size (in terms of employment) was calculated, and the study sample excludes observations in the first and 99th percentiles of this metric.

Because the number of employees is a continuous variable, we make the analysis more intuitive by creating a categorical variable for firm sizes.

Size category	Number of employees
Micro	0 – 10
Small	10 – 50
Medium	50 – 300
Large	300 or more

Table 1.4 Size Categories and Definitions

Firms are also disaggregated by their legal structure to investigate, for example, whether there are differences between firms with some foreign and privately-or state-owned firms.

Legal structure	Description
Collective	Cooperatively owned and managed firm
Private enterprise	Domestically owned private firm
Limited liability company	Domestically owned, incorporated firm
Joint stock without state	Publicly held firm, without Government ownership
Joint stock with state	Publicly held firm, with Government ownership
FDI firm (100%)	Firm owned by FDI
Joint venture (State Owned Enterprise + FDI)	Joint Government and FDI ownership
Joint venture (Private + FDI)	Joint private and FDI ownership

Table 1.5 Legal Structures and Definitions

Finally, because analysis at the level of each of Vietnam's 58 provinces is unwieldy, provinces are grouped by region to generate stylised facts about enterprises, technology transfer, and geographic location from the cross-section.

We disaggregate the cross-section by these characteristics to get traction on the distribution of firms in the sample by location, size, and legal structure. Table 1.6 shows that most firms in the sample are located in the Red River Delta (RRD) and in the South East (which includes Ho Chi Minh city).

Region	Micro	Small	Medium	Large	Total	% of Total
Red River Delta	131	1,015	859	296	2,301	29%
North East	30	228	150	60	468	6%
North West	4	30	16	5	55	1%
North Central Coast	23	252	157	21	453	6%
South Central Coast	48	237	206	85	576	7%
Central Highlands	16	69	49	13	147	2%
South East	120	960	1,326	579	2,985	38%
Mekong River Delta	84	487	255	126	952	12%
Total	456	3,278	3,018	1,185	7.937	100%

Table 1.6 Number of Enterprises by Region and Size Category

Table 1.7 does this for firms' legal structure. The largest shares of the total sample are limited liability companies, and the largest firms in Vietnam (those with 300 or more employees) are

dominated by foreign direct investment (530 firms, or around 44% of Vietnam's largest companies).

Ownership structure	Micro	Small	Medium	Large	Total	Percent
Collective	27	131	57	3	218	3%
Private enterprise	168	865	292	30	1,355	17%
Limited liability company	214	1,585	1,221	253	3,273	41%
Joint stock without state	29	382	544	211	1,166	15%
Joint stock with state	0	13	124	110	247	3%
FDI firm (100%)	18	274	673	530	1,495	19%
Joint venture (State Owned Enterprise + FDI)	0	5	46	26	77	1%
Joint venture (Private + FDI)	0	23	61	22	106	1%
Total	456	3,278	3,018	1,185	7,937	100%

Table 1.7 Number of Enterprises by Legal Structure and Size

Using International Standard Industrial Classification (ISIC) codes to separate firms by industry is a useful disaggregation too. Table 1.8 concludes the overview of the 2011 survey sample by listing and describing the ISIC codes used through this analysis:

ISIC 2-digit & Sector Description
15 - Manufacture of food products and beverages
17 - Manufacture of textiles
18 - Manufacture of wearing apparel; dressing and dyeing of fur
19 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21 - Manufacture of paper and paper products
22 - Publishing, printing and reproduction of recorded media
23 - Manufacture of coke, refined petroleum products and nuclear fuel
24 - Manufacture of chemicals and chemical products
25 - Manufacture of rubber and plastics products
26 - Manufacture of other non-metallic mineral products
27 - Manufacture of basic metals
28 - Manufacture of fabricated metal products, except machinery and equipment
29 - Manufacture of machinery and equipment
30 - Manufacture of office, accounting and computing machinery
31 - Manufacture of electrical machinery and apparatus
32 - Manufacture of radio, television and communication equipment and apparatus
33 - Manufacture of medical, precision and optical instruments, watches and clocks
34 - Manufacture of motor vehicles, trailers and semi-trailers
35 - Manufacture of other transport equipment
36 - Manufacture of furniture
37 - Basic Metal Industries

Table 1.8 ISIC Codes and Descriptions

Finally, Table 1.9 disaggregates firms by their industrial sector and their size. The sample does not have a dominant industrial classification, so evidence on technology transfer is probably not biased by oversampling a specific industry; this would happen if, for example, industries with a higher average capital investment were over-represented in the survey.

ISIC 2-digit & Sector Description	Micro	Small	Medium	Large	Total	Percent
15	114	568	439	172	1,293	16%
17	11	124	183	52	370	5%
18	20	109	191	257	577	7%
19	4	26	81	97	208	3%
20	62	304	186	24	576	7%
21	12	204	165	27	408	5%
22	17	100	66	5	188	2%
23	0	3	0	0	3	0%
24	18	168	157	35	378	5%
25	22	261	284	75	642	8%
26	27	341	340	96	804	10%
27	9	119	74	15	217	3%
28	65	437	285	40	827	10%
29	16	111	84	16	227	3%
30	2	3	2	6	13	0%
31	8	45	67	31	151	2%
32	1	22	28	24	75	1%
33	2	13	12	7	34	0%
34	1	30	30	23	84	1%
35	13	71	78	22	184	2%
36	31	219	266	161	677	9%
37	1	1	0	0	2	0%
Total	456	3,279	3,018	1,185	7,938	100%

Table 1.9 Firm Size by Sector

This chapter provided a summary of the survey instrument and the categories used through this report. Because all firms operate in a legal and institutional environment that affects their decisions about which type and quality of technology to use, the following chapter outlines the relevant Vietnamese policy environment, highlighting some constraints faced by firms and instruments used by the government to promote transfer or investment.

2 Technology research and diffusion policy in Viet Nam

This chapter provides a brief overview of current legislation affecting investment in technology. While a comprehensive study of the interaction between Party decrees, Government Ministry policies, and national and legislation is beyond the scope of this report, it will become a priority research theme in coming years. In particular, policy cohesion will be essential to ensure that schemes are mutually compatible.

This chapter focuses on the legislative environment and give a summary of constraints that impede investment, emphasising the role of direct and indirect government support for technology investment.

2.1 Direct support

Several key pieces of legislation, summarised in Table 2.1 describe the current broad legal regime:

Decree / policy	Description
Law on Technology Transfer enacted in 2006	Enables enterprises to extract a part of their pre-tax profit for establishing scientific and technological development fund and fund for supporting technology transfer.
Law on Foreign Investment in 2005	Specify the insurance of industrial ownership and legal interests of foreign and domestic investors, including in technology transfer activities
Law on Science and technology promulgated in 2000	Governs ownership of research outputs and copyright

Table 2.1 Selected Policies

While this legislative framework provides sufficient conditions for technology it is not an industrial policy promoting upgrading (renovation) of existing technology and capital equipment, or investment in new technology.

Resolution 6 of the Vietnamese Communist Party Congress IX in 2001 accelerated the Government's program of modernising technology through a combination direct investment by the state in specific industries and enterprises (using public funds for investment), and indirect investment by providing tax breaks and other incentives.

This approach has produced some successes: significant public investment has occurred, mainly through state-owned enterprises, which has generated significant increases in production and capacity that are partially responsible the sustained increase in national output dating back to the Doi Moi era. However, the lack of transparency surrounding the allocation of state funds and the difficulty of evaluating the use of those investments makes it difficult to evaluate how effective they have been.

Table 2.2 lists key decrees and other legislation that represent public support for investment in new plants, property, and equipment.

Decree / policy	Description
National Focal Technical – Economic Programmes conducted in accordance with Decision No 54/1998/QĐ-TTg dated 3 March 1998	State budget earmark to support investment in technology renovation and technology transfer in focal industries: information technology, bio-technology, construction material technology and atomization technology
Ministry of Science and Technology and funded by state science and technology development budget has responsibility for coordinating and implementing the sequence of state five-year R&D plans	Support for focal industries (see above). Financial support for these programmes includes full or partial financing for research and development activities, for modern technology mastering and application.
Decree No 119/1999/NĐ-CP issued by the Government on 18 September 1999	Decree No 119 stipulates that enterprises with scientific and technological activities under the areas encouraged by the State shall be provided with 30% of total research costs and 70% of total value of successful projects funded by state funds
National Technology Renovation Foundation established by Decision No 1342/QĐ-TTg dated 5 August 2011	Access to preferential credits with a special guarantee mechanism to provide firms with capital to upgrade production equipment
Decision No 418/QĐ-TTg dated 11 April 2012	Action plans and additional financing mechanisms for accelerating technology renovation and transfer activities

Table 2.2 Selected Technology-Relevant Legislation

More recently, the National Foundation for Science and Technology Development (NAFOSTED) was established[3] to support science and technology research companies with access to preferential loans. While more than 10 major projects were funded by the scheme in 2009, the link between funding and firms activities has been controversial, NAFOSTED also suffers from a lack of transparency about funding decisions that characterises other state-sponsored technology investment programs.

2.2 Indirect support

The state has also put in place a large number of *indirect* policies to encourage technology renovation and transfer. These range from tax incentives to accelerated depreciation, the cumulative effect of which is to reduce the cost of investing in new equipment. Table 2.3 summarises key pieces of relevant legislation.

Firms importing machines, equipment, or material that cannot be produced locally do not pay import taxes or VAT on these imports, and companies engaged in science or technology research as their main activity are subject to a low tax rate of 5 percent. Many other preferences are implemented through the business income (corporate) tax regime, including:

3 Decision No. 1342/QĐ-TTg dated 05 August 2011 of the Prime Minister

- Rapid depreciation to assets, machinery, and equipment
- All of costs caused by the implementation of science and technology activities financed by the company can be charged as businesses expenses
- Firms are exempted from business income tax for income from contracts of scientific research and technology development projects, and scientific and technology information services;
- With new projects on scientific research, science and technology services, and technology transfer, companies are allowed to enjoy preferential business income tax or an exemption from business income tax for a maximum of four years since the taxable income emerged, and a reduction up to 50 percent with taxable income for up to nine years.
- Finally, in order to facilitate technology transfers and the horizontal spillovers explored further in this report, the Vietnamese Government has demarcated two "high tech zones": Lang – Hoa Lac zone and on in HCMC, investing in infrastructure and encouraging technology and research firms to locate there.

Law / Policy	Description
Law on Value Added Tax and guiding documents	Enterprises are exempt from Value Added Tax (VAT) when importing equipment that is not produced domestically. Scientific / research organisations receive a low tax rate of 5%.
Law on Import and Export Tax	Import tax exemptions for goods used in research
Law on Corporate Income Tax	Decree 119 applies many preferences to enterprises engaged in research and development activities as well as technology renovation and technology transfer, including: Accelerated depreciation for capital equipment, research institutions are tax-exempt, firms investing in technology transfer or research enjoy preferential tax rates, up to a full four-year exemption
Law on Domestic Investment	In addition to the above tax preferences, dividends invested in joint stock organizations operating in science and technology field, bonus for technology improvement and invention shall be exempted from income tax. Enterprises with investment projects under the preferential areas specified in the Law on Domestic Investment enjoy a reduction of 50% of land use fees, and exempted from land lease fees for 6 years in case of land lease.
Vietnam Development Bank, Scientific and Technological Development Support Foundation, Technology Transfer Support Foundation, and others	Provide credit to enterprises that invest in technology renovation and technology transfer Policies on preferential credit via establishment of state owned research and development, technology renovation and technology transfer foundations.
Law on Technology Transfer enacted in 2006	Enables enterprises to extract a part of their pre-tax profit for establishing scientific and technological development fund and fund for supporting technology transfer.

