Industrial upgrading with shifting resource toward external information sources

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Abstract: Using data from an original and unique firm-level survey conducted in Southeast Asia, this paper examines the impacts of shifting from exploiting internal resources to exploring external information sources on product innovations and engaging foreign market for firms in emerging economies. This paper explores how the impacts of a shift toward external links vary across knowledge resources from trade and non-trade partners as well as across domestic and international partners. We also present findings regarding how the impacts of shifting to exploring external information sources vary between local firms and foreign affiliates. A 10% shift in resource allocation from internal resources to external links can generate a 1.4 percentage point increase in the likelihood of costly product innovation as well as a 1.9–3.8 percentage point increase in the probability of foreign market participation.

Keywords: technology transfers; Southeast Asia.

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1 Introduction

Despite extensive research, numerous questions remain regarding effective resource use by firms in emerging economies. How do firms in developing or emerging economies combine internal and external resources to achieve innovation and upgrade their industrial capacity? How do the roles played by partners within a supply chain or those by non-trade partners differ? Are international knowledge capital flows more likely to accelerate the industrial upgrading process? How do foreign affiliates and local firms obtain returns from external knowledge links? To answer these questions, this paper presents new empirical evidence on the innovation effects of knowledge links using original data from firms in the following Southeast Asian countries: Indonesia, the Philippines, Thailand and Vietnam. Specifically, this paper explores the different roles played by internal resources and external information links in firm-level product innovation and foreign market engagement. In particular, we examine the impact of a firm changing from exploitation of internal resources to resource allocation that seeks to develop external information links. We investigate how shifts from internal to external information sources affect firm-level upgrading if the resultant combination of internal and external resources generates higher returns for product innovation and foreign market participation.

This paper's theoretical background stems from a facet of recent endogenous growth theory highlighting knowledge creation under time and ability constraints (Berliant and Fujita, 2008, 2009, 2011, 2012). Economic agents divide their time between two activities: producing goods with existing personal knowledge and interacting with others in seeking new and profit-increasing ideas for industry upgrading. As the latter is more costly, a serious trade-off exists between exploitation of internal resources and exploration of new ideas (March, 1991). In this paper, we extend this framework to allowing agents to divide their exploration time between trade and non-trade partners across space. This paper utilises this framework to examine how a shift in resources toward interacting with others affects an industry's upgrading process. To empirically

investigate this, this paper uses methodologies from two strands of empirical literature. The first concerns vertical inflows of knowledge between multinational parent firms and affiliates, and the other follows the literature of knowledge acquisition from external parties including *make or buy* decisions for technology upgrading.

The first line of research mentioned above investigates multinationals' vertical inflows of knowledge. Rappoport et al. (2013) document the behaviours of US multinationals by focusing on the types of their overseas investments: horizontal vs. vertical foreign direct investment (FDI), which involves replacing production processes in a host country and slicing production processes, respectively. They find that US multinationals abroad operate as input-output chains aiming to ship goods to the host market. Most importantly, they also find that while industries' parents and affiliates operations are linked in an input-output table, intra-firm cross border trade of goods is less common. Upstream and downstream plants located in different countries but belonging to the same corporation do not engage in trade of goods, as Atalay et al. (2013) find that US firms do not generally engage in intra-firm domestic trade between their upstream and downstream plants. These findings suggest that parent firms diffuse knowledge capital, technology capital or managerial capital to affiliated plants and firms in disembodied forms.[1] On the basis of this line of research, this paper asks how affiliates of foreign firms engage in knowledge links with outside firms in host countries.

The second strand of literature studies the relationship between *make or buy* decisions. Since firms compare the costs and benefits of internally developing necessary resources versus out-sourcing knowledge from external sources, Veugelers and Cassiman (1999) and Cassiman and Veugelers (2006, 2007) have studied the condition of complementarity between investment in internal activities and technology acquisition from external sources. In particular, Cassiman and Veugelers (2006) estimate a multinomial logit model and bivariate probit model to isolate the key explanatory variable determining the differences in combination of innovation activities and complementarity between two activities. Nieto and Santamara (2007) show collaborative networks comprising different types of partners exert a significant impact on the degree of novelty in product innovation. They conclude that the impact on the degree of novelty from cooperation with research organisations is not as significant as that from cooperation with suppliers and customers. Frenz and Ietto-Gillies (2009) point out that external collaboration is less successful than international internal networks, which contrasts with Nieto and Santamara (2007). The literature focuses on sources of knowledge and their different impacts on innovation performance. Previous studies have also found that firms' efforts at innovation or their accomplishments are positively correlated with various types of links; furthermore, the degree of innovativeness has a positive correlation with various sources of knowledge. Finally, Laursen and Salter (2006) show searching widely affects innovative performance. They examine the effect of number of sources (i.e., breadth of external knowledge sourcing strategy and variety of linkage) on the innovation performance of the firm.[2] Contrary to Cassiman and Veugelers (2006), Laursen and Salter (2006) and other studies, this paper focuses on determining how a shift in resources from exploiting internal information sources to interacting with others (learning new technology) affects industry upgrading, which contributes to future profits. We also allow local firms and foreign affiliates to choose different combinations of internal and external information sources.

We conducted the original survey across manufacturing firms located in four emerging Southeast Asian countries. On the basis of the firm-level dataset, we explore by firm which types of knowledge sources affect innovation and exporting activities as well as the reasons for this influence. Our empirical findings are unique and therefore important to both the theoretical and empirical literature. First, shifting information sources from internal resources to external information sources has a sizable impact on product innovation with technology new to the firm as well as both intensive and extensive margins of exports. Second, shifting information sources toward non-trade partners (hereafter referred to as 'learning links') plays a significant role in costly product innovation and foreign market participation. Third, the impacts of shifting information sources toward trade partners (hereafter referred to as 'trade links') on both intensive and extensive margins of exports are large compared with the case of learning links. Fourth, domestic and international knowledge flows play different roles in firm-level industry upgrading. It is also worth noting that, contrary to the theory and empirics of international technology diffusion, costly product innovation does not result from global information spillovers. Finally, local firms are less likely to utilise either local or global trade links when they engage in foreign markets if local firms and foreign affiliates have heterogeneity in managerial capital. The findings in this paper yield a policy implication. Since industrial policies related to fostering links constitute a heavy burden for individual firms lacking sufficient financial and human resources, a cost-effective alternative is to develop mechanisms for collective learning that allow firms to share information and resources necessary for innovation. From this perspective, investment and trade promotions are both measures to promote knowledge spillover. Governments also provide private firms with assistance for capacity building and collective learning either directly or indirectly through business organisations. Capability building by local firms has not been sufficient to affect multinational companies' local sourcing strategies. However, East and Southeast Asian countries facing stiff competition from global production chains are placing increased emphasis on technological upgrading as part of task trading (WTO and IDE-JETRO, 2011). Furthermore, when quality-complementarity exists between local firms, input quality and plant productivity are complementary in generating output quality (e.g., Kugler and Verhoogen, 2008, 2009, 2011). This paper's empirical results also suggest important implications that are helpful when considering the innovation performance of local firms. The findings in this paper indicate that less innovation-capable firms, for example local firms, benefit from the variety of links or agglomeration economies.

The rest of this paper is organised as follows. Section 2 describes the data and empirical methodology. Section 3 presents the main results. We also present another specification to discuss implications for local firms, and robustness checks are also shown. Section 4 concludes the paper.

2 Data

2.1 Survey and sampling

Southeast Asian countries serve as particularly useful case studies for two main reasons. First, agglomeration has been a major driving force behind industrial development and fostering rich production networks both within and across Southeast Asian countries.

Since most manufacturing activities in Southeast Asia are geographically concentrated in industrial districts, local firms in agglomeration can utilise other firms' inputs without increased transportation costs. Second, affiliates of foreign firms in this region have played a leading role in establishing production networks and they also have rich internal resources. These features allow us to highlight the differences between the resource utilisation of local and multinational companies.

To detect effective knowledge sources, we conduct an original survey of local and foreign firms in Southeast Asia. With reference to the Oslo Manual, an original questionnaire was developed for this survey. The data used in this paper is constructed from the responses to this questionnaire survey conducted in four ASEAN countries. The sample population is restricted to manufacturing sector firms currently operating in the main industrial districts in the four ASEAN countries. The countries surveyed were Indonesia, the Philippines, Thailand and Vietnam. The sampling frame is restricted to selected manufacturing districts in each country:

1 JABODETABEK (Jakarta, Bogor, Depok, Tangerang and Bekasi) for Indonesia
2 CALABARZON (Cavite, Laguna, Batangas, Rizal and Quezon) for the Philippines

3 Greater Bangkok for Thailand

4 Hanoi and Ho-Chi-Minh City for Vietnam.

The questionnaire was distributed in December 2008 and January 2009. Sampling frames are the official statistics of each surveyed country for administrative use. Responses were collected through mail, phone interviews and face-to-face interviews. The responses from each surveyed country are not necessarily a random sample. To address this problem, we compare our sample with official statistics. The representativeness of our sample is shown in Table 1.