Table 2.3 Technology Investment Legislation

2.3 Constraints on technology transfer and research

It appears the state provides some financial support to firms investing in technology or performing research and development, and the majority of these funds have been allocated to large, state-owned enterprises. Data from the General Statistics Office's business survey 2001 -2004 showed that 86% of state owned enterprises received state support for R&D projects, the remaining are private enterprises. No firms with foreign investment (either portfolio or FDI) received state capital support for R&D projects.

Between 2008 and 2012 the Government provided financial support to numerous firms to counteract the global economic contraction. However, the sector still lacks a transparent government program that support firms to invest in new technology, despite the difficulty these firms have accessing loans from through the usual channels due to lack of collateral and inability to meet counterpart financing requirements (typically 30 percent of the loan requested).

Generally, it appears that regulations for government loan or investment incentive schemes are not transparent, and require a large number of documents and administrative procedures. This situation is exacerbated by the fact that many different state and semi-state actors are responsible for the raft of programs in place, including the Ministry of Planning and Investment, the Ministry of Finance, and the Ministry of Science and Technology.

When support is provided, it is generally done on the basis of requests by specific firms, rather than an active search by government agencies or an open tendering process. Comparatively, successful technology investment schemes in other countries are characterised by independent, competitive, and transparent mechanisms. Overall, many enterprises that are *eligible* for direct financial support, but refuse it because of the difficulty of the application process.

More broadly, to the extent that investment in technology transfer and research occurs, it is financed by either state or internal firm funds, reflecting the lack of other capital investment channels in Vietnam. In other countries, these include venture capital and capital markets, and how to development of these investment channels should be an important area for further research.

3 Constraints to upgrading technology

Firms can increase their levels of technological sophistication along several distinct dimensions, and Figure 3.1 shows the range of upgrading strategies pursued by Vietnamese firms, some of which use more than one strategy to acquire or adapt relevant technology. The dominant approaches are improving product quality, process organisation, or product variety. Firms are not typically increasing the number of enterprise activities or changing into different sectors. This evidence from this cross-section is consistent with the survey's previous round, and suggests that Vietnamese firms are trying to produce the *same* products more efficiently or at higher quality, rather than expanding into new sectors.

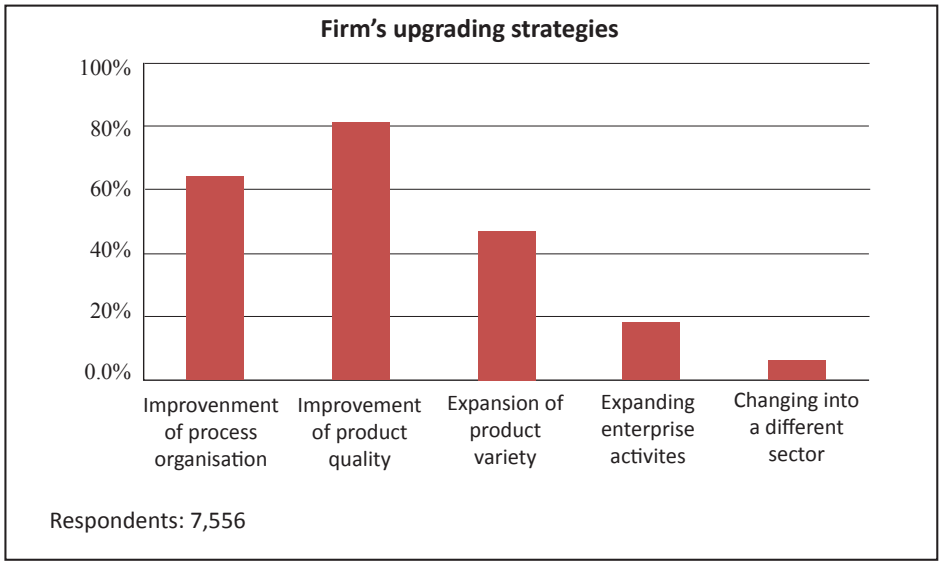

Figure 3.1 Firms' upgrading strategies

However, as we see in Table 3.1 the majority of firms are constrained when trying to upgrade their production processes / technologies. Evidence-based public policy that targets these constraints can play a role in encouraging technology transfer to Vietnamese firms.

Response	Number of respondents	%
No	245	3.09
Yes	7,692	96.91

Table 3.1 Firms that perceive constraints to upgrading

The benefit of high-resolution survey data is that we can study firms' perceived constraints at a high level of detail. Table 3.2 shows results from asking firms to score the severity of several kinds of constraints. An important result is that while financing constraints matter, other constraints also play an important role, with the exception of communication infrastructure: the widespread availability of high-speed internet and phone connections and mobile telephony appears to be effective for most firms.

How severe are these constraints for doing business (0 = No Problem, 10 = Severe Problem)	
Variable	Average
Basic infrastructure (electricity, energy, land, …)	5.67
Transport infrastructure (roads, airports, …)	4.38
Communication infrastructure	3.79
Financing constraints (credits, foreign capital, …)	6.12
Labor force (number of)	5.16
Technological know-how (skilled labor)	5.69
Technologies (machinery, equipment)	5.80

Table 3.2 Severity of Constraints

Regression analysis is the standard framework in which to analyse which factors explain an outcome of interest. Interpreting the estimates from this form of analysis is simple: larger coefficients (estimates) mean that the variable has a larger effect on the outcome (in this case, the total level of constraints perceived by the firm). The number of asterisks shows the level of statistical significance, loosely defined as the degree of confidence we have in the estimate's accuracy. These regressions usually have a "base" category, which means the coefficients are estimated relative to that category.

These are not intended to be robust, well-specified econometric models, but serve as guides to the main features and patterns of data. Table 3.3 shows that firms size is strongly associated with additional constraints, and because the estimated effect of the firm's legal structure on the level of perceived constraints does not vary greatly, we find that constraints bind almost equally across all different kinds of Vietnamese firms *compared to* the base category of large firms in HCMC in the food-processing industry.

This suggests policies targeting these constraints can be implemented across sectors and firm types, and may be useful for a broad cross-section of Vietnamese firms. This is encouraging: broad policies are easier to implement than targeted or sector-specific policies.

Does firm size or type explain the severity of constraints?

Firm size		1.244*** (0.188)
Legal Structure	Collective	33.158*** (1.603)
	Private enterprise	31.288*** (1.053)
	Limited Liability Company	32.530*** (1.027)
	Joint stock without state	33.267*** (1.175)
	Joint stock with state	31.341*** (1.727)
	FDI firm (100%)	31.687*** (1.310)
	Joint venture (SOE+FDI)	27.986*** (2.641)
	Joint venture (Private+FDI)	31.171*** (2.152)
	Constant	18.233*** (0.154)
Observations		7,374
Pseudo R-squared		0.0370
Region dummies		Yes
Sector dummies		Yes
Note: Tobit estimates, left censored, t-statistics reported below coefficients. Base: Large, FDI, Region 7 (HCMC), Food Processing (ISIC 15). Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Table 3.3 Firm Size and Constraint Severity

3.1. Horizontal spillovers and competition

Horizontal spillovers occur when firms competing in the same sector or closely-related sectors see innovations occurring in their competitors and copy them. One argument for encouraging FDI is domestic firms absorb the technologies used by foreign-owned firms.

Firstly, domestic firms could learn about new technologies or processes from foreign firms by competing with them internationally- the *internationalisation effect*. Secondly, a horizontal spillover can occur when a domestic firm improves efficiency by copying technologies by observing a foreign competitor- *demonstration effect*. Alternately, a foreign competitor could train Vietnamese workers, making them more productive creating a horizontal spillover due to the *worker mobility effect* when the workers are hired by local firms.

A necessary condition for horizontal spillovers is a competitive market. Vietnam's transition to a dynamic market economy has created competition between firms that try to improve quality or reduce price to capture bigger market shares or, in the case of exporters, attract and retain discerning international customers.

Domestic competition is healthy: Figure 3.1-1 shows that 78% of firms report *some* number of domestic competitors, and 36% of firms face more than 10 competitors.

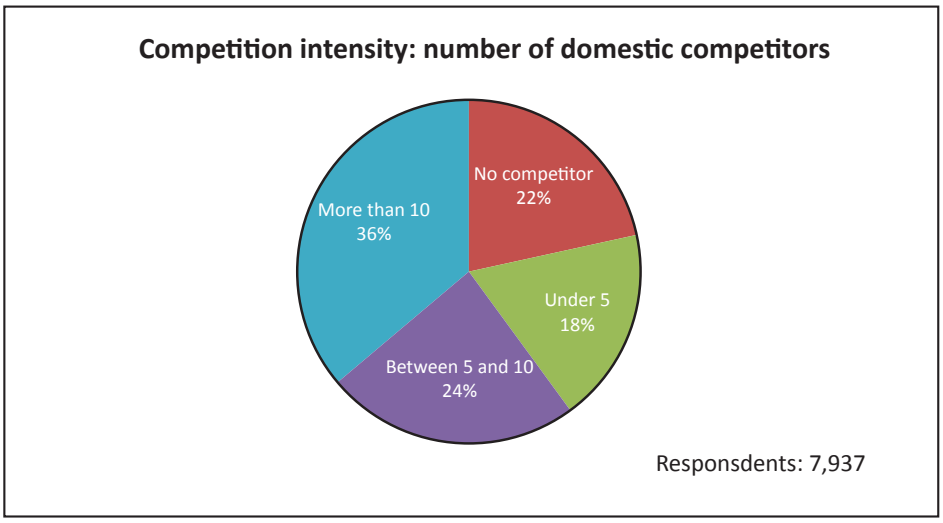

Figure 3.1-1 Competition Intensity, Domestic

This is not true for exporting firms: Figure 3.1-2 shows that nearly 40% of exporters claim to have no significant competitor, suggesting they are operating in niche markets that insulate them from competitive pressures. Increasing the number of exporting businesses is still a challenge: in the overall sample of around 8,000 firms, only around 1,300 firms were exporters.

Since export-led growth is a core Government policy, enabling firms to move into foreign markets overseas should still be a priority for policymakers. Only 8% of exporting firms have more than 10 competitors, and this finding should be explored in future studies to understand the nature of the competitive pressures the Vietnamese export sector faces.

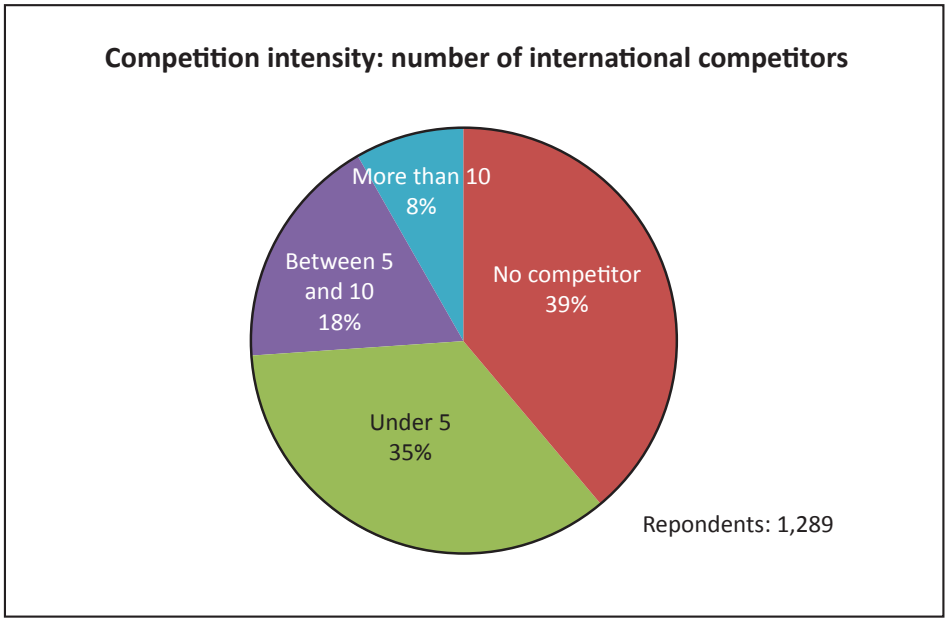

Figure 3.1-2 Competition Intensity, International

4 Vertical Technology Spillovers

Firms can also become more efficient by interacting with customers or suppliers. This form of technological transfer is called diffusion, and comes from interactions between firms, customers and suppliers rather than market competition. We differentiate this type of technology diffusion from horizontal spillovers and call it a *vertical* spillover.