Our questionnaire comprises four parts. The first part concerns a firm's basic characteristics such as the year of establishment, ownership type, and number of employees. The second part includes questions regarding the firm's achievements in terms of product innovations, process improvements, and foreign market participation. The third part covers sources of information and technologies used to conduct innovative activities. This survey's unique features and advantages are contained in this part, as respondents are asked about two features of their external information sources: difference between trade and non-trade partners and spatial dimensions of information sources. This enables us to establish a dataset linking measures of industry upgrading with decisions regarding the utilisation of internal sources and external interactions. A total of 411 firms were included in our analysis. Our ownership threshold for local firms is 100%. Our ownership threshold for a foreign-owned corporation (foreign affiliates) is also 100%. We do not have any ownership threshold for joint-venture firms (hereafter JV firms). By national origin, 257 firms are local; thus, the remaining 154 are foreign affiliates or JV firms. A total of 16.5% of firms are from the Philippines. Vietnam provided 32.1% of sample firms, and 27.0% of sample firms are from Indonesia.

Table 1 Industry composition of our dataset and official statistics

Our sample	*Whole sample*	*Indonesia*	*The Philippines*	*Thailand*	*Vietnam*
Food	14.4%	19.8%	26.5%	14.0%	3.8%
Apparel	15.3%	24.3%	19.1%	14.0%	6.8%
Wood products	3.9%	8.1%	1.5%	4.0%	1.5%
Paper	3.9%	7.2%	1.5%	4.0%	2.3%
Chemicals	10.7%	4.5%	11.8%	14.0%	12.9%
Other material	5.8%	5.4%	5.9%	3.0%	8.3%
Metal products	6.6%	1.8%	8.8%	11.0%	6.1%
Electronic products	9.0%	1.8%	19.1%	2.0%	15.2%
Transportation equipments	6.3%	4.5%	1.5%	10.0%	7.6%
Machineries and other manufacturing	23.6%	21.6%	4.4%	24.0%	34.8%
N	411	111	68	100	132
Weight	1	0.270	0.165	0.243	0.321
Official statistics	*Weighted average*	*Indonesia*	*The Philippines*	*Thailand*	*Vietnam*
Food	23.0%	28.3%	21.3%	25.4%	18.7%
Apparel	20.8%	22.4%	14.7%	37.1%	16.4%
Wood products	6.9%	5.6%	3.1%	14.1%	9.2%
Paper	7.5%	4.8%	9.8%	1.7%	10.9%
Chemicals	10.8%	10.9%	14.3%	1.8%	11.8%
Other materials	7.5%	7.9%	8.0%	3.3%	9.7%
Metal products	7.7%	3.5%	6.3%	7.5%	14.5%
Electronic products	4.1%	1.9%	7.3%	0.4%	3.6%
Transportation equipments	8.0%	12.6%	8.4%	7.5%	2.8%
Machineries and other manufacturing	3.7%	2.0%	6.7%	1.2%	2.4%
Year	–	2008	2008	2007	2008

Notes: Manufacturing of precision instruments is included in other machineries while it is included in electronic products for Vietnam. Weighted average for official statistics is calculated based on the country weight of our dataset.

Source: ERIA Establishment Survey 2008 for our dataset, 'Statistical Yearbook of Indonesia 2011' for Indonesia, '2008 Annual Survey of Philippine Business and Industry' (preliminary results) for the Philippines, '2007 Industrial Census' for Thailand and 'Statistical Yearbook of Vietnam 2010' for Vietnam.

2.2 Definition of variables and empirical strategy

This section presents the framework used to empirically examine the impacts on measures of firm-level industry upgrading of a shift in resource allocation from internal

resources to external links. We perform a firm-level cross-section regression to test the following hypotheses:

1 shifting information resources toward external links is associated with costly industry upgrading

2 trade and learning links enable firms to follow different directions of industry upgrading

3 for firms in developing economies, shifting information resources toward global partners is associated with costly industry upgrading.

This paper uses the following six outcome measures for industry upgrading. The first two are outcomes of product innovation. Since we expect that introducing a new product is more costly than changing an existing product's design and packaging but that the new product also offers higher returns, this paper implements two vertically differentiated product innovation measures in terms of costs and benefits.

- changing design and packaging
- introduction of new product based on technology new to the firm.

The remaining four measures concern outcomes of exporting or engaging with global supply chains. The first outcome is dealing with an intensive margin of exporting. The second outcome is engaging in a global production network through shipping intermediate products to multinational companies or JV firms in each surveyed country. The final two outcomes deal with extensive margins of exports.

- increase in exports to developed economies
- finding a new multinational corporation (MNC) or JV buyer within each surveyed country
- finding a new buyer in East Asia
- finding a new buyer in other regions (e.g., the European Union or USA).

We estimate the following reduced-form regression equation of industry upgrading outcomes on several measures of resource allocation toward external links while controlling the effects of other observable firm-level explanatory variables, industry differentials and differences among countries. More precisely, this paper estimates the coefficient γ of the share of external links over the number of different information source categories in order to test if a shift toward external links is associated with measures of industry upgrading.

$$(outcome)_i = \alpha + \gamma\left(\frac{Total\ \#External\ Links}{Total\ \#Links}\right)_i + \delta(covariates)_i + \varepsilon_i \quad (1)$$

where the dependent variable $(outcome)_i$ signifies the different measures of industry upgrading, the explanatory variable *Total #External Links* is the sum of external categories of information sources, *Total #Links* is the sum of internal and external categories of information sources that firm i utilises and the cross-sectional covariates and unobserved characteristics for firm i are captured by $(covariates)_i$ and ε_i, respectively. This paper runs a probit regression and obtains the marginal effects of an increase in the

share of external links over the total number of available categories of information sources.

Second, we estimate the following regression equation to test if trade and learning links have different impacts on industry upgrading. Coefficients γ_1 and γ_2 suggest the relative importance of impacts on industry upgrading from shifting information sources from external sources to trade or learning.

$$(outcome)_i = \alpha + \gamma_1 \left(\frac{Total\ \#Trade\ Links}{Total\ \#Links} \right)_i + \gamma_2 \left(\frac{Total\ \#Learning\ Links}{Total\ \#Links} \right)_i + \delta(covariates)_i + \varepsilon_i \quad (2)$$

where the explanatory variable *Total #Trade Links* is the sum of the trade category of information sources from outside firm *i* and *Total #Learning Links* is the sum of the learning category of external information sources from outside firm *i*. This paper predicts that increases in the share of trade-related links over all available information sources can explain increases in costly exporting activity, but increases in the share of learning links can explain increases in product innovation based on knowledge and technology that are new to the firm.

Finally, this paper tests if the return to global forms of information spillover is associated with industry upgrading. For this purpose, we deconstruct trade and learning links into four categories:

1 sum of local trade links

2 sum of local learning links

3 sum of global trade links

4 sum of global learning links.

We compute the share of each linkage type over all available external links. This paper uses the following regression equation to estimate the relative importance of the shares of global trade and learning links. Furthermore, it predicts that the coefficients of global trade links (γ_3) and global learning links (γ_4) will be higher than those of local trade links and local learning links when controlling for firm-level characteristics.

$$\begin{aligned}(outcome)_i = \alpha &+ \gamma_1 \left(\frac{Total\ \#Local\ Trade\ Links}{Total\ \#Links} \right)_i \\ &+ \gamma_2 \left(\frac{Total\ \#Local\ Learning\ Links}{Total\ \#Links} \right)_i \\ &+ \gamma_3 \left(\frac{Total\ \#Global\ Trade\ Links}{Total\ \#Links} \right)_i \\ &+ \gamma_4 \left(\frac{Total\ \#Global\ Learning\ Links}{Total\ \#Links} \right)_i + \delta(covariates)_i + \varepsilon_i \end{aligned} \quad (3)$$

The estimation results are shown in the next section. This paper also presents the results of falsification tests conducted using several measures of process improvements for dependent variables.

2.3 Measuring allocation of information sources toward external links

To measure the prevalence of external information sources across firms, we collect information regarding the utilisation of each linkage to the firm. The survey contains five items:

1 internal categories of information sources across departments within a firm as well as information from JVs

2 the trade category of local links with external trade partners

3 the learning category of local links with non-trade partners

4 the trade category of global external links and

5 the learning category of external global links as well as the total number of available forms of information sources.

Then, we compute the shares of internal information sources and four different categories of external links, beginning with indicators related to information sources as our main explanatory variables:

- Share of internal information sources: this share is constructed utilising five internal information sources over all available internal and external resources:
  1 own sales department or sales agent
  2 own production or manufacturing department
  3 technological agreement with headquarters or affiliated firm
  4 JV with other local firms and
  5 JV with other foreign-owned firms.