We present descriptive statistics for the 2010 panel data that are related to two kinds of vertical technology spillover:

- Backward linkages: technology transfer from a local FDI firm or an international client to a Vietnamese supplier
- Forward linkages: technology transfer from a local FDI firm or an international client to a Vietnamese customer

There are several ways these links might benefit firms:

- Direct knowledge transfer
- More stringent requirements for product quality, delivery, or documentation
- Increased demand for domestically-produced inputs from foreign firms or local FDI firms

4.1. Backward linkages

Backward linkages can arise in either intermediate or final product markets.

Empirically, Figure 4.1-1 shows that firms in the 2011 survey's cross-section predominantly produce final products, and only a minority of firms produce both intermediate and final goods.

Table 4.1-2 disaggregates the location of output sales value by firm size and shows larger firms are the most likely to export. While exporters perceive themselves to be operating in niche markets with few competitors, exporting requires relatively high levels of sophistication and access to capital. Given the positive effects of exporting on economic growth, enabling smaller firms to sell their output to international markets is still a policy challenge.

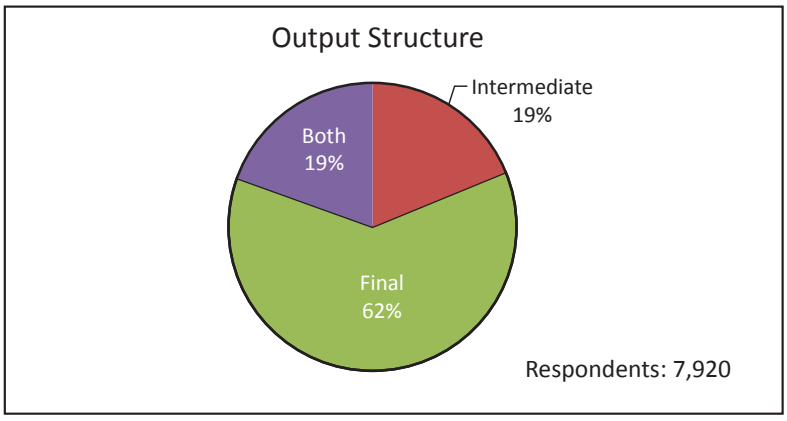

Figure 4.1-1 Output Structure

Average share of output, all firms (%)					
	Total	Micro	Small	Medium	Large
Same province	25.8	35.4	30.3	22.8	12.8
Neighboring province	21.3	19.3	21.2	21.3	22.7
Non-neighboring province	27.3	25.0	26.3	28.1	31.7
Another country	25.5	20.1	22.3	27.9	32.8

Table 4.1-1 Average Share of Output

Where does the enterprise sell its products?	
Country	%
USA	18.02
Japan	14.61
Taiwan	12.08
South Korea	9.91
China	6.56

Table 4.1-2 Location of Sales

The majority of Vietnam's output is sold in high-income countries that feature competitive markets for imports, strong regulatory regimes (for example, sanitary and phytosanitary standards), and customers that have a large number of viable substitutes. Firms' ability to compete internationally suggests they can take the next step up the quality ladder by increasing value-addition, quality, levels of technological sophistication, and human capital.

Table 4.1-3 fits simple regression model in which exporting status is an outcome explained by the firm size or firm legal structure. Since the base category is large firms, the negative coefficients for firm size show that, relative to large firms, small firms are less likely to be able to export, consistent with the simple breakdown of Table 4.1 Similarly, firm structures other than pure Foreign Direct Investment make it less likely for a firm to be an exporter. Cumulatively, these results indicate that encouraging the entry of large firms financed by external capital will increase Vietnam's export base.

Characteristics of exporting firms			
Firm size	Micro	-0.047*** (0.004)	-0.042*** (0.003)
	Small	-0.058*** (0.007)	-0.054*** (0.006)
	Medium	-0.014** (0.006)	-0.016*** (0.005)
Legal structure	Collective	-0.031*** (0.009)	-0.025*** (0.009)
	Private enterprise	-0.033*** (0.006)	-0.028*** (0.006)
	Limited liability company	-0.025*** (0.006)	-0.019*** (0.006)
	Joint stock without state	-0.025*** (0.005)	-0.014** (0.006)
	Joint stock with state	-0.015* (0.009)	-0.007 (0.010)
	Joint venture (SOE+FDI)	-0.001 (0.019)	0.002 (0.018)
	Joint venture (Private+FDI)	-0.012 (0.014)	-0.008 (0.014)
Region dummies Sector dummies Total observations Pseudo R-Squared		No No 7,937 0.06	Yes Yes 7,932 0.11
Note: Dependent variable is an indicator taking the value of one if the firm exports or zero otherwise. Probit estimates, marginal effects reported. T-statistics are heteroskedasticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15). *** p<0.01, ** p<0.05, * p<0.1.			

Table 4.1-3 Characteristics of Exporting Firms

4.2 Contracting with customers

A strong predictor for technology transfer is contract duration, a proxy intangibles like trust and the strength of the working relationship between firms. Longer contracts suggest firms can deliver output of consistent quality, making contract duration a valuable indicator both as an indicator of the level of firms' sophistication and for its instrumental role in creating favourable conditions for technology transfer. In many cases, this commitment is a necessary (not sufficient) condition for the transfer of technology through deliberate transfer or diffusion.

Descriptive statistics in Table 4.2-1 show that only 1.4% of Vietnamese firms surveyed have long-term contracts (36 months or longer), and that less than 15% make additional investments in technology or the organisation of production as a result of their contracts.

Firms engaging in long-term contracting (36 months or more) with customers	1.43%	7,462 = No, 108 = Yes
Firms making additional investments due to **domestic** contracts	14.71%	2,639 = No, 400 = Yes
Firms making additional investments due to **international** contracts	13.16%	7,462 = No, 108 = Yes
Contract duration (domestic or international suppliers)	Less than 12 months: 42.38% 12 months: 50.02% More than 12 months: 7.61%	

Table 4.2-1 Long Term Contracting, Customers

This cross-section gives researchers a high-resolution picture of the term structure of firms' contracts. The simple histogram of Figure 4.2-1 demonstrates that most firms have contracts of only a few months, with a significant mass around one year / 13 months, and few firms are able to engage in contracting longer than thirteen months.

This suggests that constraints faced by Vietnamese firms are impeding the creation of long term contracts and therefore causing higher volatility in production schedules, while decreasing the likelihood of technology transfer.

Table 4.2-2 deepens the analysis by exploring which kinds of firms have formal technology transfer arrangements. Because the base category is large firms based in HCMC, we see that micro to medium sized firms are less likely to benefit from this kind of transfer. We cannot determine the success or quality of technology transfer, only whether such an arrangement is in place; finding out how technology transfer affects variables such as revenues, profits, and labour force size will be studied through further in-depth research papers using this data.

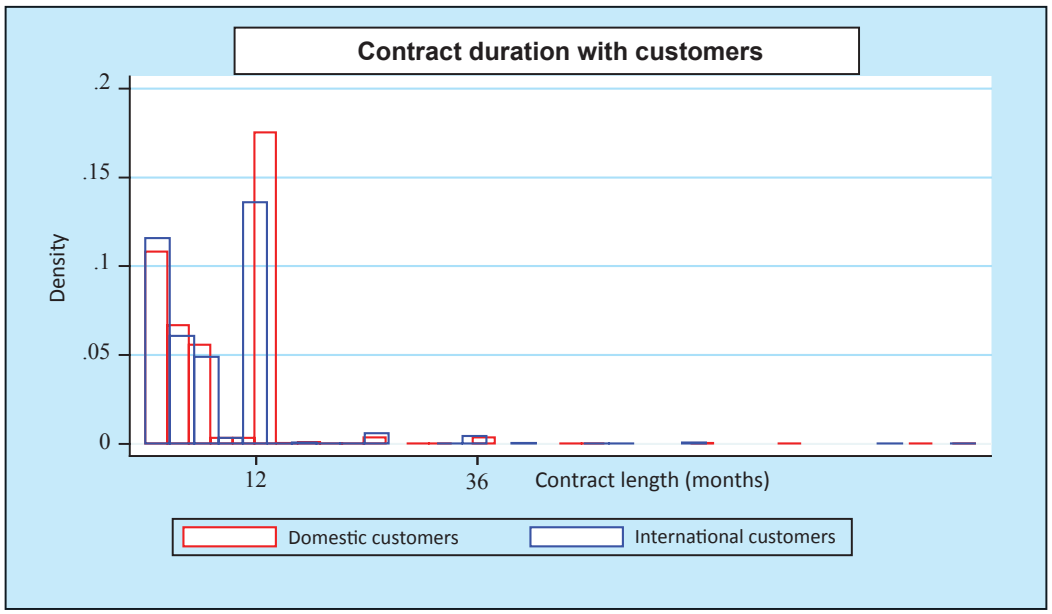

Figure 4.2-1 Contract Duration, Customers

Percent of firms reporting technology transfer from customers to the firm (both domestic and international customers):		17.98%	No = 6,510 Yes = 1,427
Characteristics of Firms Involved in Direct Technology Transfer Arrangements (Backward Linkages)			
Firm size	Micro	-0.114*** (0.013)	-0.123*** (0.012)
	Small	-0.082*** (0.013)	-0.098*** (0.014)
	Medium	-0.027** (0.012)	-0.034*** (0.013)
Legal structure	Collective	0.044 (0.033)	0.016 (0.032)
	Private enterprise	0.021 (0.017)	0.007 (0.018)
	Limited liability company	0.061*** (0.013)	0.050*** (0.014)
	Joint stock without state	0.111*** (0.018)	0.074*** (0.018)
	Joint stock with state	0.123*** (0.032)	0.097*** (0.032)
	Joint venture (SOE+FDI)	0.065 (0.051)	0.037 (0.049)
	Joint venture (Private+FDI)	0.013 (0.041)	0.006 (0.040)
Region dummies Sector dummies Pseudo R-Squared Observations		No No 0.0113 7,937	Yes Yes 0.033 7,932
Note: Dependent variable is an indicator taking the value of one if the firm engages in transer. Probit estimates, marginal effects reported. T-statistics are heteroskedasticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15). *** p<0.01, ** p<0.05, * p<0.1.			

Table 4.2-2 Backward Linkages: Firm Characteristics

Around 18% of firms have a transfer agreement in place from their customers to the enterprise (a backward linkage). Coefficients estimated from a very simple model suggests that larger firms are more likely to have such an arrangement in place (since the coefficients on various categories of firm size are negative relative to large firms), while firms that are jointly owned by shareholders and the State appear more likely to have a formal technology transfer arrangements in place.

A standard assumption made by policymakers and many economists is that transfer is more desirable when the linkage is with an international firm which are likely to have more sophisticated technology. We can get some idea of the kinds of technology transfer arrangements that exist by comparing them across domestic and international firms. The survey instrument asked whether the backward linkage arose from consensual technology transfer (either contracted or not), or non-consensual technology transfer.

Whether the linkage is with an international or domestic firm, Figure 4.2-2 and Figure 4.2-3 show that 75% of the transfer agreements were consensual and formally contracted. This is encouraging evidence that, for the small share (around 17% of the cross-section of firms) of firms benefiting from backward linkages, those linkages are mutually agreed.