  On the basis of our hypotheses stated in the previous section, we expect that firms relying more on internal resources tend not to engage in product innovation or market creation.

- Share of external resources: this share is constructed from accessing two external information sources over all available internal and external resources:
  1 trade links, which are information sources embodied in a business-to-business transaction and
  2 learning links, which are non-pecuniary information sources providing direct communication with agents outside pecuniary transactions in a production chain.

  This is an inverse measure of internal information sources. Therefore, the sum of shares of internal and external sources equals to one. We expect that firms relying more on external information sources tend to achieve costly innovation and market creation.

- Share of trade links: this share is computed by accessing two trade-related information sources across space over all available external resources:
  1 local trade links, which are information sources of local business transactions with a local supplier or buyer and

2 global trade links, which are information sources of business transactions with foreign-owned suppliers in either the surveyed countries or foreign countries.

This paper expects that firms shifting more resources toward trade links tend to achieve market creation.

- Share of learning links: this share is computed by accessing local and global learning links with non-trade related information sources across space over all external resources. Both are information sources from non-trade partners across space. Local learning links are constructed from:
  1 licensing technologies from other local firms
  2 local consultants hired by an establishment
  3 technical assistance provided by government
  4 technical assistance provided by a local business organisation
  5 research consortiums with government support
  6 research consortiums with a local business organisation
  7 business consortiums with the government
  8 business consortium with a local business organisation and
  9 technical cooperation with a local university or institute.

  On the other hand, global learning links are constructed by three items:
  1 licensing technologies from other MNCs
  2 international consultants hired by an establishment and
  3 technical cooperation with a foreign university or institute.

The sum of shares of trade and learning links equals the share of external links. This paper expects that firms shifting more resources toward learning links will exhibit a higher propensity of product innovation using new technologies.

Table 2 Measuring external links: trade and learning forms across space

Variable		*Whole mean*	*N = 411 std. dev.*	*Local mean*	*N = 257 std. dev.*	*Foreign mean*	*N = 154 std. dev.*
A	*Internal resources*						
	Own sales department or sales agent	0.630	0.483	0.700	0.459	0.513	0.501
	Own production or manufacturing department	0.871	0.336	0.840	0.367	0.922	0.269
	Technological agreement with the HQ or affiliated firm	0.725	0.447	0.646	0.479	0.857	0.351
	Joint venture established with other local firms	0.455	0.499	0.463	0.500	0.442	0.498
	Joint venture established with other foreign-owned firms	0.530	0.500	0.471	0.500	0.630	0.484
B	*Local trade links*						
	Local supplier or customer	0.579	0.494	0.572	0.496	0.591	0.493

Source: ERIA Establishment Survey (2008)

Table 2 Measuring external links: trade and learning forms across space (continued)

Variable		*Whole mean*	*N = 411 std. dev.*	*Local mean*	*N = 257 std. dev.*	*Foreign mean*	*N = 154 std. dev.*
C	*Local learning links*						
	Licensing technologies from other local firms	0.630	0.483	0.560	0.497	0.747	0.436
	Local consultant hired by your establishment	0.328	0.470	0.377	0.486	0.247	0.433
	Technical assistance provided by government	0.392	0.489	0.475	0.500	0.253	0.436
	Technical assistance provided by local business organisation	0.428	0.495	0.494	0.501	0.318	0.467
	Research consortium with the support of government	0.326	0.469	0.393	0.489	0.214	0.412
	Research consortium with the local business organisation	0.316	0.466	0.381	0.487	0.208	0.407
	Business consortium with the government	0.331	0.471	0.405	0.492	0.208	0.407
	Business consortium with local business organisation	0.326	0.469	0.393	0.489	0.214	0.412
	Technical cooperation with local university or institute	0.328	0.470	0.377	0.486	0.247	0.433
D	*Global trade links*						
	Foreign-owned supplier or customer	0.630	0.483	0.529	0.500	0.799	0.402
E	*Global learning links*						
	Licensing technologies from other MNCs	0.333	0.472	0.292	0.455	0.403	0.492
	International consultant hired by your establishment	0.268	0.443	0.268	0.444	0.266	0.443
	Technical cooperation with foreign university or institute	0.304	0.461	0.331	0.471	0.260	0.440

Source: ERIA Establishment Survey (2008)