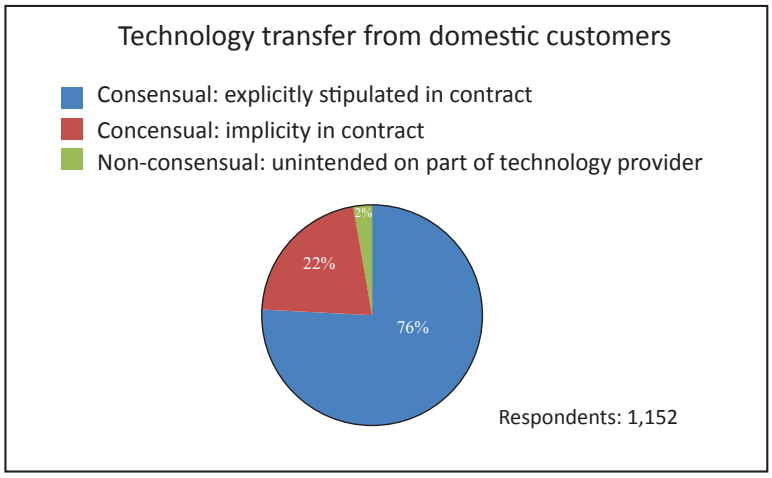

Figure 4.2-2 Technology Transfer, Domestic Customers

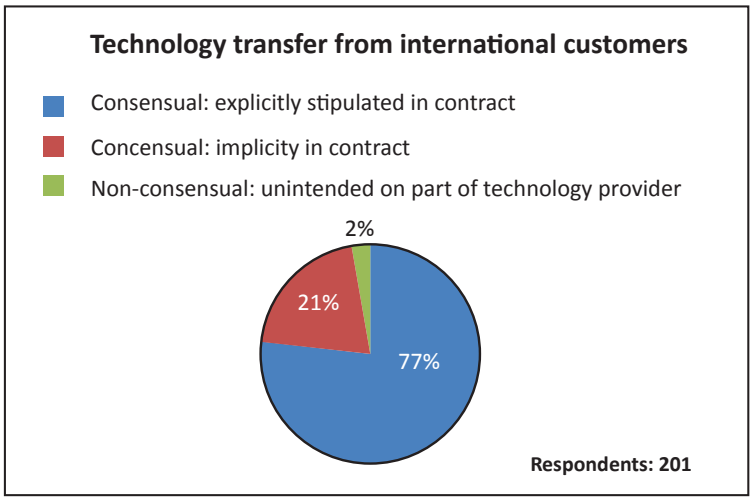

Figure 4.2-3 Technology Transfer, International Customers

4.3 Forward linkages

The previous section explored backward linkages in which customers transfer technology to their suppliers. This sub-section examines the alternative of a forward linkage, in which suppliers transfer technology to customers.

As expected, Table 4.3-1 shows domestic suppliers are located near the Vietnamese firms that purchase their output, a pattern that holds across all categories of firm size. The largest firms, however, are the most likely to procure inputs from a non-neighbouring province, since these companies have the capacity for logistics and supply chain management.

Where Does the Firm Procure its Domestic Inputs, %					
	Total	Micro	Small	Medium	Large
Same province	56.0	70.1	60.2	52.6	46.3
Neighboring province	21.1	12.3	19.0	23.2	25.3
Non-neighboring province	22.9	17.6	20.8	24.2	28.5
Total	7556	448	3204	2862	1042

Table 4.3-1 Source of Inputs, Domestic

As in the case of backward linkages, the duration of contracts is a useful proxy for concepts such as mutual trust and reliability, and Figure 4.3-1 shows that most contracts are less than roughly 1 year long. Technology transfer (either consensual and explicitly contracted, or through diffusion and learning-by-doing) is more likely to occur between firms with longer contracts in place.

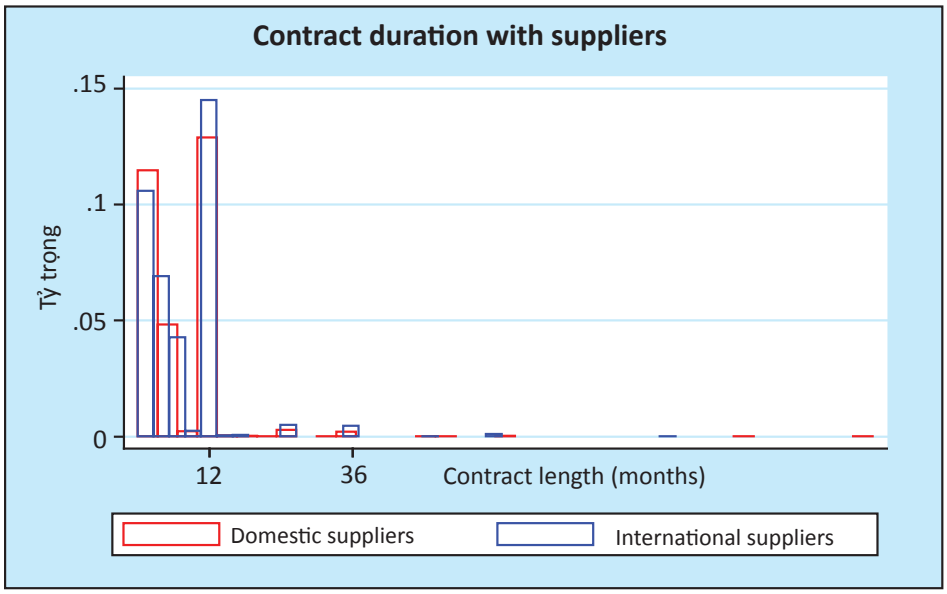

Figure 4.3-1 Contract Duration, Suppliers

As in the case of backward linkages, Vietnamese firms buying inputs from both international and domestic firms (including domestically-located FDI firms) have short term purchase contracts in place. The majority of firms have contracts less than 13 months, and almost no firms have contracts greater than three years.

Examining source countries in Table 4.3-2, we see the majority of firms' inputs (measured by value) come from China. Since Table 4.1-2 showed most firms' output is sold to high income markets, these statistics suggest that Vietnam's current value-addition model is to buy low-priced inputs from China and produce higher-value outputs for Western markets.

A drawback of this production structure is that it reduces the likelihood of a beneficial forward linkage from suppliers to Vietnamese firms: Chinese technology is typically depends on high ratios of labour to capital, and may be similar to current Vietnamese technology.

Country name	% of input by value
China	23.5
Taiwan	16.65
South Korea	10.98
Japan	10.1
Thailand	4.47

Table 4.3-2 Share of Input by Source

The descriptive statistics of Table 4.3-3 support this interpretation, with a smaller share of respondents making additional investments in technology or capacity due to relationships with either domestic or international suppliers. In addition to the percentages, we see that the absolute number of respondents indicating these investments are in place is very small. In the case of international contracts with suppliers, it is only 279 firms in the 2011 survey cross-section.

Firms engaging in long-term contracting with suppliers	1.1%	7,473 = No, 83 = Yes
Firms making additional investments due to **domestic** contracts	14.93%	6,422 = No, 1,127 = Yes
Firms making additional investments due to **international** contracts	11.77%	2,092 = No, 279 = Yes
Average contract duration, percent	Less than 12 months: 10.6% 12 months: 13.8% More than 12 months: 75.5%	

Table 4.3-3 Contracting Duration, Suppliers

It is useful to fit a minimal econometric model to see if firm size or legal structure determine the probability a firm benefits from technology supply from a supplier to the firm. Table 4.3-4 shows that large, FDI firms are the most likely to import inputs from overseas. Smaller, Vietnamese-owned firms generally rely on domestic inputs, so diversifying the Vietnamese value chain remains a challenge for industrial policy.

Characteristics of importers (of raw materials and intermediate inputs)			
Firm size	Micro	-0.237*** (0.007)	-0.214*** (0.007)
	Small	-0.305*** (0.014)	-0.304*** (0.015)
	Medium	-0.151*** (0.014)	-0.157*** (0.014)
Legal structure	Collective	-0.233*** (0.006)	-0.198*** (0.007)
	Private enterprise	-0.321*** (0.008)	-0.258*** (0.009)
	Limited liability company	-0.357*** (0.013)	-0.283*** (0.013)
	Joint stock without state	-0.254*** (0.008)	-0.189*** (0.010)
	Joint stock with state	-0.191*** (0.009)	-0.143*** (0.012)
	Joint venture (SOE+FDI)	-0.112*** (0.031)	-0.058 (0.038)
	Joint venture (Private+FDI)	-0.062* (0.033)	-0.012 (0.038)
Observations Region dummies Sector dummies		7,556 No No	7,552 Yes Yes
Note: Dependent variable is an indicator taking the value of one if the firm procures inputs outside the country. Probit estimates, marginal effects reported. T-statistics are heteroskedasticity robust. Base: Large, FDI, Region 7 (HCMC area), Food processing (ISIC 15). *** p<0.01, ** p<0.05, * p<0.1.			

Table 4.3-4 Characteristics of Importing Firms

Taking a closer look at the available data, we find that only around 4% of firms have a forward linkage with an international supplier, while around 14% of firms have this form of technology transfer agreement in place with a domestic supplier.

Table 4.3-5 examines which characteristics explain whether a firm is benefits from a forward linkage. Surprisingly, joint-venture firms in 2010 were highly likely, compared to the rest of the sample, to have a forward linkage agreement in place. Since the coefficients are measured compared to the base of the index, this means joint-venture firms are more likely than wholly

foreign-owned (FDI) firms to benefit from forward linkages. This is baseline evidence that joint ventures may be effective tools for technology transfer, and that large joint-venture operations are the most successful at enabling this transfer.

Share of firms reporting direct technology transfer from international suppliers (percent):		4.39	No = 7,224 Yes = 332
Share of firms reporting direct technology transfer from domestic suppliers (percent):		14.16	No = 6,486 Yes = 1,070
Characteristics of firms involved in direct technology transfer arrangements (forward linkages)			
Firm size	Micro	-0.122*** (0.010)	-0.124*** (0.009)
	Small	-0.091*** (0.012)	-0.103*** (0.013)
	Medium	-0.031*** (0.012)	-0.035*** (0.012)
Legal structure	Collective	0.015 (0.029)	-0.011 (0.027)
	Private enterprise	-0.029** (0.015)	-0.030* (0.015)
	Limited liability company	0.026** (0.013)	0.016 (0.013)
	Joint stock without state	0.080*** (0.017)	0.041** (0.017)
	Joint stock with state	0.072** (0.029)	0.038 (0.026)
	Joint venture (SOE+FDI)	0.221*** (0.060)	0.188*** (0.060)
	Joint venture (Private+FDI)	0.073* (0.043)	0.070 (0.043)
Observations Region dummies Sector dummies Pseudo R-squared		7,556 No No 0.0537	7,552 Yes Yes 0.0352

Note: dependent variable is an indicator taking the value of one if firm contracts involve direct technology transfer arrangements from customers, zero or otherwise. Probit estimates, marginal effects. T-stats reported in parentheses are heteroskedasticity robust. Base: large, FDI, region 7 (HCMC area), Food processing (ISIC 15)

Table 4.3-5 Firm Characteristics: Forward Linkages

5 Research and Technology Development

Increasing inputs to production- labour and capital- increases economic growth, but this at a decreasing rate: sustained growth requires investing in both technology, meaning both how goods and services are produced and the methods and processes of organising inputs.

Technology can be improved through research & development or buying or adapting technology that already exists. Most firms can realise large increases in efficiency and product quality by adopting technologies that already exist and adapting them to the Vietnamese context.

Figure 5.1 shows that around 11% of respondents developed some form of new technology. This is a small share of the cross-section: researching original technologies is expensive, time-consuming, and is not guaranteed to be successful.

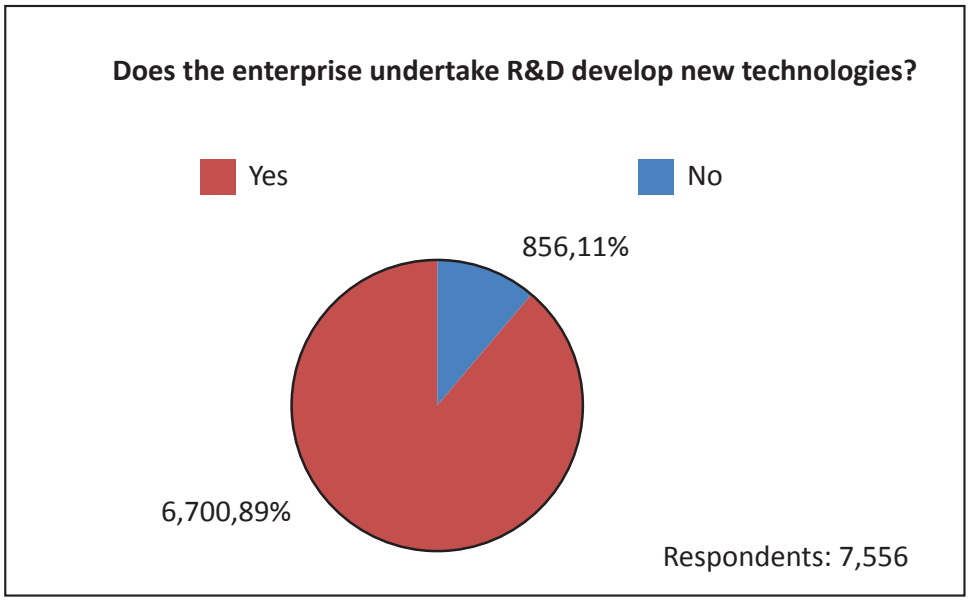

Figure 5.1 Firms Performing R&D

We fit a minimal econometric model to see which firms are the most likely to engage in research and development. Since coefficients in Table 5.1 are measured relative to the base category, this means that large firms are the most likely to be engaged in technology transfer. Companies jointly owned by shareholders and the State are the most likely (relative to FDI firms, the base category, and all the other forms of legal ownership) to engage in R&D.

This promising result suggests certain firms can develop new (potentially lucrative) technology within Vietnam. But the small number of firms that actually do this means the majority of improvements in output per worker will occur through Vietnamese firms adapting technology that already exists.

Characteristics of firms engaging in R&D			
Firm size	Micro	-0.080*** (0.009)	-0.084*** (0.007)
	Small	-0.069*** (0.010)	-0.089*** (0.010)
	Medium	-0.034*** (0.009)	-0.047*** (0.009)
Legal structure	Collective	-0.021 (0.023)	-0.005 (0.027)
	Private enterprise	-0.019 (0.013)	-0.008 (0.014)
	Limited liability company	0.031*** (0.011)	0.035*** (0.012)
	Joint stock without state	0.104*** (0.017)	0.090*** (0.018)
	Joint stock with state	0.245*** (0.035)	0.214*** (0.035)
	Joint venture (SOE+FDI)	0.083* (0.048)	0.049 (0.041)
	Joint venture (Private+FDI)	0.134*** (0.046)	0.133*** (0.046)
Observations Region dummies Sector dummies Pseudo R-squared		7,556 No No 0.0554	7,554 Yes Yes 0.0843

Note: Dependent variable takes a value of one if firm undertakes research and development activities, zero otherwise. Probit estimates, marginal effects. T-stats reported in partnesis are heteroskedasticity robust. Base: large, FDI, region 7 (HCMC), Food Processing (ISIC 15).

Table 5.1 Characteristics of R&D Firms

To clarify the degree of innovation occurring in Vietnam, the 2011 survey asked respondents to evaluate whether their research activities created products that are new to the world, or new to the market in which they operate. Figure 5.2 shows that most firms are creating technologies that are new to the firm or new to the market in which the firm operates. A minority of firms are innovating at the technological frontier and creating products that are new to the world. Technology transfer policy should therefore emphasize the transfer of existing technology to Vietnamese firms, as this represents low hanging fruit: a relatively low-cost means to increase efficiency and productivity.

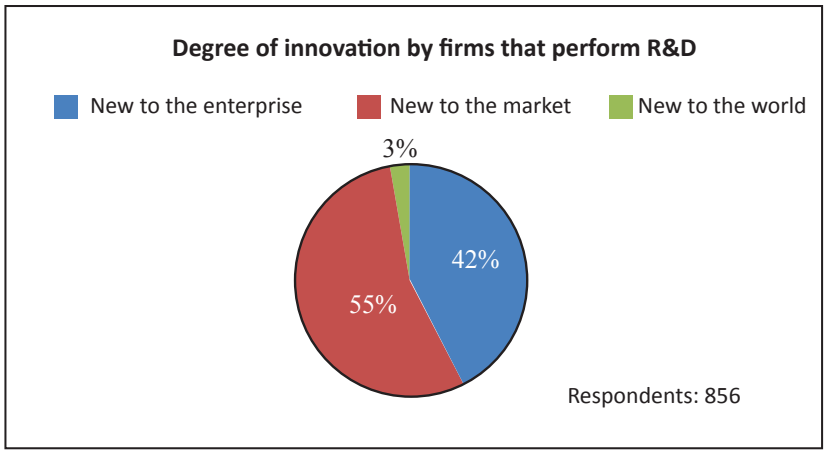

Figure 5.2 Type of Innovation, R&D Firms

A relevant topic for future research is why firms choose to innovate rather than adapt existing technology, and the degree to which this innovation represents an advance in technology, rather than some extensive form of adaptation.

Fewer than 900 firms in a cross-section of nearly 8,000 engaged in any form of research and development. The data enable researchers to get some idea of where research and development partners are located. About 160 firms report having an external R & D partner, and for two-thirds of these firms that partner is located within Vietnam; the remaining 33% of firms have an external research partner based overseas. Cumulatively, only a tiny minority of companies develop products that are new to the world, and most of those have partnered with other Vietnamese firms.

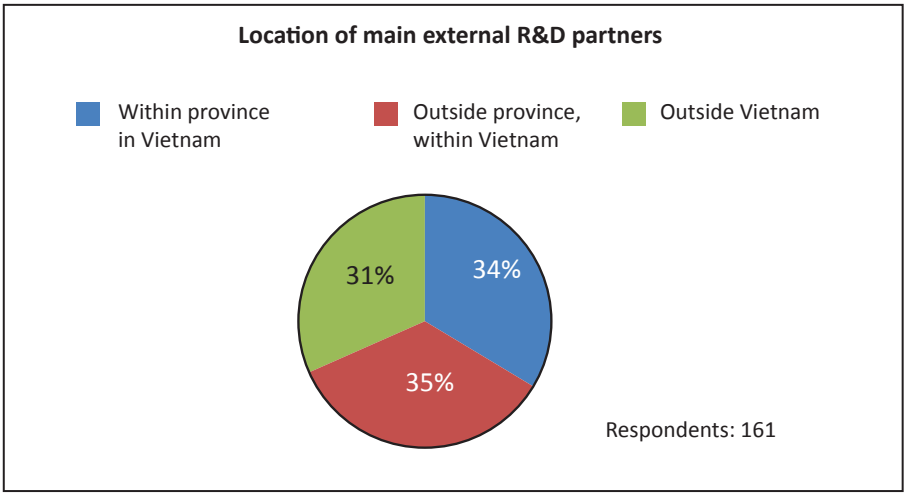

Figure 5.3 Location of R&D Partner

6 Technology transfer through diffusion

Given the different in levels of sophistication between firms in Vietnam and firms operating outside Vietnam in the same sector, a low-risk, and low-cost approach to technology transfer should emphasise the adoption and adaptation of existing technology instead of costly and potentially unsuccessful research and development. The survey instrument summarised in this report allows researchers to study firms that benefit from diffusion.

Examining the full cross-section of firms surveyed in 2011 in Figure 6.1, only around 8% of firms engage only in R&D, while around 5% of firms only adapt technology that already exists. Most importantly, 84% of firms surveyed claimed to have no program of either technology adaptation or research and development. This represents a large and underexploited set of labour and capital that will benefit from a systematic, Government-led policy encouraging technology diffusion.

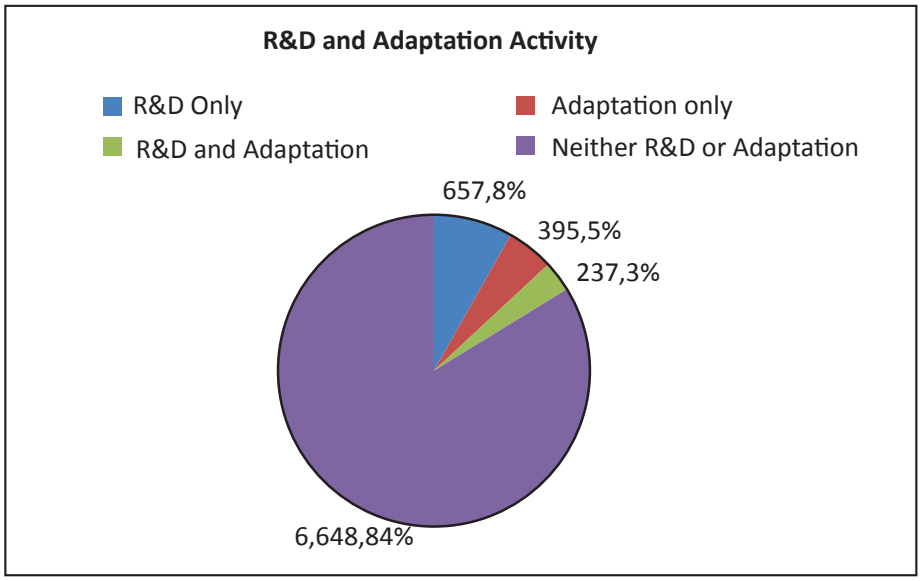

Figure 6.1 R&D and Adaptation

The 2010 survey instrument generates rich data that allows researchers to investigate which firm characteristics are positively associated with engaging in research or technology transfer. Table 6.1 shows that of the firms surveyed, large firms and joint stock companies with some state ownership were the most likely to be involved in adaptation.

		Adaptation and R&D		R&D Only	
Firm size	Micro	0.064*** (0.006)	0.052*** (0.007)	0.049*** (0.005)	0.047*** (0.005)
	Small	0.042*** (0.009)	0.025*** (0.009)	0.033*** (0.008)	0.035*** (0.009)
	Medium	0.025*** (0.009)	-0.015* (0.008)	0.021*** (0.008)	0.020*** (0.008)
Legal Structure	Collective	-0.010 (0.022)	-0.005 (0.021)	0.022 (0.025)	0.011 (0.023)
	Private enterprise	0.046*** (0.015)	0.047*** (0.014)	0.085*** (0.016)	0.057*** (0.015)
	Lim. liability co.	0.008 (0.010)	0.002 (0.009)	0.017* (0.009)	0.010 (0.009)
	Joint stock without state	0.051*** (0.015)	0.031** (0.013)	0.048*** (0.015)	0.032** (0.014)
	Joint stock with state	0.157*** (0.032)	0.094*** (0.027)	0.101*** (0.034)	0.087*** (0.033)
	Joint venture (SOE+FDI)	0.109** (0.048)	0.094** (0.046)	0.099* (0.053)	0.094* (0.054)
	Joint venture (Private+FDI)	0.027 (0.031)	0.006 (0.026)	0.034 (0.036)	0.022 (0.031)
R&D	Research (Yes = 1)	0.181*** (0.016)			
Observations		7,552	7,552	6,700	6,614
Pseudo R-squared		0.0558	0.114	0.0308	0.0520
Region dummies		Yes	Yes	No	Yes
Sector dummies		Yes	Yes	No	Yes

Note: dependent variable is an indicator taking the value of one if the firm is involved in technology adaptation or R&D, zero otherwise. Probit estimates, marginal effects, t-stats reported in parentheses are heteroskedasticity robust. Base: large, FDI, region 7 (HCMC), food processing (ISIC 15).