Table 2 presents the prevalence of accessing internal and external information sources for the entire sample as well as sub-samples of local and foreign firms. It shows the dummy variables of important practices for local and foreign firms, which equals to one if firms answer that they utilise each information source; otherwise, it equals to zero. Panel A in Table 2 shows how firms utilise five types of internal resources. Local firms tend to utilise their own sales departments (70.0%), but only 51.3% of foreign firms utilise their own sales departments as internal information sources. A large difference also exists between local (64.6%) and foreign firms (85.7%) in utilising technological agreements with headquarters or affiliated firms. Furthermore, a large discrepancy exists between the types of internal information sources that are often available for local and foreign firms, even as part of their own internal resources. Panels B, C, D and E in Table 2 present local and foreign firms' prevalence of utilising external information sources such as local trade partners, local non-trade partners, global trade partners and

global non-trade partners. No difference exists between local and foreign firms in terms of accessing local trade links. However, striking differences are evident in Panel C in Table 2; foreign firms are less likely to access local information sources from non-trade partners such as governments, local business organisations, universities or research institutes. Nevertheless, foreign firms are more likely to access both global trade links (Panel D) and global learning links (Panel E). In particular, foreign firms are more likely to access foreign-owned suppliers or buyers (79.9%) than are local firms (52.9%). Foreign firms are also more likely to license technologies from MNCs than are local firms (40.3% vs. 29.2%). Contrary to these trends, however, local firms tend to engage in technical cooperation with foreign universities or institutes (33.1%). This ratio is higher for local firms than for foreign firms.

In summary, this paper determines which information sources (internal or external) are consistent with which external resources, formed by trade and learning links across space, come from local and global information sources. We compute the total number of available resources as well as the shares of:

1 external information resources
2 trade and learning links
3 local trade
4 local learning
5 global trade and
6 global learning links.

Table 2 shows the detailed statistics of internal and external categories of information sources. Several important findings have been identified:

1 large differences exist between local and foreign firms in terms of utilising internal information resources
2 both foreign and local firms tend to access local trade links
3 unlike foreign firms, local firms depend on local learning links and
4 local and foreign firms are equally likely to access global trade and learning links.

A divergence of prevalence or utilisation of information resources is evident between local and foreign firms.

This paper uses these shares of external information sources, trade links and learning links as regressors to test if resource allocation toward external information sources is important for industry upgrading as well as if resource allocation toward trade and learning links produce different paths for industry upgrading. In addition, we also test if resource allocation toward global information sources affects industry upgrading for firms in developing economies.

2.4 Sample firm characteristics

This section presents data concerning the basic characteristics of sample firms. Table 3 presents summary statistics of outcome variables, main explanatory variables and other control variables for our regression analysis. As shown by the above empirical strategy,

this paper has two outcome variables. The first is product innovations. Product innovation can refer to simple incremental innovation to difficult processes requiring larger investment in and adoption of new technology. The second outcome of interest is firm-level behaviour in terms of exporting or engaging in a global supply chain. This outcome can be displayed in several ways:

1 increasing exports to rich markets

2 engaging in a global production network by shipping products to foreign-owned firms (MNCs or JVs) in each surveyed country

3 finding a new buyer in East Asia or other regions such as Europe or the USA.

Differences in the probability of product innovation are apparent between local and foreign-owned firms (MNCs or JVs). Even a cursory examination of outcome data reveals an interesting finding: local firms are more likely than foreign firms to achieve product innovation, but foreign firms are more likely to achieve an increase in exports. Almost 48% of local firms engage in incremental innovation (i.e., changing design and packaging of existing products), compared with only 26% of foreign firms. Product innovation based on technology new to the firm also changes the fixed investment costs required for adoption of new technology. We expect that foreign firms are more likely to achieve this because their higher capability can better bear such fixed costs. Surprisingly, we determine that only 9% of foreign firms achieve product innovation based on technology new to the firm, compared with 14% of local firms. It is also noteworthy that more local than foreign-owned firms introduced a new product.

The summary statistics of export market gains show more striking differences between local and foreign firms. First, more foreign than local firms increased exports to developed economies (22.1% vs. 16.3%). Second, foreign firms were nearly twice as likely to find new foreign buyers in each surveyed country (62.3% vs. 33.9%). Third, foreign firms were also more easily able to find new buyers in East Asia as well as in regions such as the USA or Europe: 76% of foreign firms found a new buyer in East Asia, compared with only 22.6% of local firms. Meanwhile, 69.5% of foreign firms found a new buyer in the USA or Europe, compared with 28.0% of local firms.

Now, we present summary statistics of the main explanatory variables, namely, shares of internal and external links over total available information resources as shown in Table 2. In short, this paper assumes firms that have benefited from information procured from different categories of internal and external information sources. This paper compares firms having a wider range of links with those having a more limited range. Again, no substantial difference in utilising internal resources emerged between local and foreign firms. That is, no large difference exists in terms of accessing external information links between domestic and foreign firms. But foreign affiliates tend to utilise trade links as an information source (i.e., 18.2% of their external links are trade links) more than local firms do (i.e., 12.9%). On the other hand, local firms tend to have greater utilisation of learning links (i.e., 42.1% of external links are learning links). In comparison, foreign firms allocate 34% of external links to learning links for foreign affiliates.

Significant differences also exist between local firms and foreign affiliates in terms of trade and learning links across space. Foreign affiliates tend not to access local learning

links in the host country and are more likely to access global trade links. Details of constructing these linkage variables can be seen in Table 2.

Table 3 Summary statistics of variables for local firms and foreign affiliates

Variable	*Whole mean*	*N = 411 std. dev.*	*Local mean*	*N = 257 std. dev.*	*Foreign mean*	*N = 154 std. dev.*
Outcomes						
Incremental	0.399	0.490	0.482	0.501	0.260	0.440
New product based on new technology	0.122	0.327	0.140	0.348	0.091	0.288
Increase in exports to developed economies	0.185	0.389	0.163	0.370	0.221	0.416
Finding a new MNC or JV buyer in each surveyed country	0.445	0.498	0.339	0.474	0.623	0.486
Finding a new MNC or JV buyer in East Asia	0.426	0.495	0.226	0.419	0.760	0.429
Finding a new MNC or JV buyer in other countries	0.436	0.496	0.280	0.450	0.695	0.462
Main explanatory variables						
Share of internal links	0.461	0.250	0.450	0.270	0.479	0.211
Share of external links	0.539	0.250	0.550	0.270	0.521	0.211
Share of trade links	0.149	0.120	0.129	0.117	0.182	0.120
Share of learning links	0.390	0.265	0.421	0.289	0.340	0.211
Share of local trade links	0.068	0.081	0.067	0.086	0.070	0.070
Share of local learning links	0.318	0.235	0.357	0.259	0.252	0.172
Share of global trade links	0.081	0.086	0.063	0.081	0.111	0.085
Share of global learning links	0.072	0.102	0.063	0.097	0.088	0.108
Other firm-level controls						
Firm age	13.494	13.096	15.198	12.563	10.649	13.509
Firm size (number of employees)	299.574	482.047	220.175	400.932	432.078	570.497
R&D dummy	0.270	0.445	0.265	0.442	0.279	0.450

Source: ERIA Establishment Survey (2008)

Other covariates of our empirical analysis capture the basic observable characteristics of firms, industries and countries. Striking differences exist between local and foreign firms for factors such as research and development (R&D), firm size (number of employees), industries and locations. About 28% of foreign firms run R&D activities internally, while 26.5% of local firms engage in R&D activities. R&D activities in our survey include basic and applied research, but the analysis in this paper does not distinguish between them. Most Southeast Asian firms mainly engage in applied research internally.[3] Foreign and local firms exhibit substantial differences in terms of firm size. Local firms averaged 220 employees, while foreign affiliates averaged 432. There were also differences in firm age, with local firms averaging 15.2 years and foreign affiliates averaging only 10.6 years. In sum, not only covariates but also outcomes and linkage variables differ

between local and foreign firms. The next section investigates how the relationship between industry upgrading and shifting information resources toward external links varies between local and foreign firms.

3 Results

3.1 Impacts of increasing the share of external links

Table 4 reports this paper's main results. We find six different outcomes for industry upgrading. The first two columns depict product innovation:

1 Incremental and simple innovation, for example, changing design and/or packaging.

2 Introduction of new goods based on technology new to the firm.

The remaining four columns concern increases in foreign market participation or engaging in a global production network:

3 Increasing exports to developed economies.

4 Finding a new foreign buyer in each surveyed country.

5 Finding a new buyer in East Asia.

6 Finding a new buyer in other regions (e.g., USA or Europe).

These outcomes are measured by dummy variables. We run probit regressions to estimate the marginal effects of increasing the shares of external links on each of these six outcomes. Each outcome is consistent with each column in Table 4. We control for firm-level observable characteristics such as firm size, firm age, ownership characteristics and R&D as well as for differences by industry and country.