Table 6.1 Firm Characteristics: Adaptation, R&D

Similarly, we may be interested in the relationship between firm characteristics such as legal structure and size and firms that engage in both technology adaptation and research. Once again, since the excluded category of firms are wholly foreign owned ("FDI"), we see they are less likely than other firm structures to be engaged in both technology transfer and research, and this remains true once we control for performing research. There is also complementarity between doing R&D and being involved in adaptation: a coefficient of 0.18 suggests that doing one activity makes it likely for the firm to do the other.

6.1 Diagnosing technology demand

we now move from investigating which firm characteristics explain adaptation and research activities to demonstrating that the survey cross-section allows researchers to diagnose the underlying reasons for technology adaptation. Figure 6.1-1 shows that the dominant reason firms invest in new technology is to improve product quality.

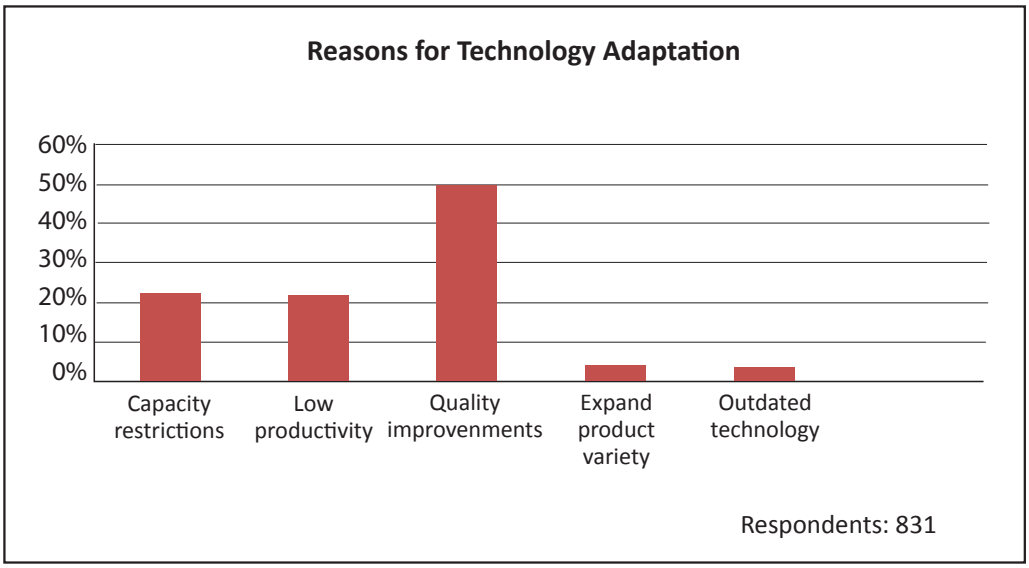

Figure 6.1-1 Reasons for Technology Adaptation

This is consistent with a larger macroeconomic history of modern Vietnam, in which firms began by taking advantage of low-cost labour and using technologies that added relatively little value to inputs. As labour becomes more expensive and investment reduces the cost of capital, firms seek to compete domestically and overseas by improving product quality. Indeed, moving up the quality ladder is regarded as a key component of sustainable economic growth for transition economies like Vietnam.

Figure 6.1-2 shows firms that invest in adaptation finance their investments using equity. State funds and venture capital play almost no role (in a sample of around 550 respondents), and Vietnam's very small number of venture capital firms do not have an impact on our sample. Since equity is strongly correlated with firm size, larger firms are much more likely to have the financial capacity to invest in technology adaptation. Making government funding available to small and medium sized firms will increase the rate of technology adaptation.

Macroeconomic analysts are concerned that credit will be tightened in the medium-term, in which case credit (loans) will play an even smaller role. Effective and transparent financing instruments need to be developed, particularly in high-priority sectors. The caveat to this policy recommendation is the same as in all other countries: state-sponsored financing needs to be carefully designed avoid graft or diversion.

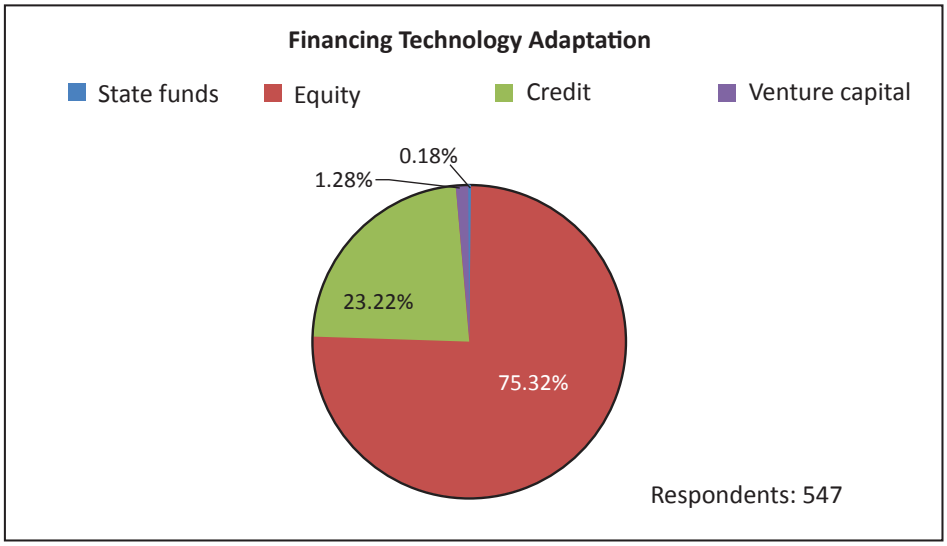

Figure 6.1-2 Financing Technology Adaptation

The need for financing is highlighted by firms that could otherwise purchase an existing technology, but are forced to adapt one because of high costs. Adaptation, like research, requires time, effort, organisational capital, and comes with a possibility of failure and sunk costs that cannot be recovered. Figure 6.1-3 shows that firms choose to adapt rather than buying technology off the shelf mostly do so because of costs.

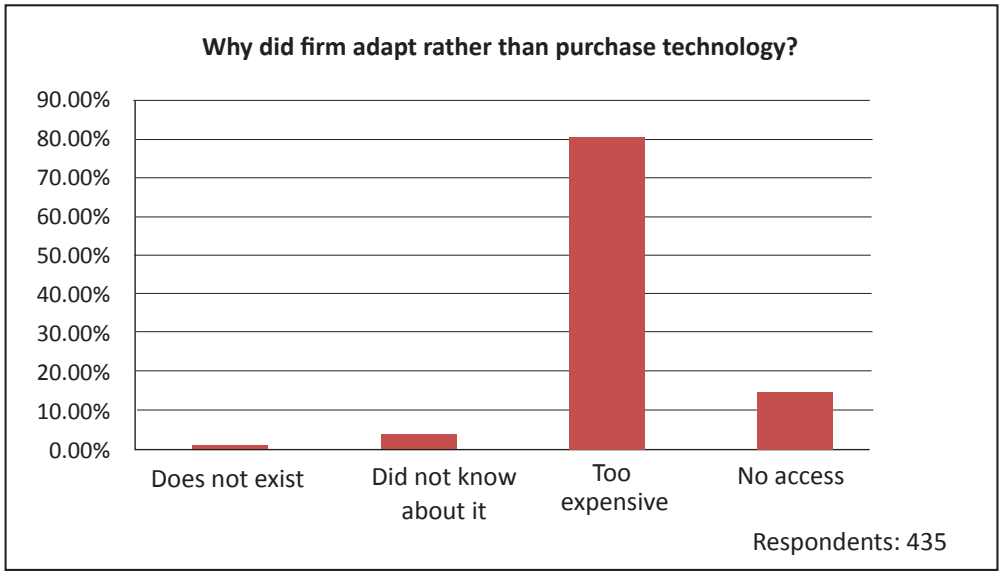

Figure 6.1-3 Adaptation vs. Purchase

Descriptive statistics show firms are constrained by the availability of financing, and existing state schemes are not effective, causing firms to adapt technology rather than purchase an appropriate and available technology. Making access to finance easier for companies is one part of the solution. However, some investment does not occur because available technology remains too expensive or inappropriate, in which case easier access to finance will not change this outcome. Similarly,

financing does not need to be financed by the Government: making capital markets more efficient is an alternative way to connect saving with investment, including in new adaptation.

6.2 Success and failure in technology adaptation

Firms can expend time, capital, and organisational effort without success, but of the small number of firms engaging in adaptation efforts at all, though, only 9% claim to have experienced a failure of some kind. While the potential payoff from investing in adaptation is uncertain, in the 2010 panel data these investments are typically successful.

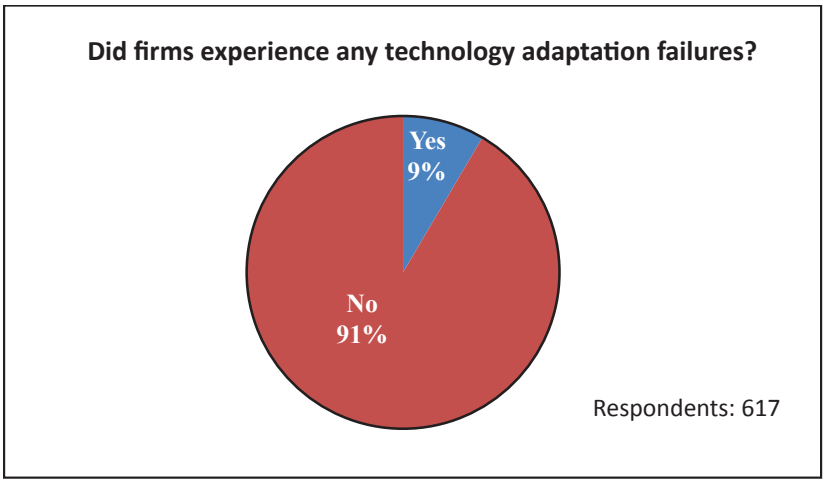

Figure 6.2-1 Adaptation Failures

While failure affects only a small share of the sample, the survey instrument enables researchers to study the factors underlying those failures. Figure 6.2-1 shows financing constraints prevented many firms from buying appropriate technology, forcing them to invest in adaptation. Figure 6.2-2 confirms that most firms that experienced failure attempted technology adaptation for the same reasons as firms that were successful: to increase the quality of good / services produced.

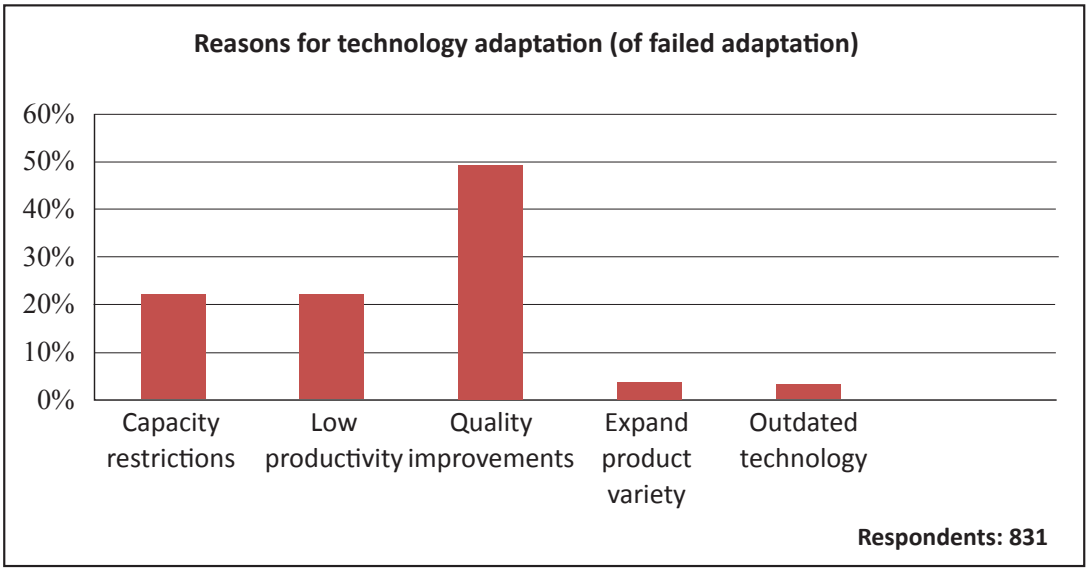

Figure 6.2-2 Purchasing Decision: Adaptation Failure

6.3 Technology needs

One of the benefits of this data is that we see which constraints on transfer firms themselves perceive as being important. The survey instrument summarized in this report enables researchers to diagnose firms' demands for technology, which can be any desired modification, replacement, or change to existing technology. Demand for technology in Vietnam is driven mostly by an effort to increase quality. Data summarised in Figure 6.3-1 is consistent with evidence from previous chapters, and shows that firms with plans to invest in new technology are trying to move up the "quality ladder."

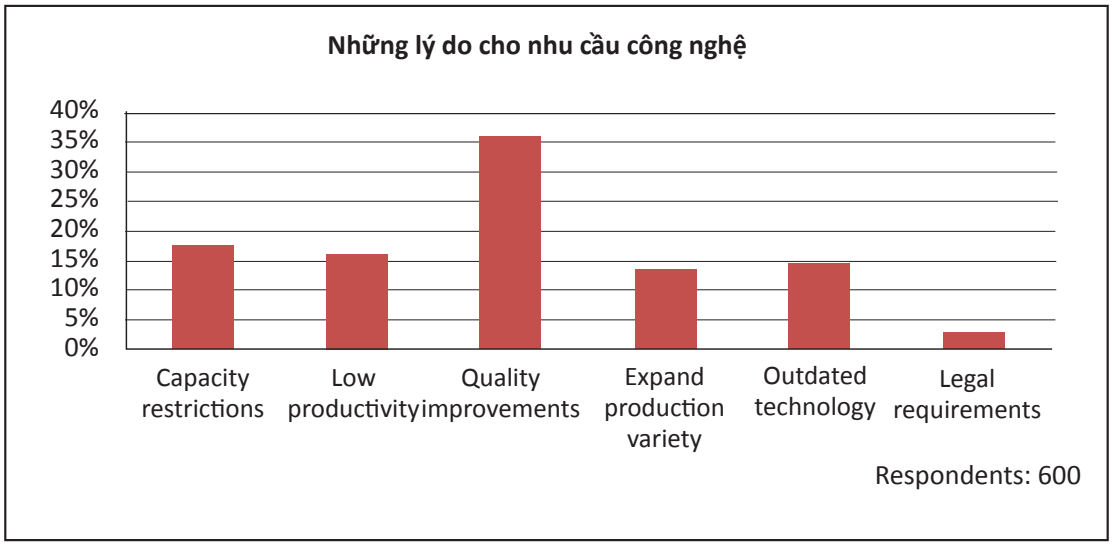

Figure 6.3-1 Reasons for Technology Demand

Increasing quality is associated with higher prices for output and requires more skilled labour but in the 2011 survey this was true for 35% of the sub-sample of 600 firms that responded to this question, or around just 3% of our total sample- very few firms are trying to improve the quality of their output by investing in new technology. Of those that are, finance is the main motivation for not buying ready-to-use technology. Figure 6.3-2 shows over 60% of the sample of 565 respondents found that investing in existing technology would be too expensive. This suggests that firms are modifying or adapting technology mainly because it is cheaper than buying ready-made technology.

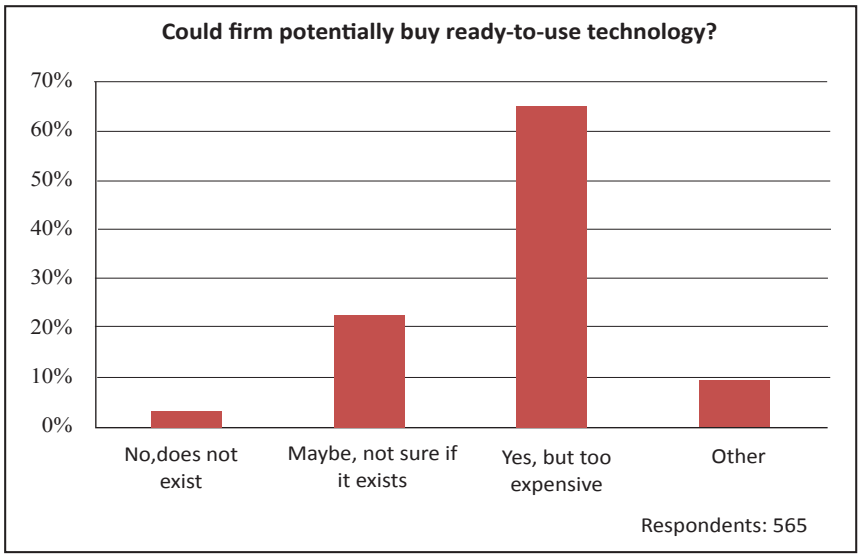

Figure 6.3-2 Reasons for Not Buying Technology

In those cases that a ready-to-use technology does exist and is appropriate, current government tax breaks or grants are not solving firms' financing constraints. For those firms that want to modify their technology, most would use loans or their own funds. Figure 6.3-3 shows that when respondents were asked how they planned to fulfil their technology demands, credit and equity were almost the only answers given.

However financing is not the only solution, and is not always either necessary or appropriate. In some cases, technology that may be available will be too expensive for the firm even low interest loans or grants are available. In other cases, the technology may be available but not appropriate for the firm.

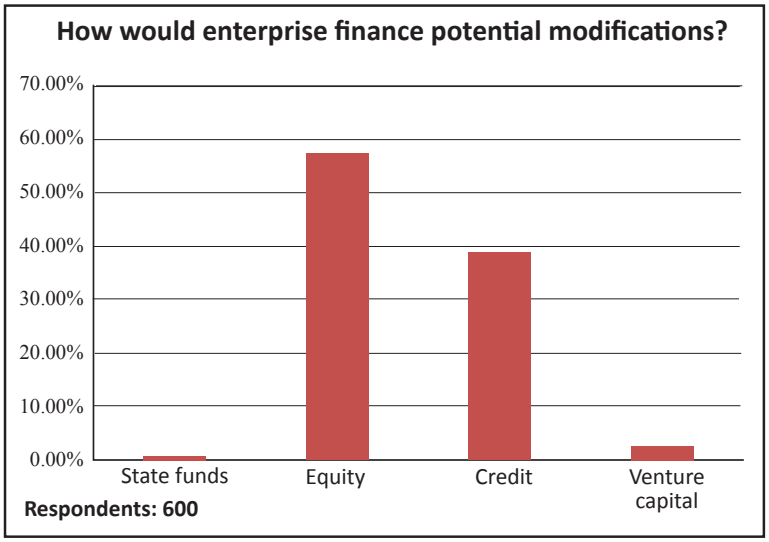

Figure 6.3-3 Financing Potential Modifications

7 Corporate Social Responsibility

Corporate Social Responsibility (CSR) is the creation of public goods or the curtailment of public bads (Besley and Ghatak, 2007), and refers activities ranging from protecting workers' rights, environmental standards, human rights, to community protection and fair trade. CSR can be formal, for example through certification or membership in international organizations, or informal but built into firms' corporate strategies.

The 2011 survey instrument introduced a new set of questions to explore the extent to which Vietnamese firms engage in socially responsible behaviour and incorporate those activities into their corporate strategy. Particular attention is paid to how much firms in Vietnam voluntarily observe labour and environmental standards, and whether they create "good jobs" for their employees and protect the environment.

Economic growth has created new challenges for industrial policy. With higher growth comes a higher population density in urban areas and greater risks for environmental degradation. At the same time, more of the labour force work in Vietnamese firms that compete internationally with other low-cost producers regionally and internationally both at home (through increased imports following trade liberalisation) and abroad in export markets. As the incentives for firms to aggressively cut costs increase, it become important to evaluate Vietnam's enterprise sector for its ability to protect the environment and create good jobs characterised by employee protection and worker safety.

These commitments and others fall under CSR. In this report, we describe introduce CSR indicators captured by the survey instrument, including formal measures (like "fair trade" certification or membership in international organizations) and informal measures that capture the way the firms "do business" in relation to environmental protection and creating good and fair working conditions.

7.1 Introducing the CSR Module

The 2011 CSR module asks detailed questions across four broad areas of CSR.

Whether the company's CSR arrangements are "formal," meaning whether there is a written policy in place and whether the firm has received any form of international or external certification.

Employee protection, including whether formal labour contracts are in place and what allowances are made within employees' contracts for illness, leave, overtime, training, and other indicators of "good" jobs, such as payments towards social insurance.

Community-based activities, which measure whether the responding firm is involved in providing additional services to the community like free health care or protecting the local environment.

Support received for firms' formal or informal Social Responsibility activities. This support can come from a range of sources (including the Government and NGOs) and can cover a range of issues from working conditions to quality standards for products.

This chapter addresses each of these aspects of CSR activities of firms in our sample with the

objective of providing a baseline summary of the issues at hand.

7.2 Formal CSR Arrangements

The survey establishes if firms have formal CSR arrangements by asking whether the enterprise has a board or a committee to oversee CSR activities. Table 7.2-1 shows that about a third of the 2011 sample have some kind of committee to determine CSR policies, and this is largely driven by large, state-owned, or foreign-owned firms. However, this does not reveal anything about the quality of the CSR policies implemented, and very few firms are *formally* certified in relation to the core CSR policies.

	N	% with committee
Full Sample	7,915	35.5
Micro	455	20.4
Small	3,268	26.3
Medium	3,012	41.5
Large	1,180	51.7
Private	5,994	32.6
State	246	58.1
Foreign	1,647	42.8

Table 7.2-1 Does the enterprise have board / committee to oversee CSR?

Table 7.2-2 disaggregates the data according to the type of policy firms have in place. On almost all measures, state-owned firms perform best in relation to social protection in the workplace including the rights of workers, health and safety, accommodating workers with HIV/AIDS, and staff training. As Vietnam undergoes increasing privatization, it will be important to make sure that firms do not lose this culture of social protection. It is also clear, however, that large firms and foreign-owned firms perform above average in relation to CSR activities on the basis of these metrics.

	% enterprises	Large Firms	State Firms	Foreign Firms
Discrimination	6.6	12.8	8.1	9.7
Rights of workers	54.5	68.4	71.3	62.6
Staff training	24.9	40.4	47.8	32.1
Employee complaints	12.1	22.6	16.6	18.5
Health and safety	48.9	63.5	70.0	55.8
Environment	35.1	48.9	54.3	42.7
HIV/Aids	3.4	7.1	8.5	4.5
Child labour	8.9	16.9	10.1	11.7
Human rights	11.9	19.8	15.4	14.4
Community protection	8.3	13.4	14.2	9.2
Fair trade	23.2	25.2	26.7	19.0

Table 7.2-2 Firms with specific policies in place

7.3 Employee protection

Employee protection refers to a range of issues, generally including firms' commitments to providing safe jobs with fair benefits and salaries, and giving women or minority groups equal access to employment. Table 7.3-1 shows that in contrast to many emerging economies, many Vietnamese firms provide social and health insurance and severance pay, and that these indicators of "good" labour contracts are clustered in larger firms. State and foreign firms are much more likely than private firms to provide fair labour conditions.

	Social Insurance (%)	Health Insurance (%)	Severance pay (%)	Monthly wage production workers (VND '000s)
Full Sample	70.1	70.8	64.7	5,335
Micro	26.1	27.2	38.6	2,197
Small	53.6	54.5	53.1	3,530
Medium	84.6	85.4	73.9	7,085
Large	96.0	95.4	83.0	7,058
Private	61.4	62.1	57.6	3,790
State	97.9	98.8	85.0	3,188
Foreign	97.4	97.7	86.9	11,144

Table 7.3-1 Benefits and salaries

Foreign-owned firms pay over twice the average monthly wage to their production workers: this confirms that foreign direct investment can deliver higher wages for workers who are employed. As average labour costs increase, however, Vietnam's exports may become less competitive, ultimately putting downward pressure on wages.

A further indicator of good hiring practices is whether women are equally represented in employment. A simple measure of this is the ratio of men to women in enterprises, summarised in Table 7.3-2. The survey shows a high ratio of male to female employees in most enterprises, except in the administration / services sector, where wages are generally low. The gender balance is "best" amongst micro-enterprises and in large or foreign enterprises. Another benefit of foreign investment may therefore be that these firms appear to have more equal hiring practices.

	Total	Management	Professionals	Manufact'g	Admin/ Service Staff
Full Sample	3.5	1.9	1.3	4.2	0.9
Micro	2.9	0.7	0.4	1.9	0.2
Small	4.1	1.2	0.9	3.8	0.6
Medium	3.6	2.1	1.5	5.2	1.1
Large	1.8	2.9	1.7	3.5	1.1
Private	3.9	1.7	1.3	4.3	0.9
State	3.0	3.1	1.9	5.9	1.8
Foreign	2.1	2.4	1.4	3.8	0.8

Table 7.3-2 Gender balance (Male:Female) among employees

7.4 Community based activities

In addition to directly impacting workers through labour contracts, firms can participate in their larger communities through, for example, investing in environmental protection to limit the impact of harmful by-products from their production processes. The motivation for firms to engage in such activities has been extensively researched in the literature. As in higher-income economies, firms invest in community-based activities to develop a better relationship with the local community, improve their public reputation, and improve efficiency by increasing employee morale; see, for example, Bagnoli and Watts (2003), Margolis et al. (2007) and Pasurka (2008).

Table 7.4-1 shows the range of community-based activities enterprises engage in, the most common of which are environmental protection and poverty alleviation. There is a strong scale effect: micro-enterprise engage much less with community-based activities than small, medium and large firms. Successive rounds of this survey will build a picture of firms' investments in CSR over time, creating a valuable resource for researchers interested in the positive role the expanding enterprise sector can play in local communities and for those interested in researching the underlying motivation and incentives for firms to do so.

	Environ't Protection	Education	Infrastruc-ture Develop't	Health Care Services	Youth Develop't	Poverty Alleviation	Local Heritage	Sporting Events
Full Sample	25.1	7.4	7.5	4.5	2.9	19.2	2.8	4.9
Micro	16.2	5.3	2.9	2.2	0.9	14.3	1.8	2.6
Small	23.6	5.9	7.5	3.2	2.2	18.1	2.9	7.3
Medium	27.5	7.5	7.6	5.2	3.6	20.1	2.9	9.2
Large	26.2	12.2	8.9	7	4.1	21.9	2.5	12.2
Private	27.1	7.4	8.2	4.3	3.3	21.6	3.2	4.9
State	32.4	19.4	11.3	7.7	7.7	34.0	2.4	10.5
Foreign	16.6	5.6	4.3	4.7	0.9	8.5	1.2	3.9

Table 7.4-1 Proportion of firms involved in community based activities

7.5 Support for CSR activities

Having provided an overview of the different forms of CSR available to firms and some descriptive statistics taken from the 2011 survey sample, we turn to whether firms are able to take advantage of existing programs to support the development of CSR initiatives or policies.

Table 7.5-1 shows there is very little support available to firms to implement CSR policies, including even relatively low-cost interventions such as providing firms with relevant information. The most common form of support used is a tax break, used by about 7% of firms. Tax breaks are most likely to be used by foreign firms and larger Vietnamese private or state firms.

	Subsidies	Tax Breaks	Information	Inspection leading to Certification
Full Sample	0.7	7.4	4.7	3.4
Micro	0.4	6.8	2.9	1.5
Small	0.5	6.7	3.9	2.1
Medium	0.8	8.1	5.3	3.6
Large	0.9	7.9	6.1	6.8
Private	0.8	7.1	0.5	0.3
State	2.4	10.9	0.9	10.1
Foreign	0.2	8.0	0.4	2.9

Table 7.5-1 Proportion in receipt of support for CSR activities

Table 7.5-2 disaggregates support received by its source and shows which agencies or groups are the most influential providers. The government remains the largest provider, but this support only reaches a small number of firms. Interestingly, suppliers are an important source of CSR support for some firms, indicating that vertical linkages play a role in adopting CSR policies; this is an interesting area for future research.

	Gov't Institution	Trade Ass'n	Chamber of Commerce	Supplier	NGO
Full Sample	45.2	9.9	8.2	9.3	2.5
Micro	47.7	4.5	2.3	15.9	2.3
Small	45.2	8.9	6.8	8.6	2.4
Medium	45.9	10.1	8.7	10.1	2.5
Large	43.5	13.0	11.1	7.7	2.9
Private	44.3	10.5	8.3	8.8	2.4
State	36.2	12.1	12.1	8.6	3.6
Foreign	50.9	7.5	7.1	11.5	2.7

Table 7.5-2 Sources of support for CSR activities

7.6 Future CSR research

A small number of Vietnamese firms have implemented Corporate Social Responsibility practices. As the country's competitive landscape changes, more workers will be involved in wage-based employment and the scope of environmental damage from industries will increase. It is now important to monitor firms to understand what motivates them to incorporate CSR practices into their decisions regarding their production. This survey provides strong evidence for improvement in the delivery of support to firms that will enable them to implement CSR policies.

While these descriptive statistics are an early step in understanding the extent of, and landscape for, CSR activities in Vietnam, further collaborative research between Vietnamese and overseas researchers is important. It will be useful to develop an aggregate index or measure of CSR implementation using data gathered by this and similar surveys to study which firm characteristics support the uptake of CSR, including the possibility that foreign firms generate positive CSR spillovers to the larger Vietnamese business sector.

8 Summary and conclusions

This report explored data and summary statistics available to researchers from the 2011 round of the Technology and Competitiveness Survey module, attached to Vietnam's General Statistics Office (GSO) larger enterprise census. In-depth studies based on the same data set will explore issues identified here in greater detail, and the report is intended to be a concise introduction to the data set and its implications for industrial policy in Vietnam.

A range of tentative conclusions emerge from studying this cross-section, and should promote further research and the development of evidence-based policies summarises in Table 81. Our main conclusion is that Vietnam is entering a new period of economic expansion, in which the increases in value-addition that have increased income and consumer choice for many people can only continue through investments in new, appropriate technology that allows existing workers to become more productive. This, in turn, will enable the country to continue along its current path of high and stable growth.

While many more firms are involved in adaptation than original research, the share of total firms integrating existing technology into their domestic operations is appears to be small, representing the primary challenge for policymakers. Even fewer firms engage in any form of original research and development, of which less than 160 report having an external partner; there are more gains to adopting and adapting technology that already exists, compared to trying to develop original technology.

While developing new technology is expensive and may lead to failure, a lot of productivity gains are possible through adapting technology that already exists. There is evidence from many other countries that one of the benefits of foreign investment is spillovers, either vertical (forward or backward linkages) or horizontal (through competition and better-trained workers).

This survey instrument enables researchers to study the benefits or costs of these spillovers. Implementing further rounds of the survey will increase the amount of historical information about each firm in the sample, enabling researchers to study the effect of changes in technology transfer on firms' profits, losses, and productivity, while accounting for the many unique features of each firm that do not change over time.

Chapter	Main conclusions
1.Technology research and diffusion policy in Viet Nam	• Make existing support schemes more transparent • Increase access of private sector to these schemes • Reduce the difficulty of applying for government financing (or other support)
2. Constraints to upgrading technology	• Vietnamese firms are mainly trying to increase the quality of output • Finance is the main constraint, but firms rate all other constraints as nearly as important • Competition intensity appears to be relatively low, especially for exporting firms
3. Vertical Technology Spillovers	• Relatively few firms benefit from backward linkages; large firms with some state ownership are the most likely to do so • Relatively few firms benefit from forward linkages; large, FDI firms are the most likely to do so • While contract durations are usually very short (a year or less), most technology transfer is consensual
4. Research and Technology Development	• Of nearly 8,000 firms in the sample, around 800 are doing original R&D, of which only a small number have an external R&D partner • Since very few firms have an external R&D partner, research output can be improved by linking Vietnamese firms with external partners
5. Technology Transfer Through Diffusion	• Vietnamese policy should emphasise adaptation rather than R&D • Most firms try to adapt technology to improve their output quality • Finance is the main reason firms adapted technology rather than buying ready-to-use technology
6. Technology Demand	• Most firms' future technology investments are to improve quality • While they could buy ready-to-use technology, it is perceived as too expensive • Most firms plan on financing investments out of loans and equity, rather than state funds or venture capital
7. Corporate Social Responsibility	• Many firms perform some form of CSR; it will be important to maintain this as competition and privatisation increase • Foreign firms and state firms have good employee protection, but foreign firms pay a much higher average wage • Relatively few firms benefit from any kind of Government support for CSR

Table 8.1 Main Conclusions

This form of economic analysis ultimately gives policymakers a clear understanding of which sectors and which types of firms are likely to generate technology spillovers that benefit the firm's larger sector and, ultimately, enable increases in national productivity that create economic growth.

Evidence from the 2011 survey suggests that firms face a full set of constraints to investing in new technology, including the adaptation of existing technology. While financing emerges as a major issue, firms are also constrained by problems ranging from the availability of skilled workers to infrastructure.

This report generates a few clear policy recommendations. Firstly, many government support schemes exist to encourage investment in new technology, but most firms prefer to finance their investments from loans or retained earnings. The government schemes are generally very bureaucratic and difficult to access to private firms, and most support is allocated to the state-owned sector. Making it easier for private firms to access existing support and increasing access to finance should be one aspect of Vietnam's industrial policy.

The government can move to review and streamline existing policies to support technology transfer, and disseminate information about available schemes to firms through the People's Committees at the Province level. However, since firms face a range of constraints, access to finance should not be the only solution pursued and cannot be a panacea.

Secondly, the procedures for accessing these schemes or incentive programs should be published, and the administrative burden of accessing them reduced. Ideally, a "one-stop" investment support program could be developed through state and donor funds to help firms access existing support programs with much less administrative overhead.

To evaluate the effectiveness of various programs, it will be essential to develop and maintain a database of firms that have benefited from various schemes, and the extent and kind of support provided. This database could then be studied by agencies like CIEM to determine which programs are most effective and deliver the greatest value for money.

Finally, as competition in the enterprise sector increases, businesses may compromise their role as social actors and decrease or eliminate their CSR activities. These issues are captured in the new Corporate Social Responsibility set of questions, which allow researchers to study a range of issues about how firms structure contracts and engage with their local communities. These questions will form the basis of a CSR index that researchers and policymakers will use to evaluate this process in Vietnam. The government can play a positive role here by reviewing and integrating policies that enable or encourage firms to engage in CSR, and deliver this information through existing agencies like the Vietnam Chamber of Commerce and Industry.

This survey's ultimate purpose is to diagnose the state of technology transfer in the burgeoning enterprise sector. As the country transitions from agriculture towards manufacturing and services, and faces tougher global competition, enabling firms to maximise the benefits of existing technology will deliver the growth necessary to consolidate the impressive gains in living standards made so far.

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