Table 4 begins with product innovation. Panel A in Table 4 presents the impacts of an increase in the share of external links over all available information sources on measures of industry upgrading: product innovation and exporting. Panel A reveals how shifting resources toward external links increases the probability of industry upgrading as compared with shifting resources toward internal links. The regression results suggest that firms relying more on external links tend to have an increased probability of achieving costly product innovation and foreign market participation. Column 1 of Panel A in Table 4 shows that incremental innovation is not associated with a shift in information sources toward external links. The marginal effect of increasing the share of external links has no statistical significance, but the coefficient shows a negative sign. This implies that firms cannot achieve incremental or simple innovation even though they allocate information resources toward external links. This suggests that firms can improve their existing products without needing costly investment in external links to acquire knowledge capital. On the other hand, Column 2 of Panel A in Table 4, which presents the marginal effects of increasing the share of external links, shows a result of 0.144 with a standard error of 0.0576. Since the standard error is low, this result is statistically significant at the 5% level. This means that a 10% increase in the share of external links yields a 1.44% point increase in the probability of introducing a new product based on technology new to the firm.

Table 4 Marginal effects of increasing the share of external links on outcomes

		(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
		Design or packaging changes	*New product with new technology*	*Increase in exports to developed countries*	*Finding a new foreign buyer in each country*	*Finding a new buyer in East Asia*	*Finding a new buyer in EU or US*
A	*Internal vs. external*						
	Share of external links	–0.110	0.144**	0.186**	0.382***	0.335**	0.376***
		(0.112)	(0.0576)	(0.0793)	(0.127)	(0.135)	(0.129)
B	*Trade vs. learning*						
	Share of trade links	0.198	–0.121	0.393**	0.621**	0.929***	0.622**
		(0.257)	(0.140)	(0.174)	(0.286)	(0.293)	(0.284)
	Share of learning links	–0.154	0.173***	0.153*	0.346***	0.251*	0.337**
		(0.118)	(0.0612)	(0.0860)	(0.133)	(0.148)	(0.135)
C	*Local vs. global*						
	Share of local trade links	0.132	–0.193	0.261	0.995***	0.639*	0.658*
		(0.325)	(0.177)	(0.228)	(0.338)	(0.357)	(0.344)
	Share of local learning links	–0.112	0.198***	0.0247	0.330**	0.00678	0.254*
		(0.128)	(0.0665)	(0.0960)	(0.143)	(0.174)	(0.144)
	Share of global trade links	0.397	0.0149	0.405*	–0.00750	1.148**	0.480
		(0.380)	(0.195)	(0.241)	(0.403)	(0.450)	(0.430)
	Share of global learning links	–0.441	–0.0129	0.643***	0.618**	1.037***	0.675**
		(0.288)	(0.141)	(0.166)	(0.276)	(0.337)	(0.314)
Other firm-level controls		✓	✓	✓	✓	✓	✓
Industry		✓	✓	✓	✓	✓	✓
Country		✓	✓	✓	✓	✓	✓
Observations		411	411	411	411	411	411

Notes: The control variables are firm age, firm size, R&D dummy, MNCs dummy, JVs dummy, industry and country.
Reference group for MNCs and JVs is local firms. Thailand is reference country for Indonesia, The Philippines and Vietnam. Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Source: ERIA Establishment Survey (2008)

We now discuss other measures of industry upgrading: intensive and extensive margins of exports and engaging in a global production network. Column 3 of Panel A in Table 4 presents results indicating that an increase in the intensive margin of exporting is associated with a shift of information sources toward external links. The marginal effect of a firm increasing its share of external links is 0.186 with a standard error of 0.079. This indicates that a 10% increase in the share of external links over all available information source yields a 1.86% point increase in the probability of increasing exports to rich markets. Column 4 of Panel A in Table 4 shows that participation in a global supply chain is also associated with an increase in the share of external links over all available information sources. The marginal effect of an increase in the share of external links on

finding a new foreign buyer in each surveyed country is 0.382, with a standard error of 0.127. That is, in each surveyed country, a 10% increase in the share of external links provides a 3.8% point increase in a firm's probability of finding a new foreign buyer. Columns 5 and 6 of Table 4 show that extensive export margins are also associated with a shift of information sources from internal resources toward external links. The marginal effect of increasing the share of external links on finding a new buyer in East Asia is 0.335 with a standard error of 0.135 (Column 5). This suggests that a 10% increase in the share of external links over all information sources results in a 3.35% point increase in a Southeast Asian firm's probability of finding a new buyer in China, Korea or Japan. Finally, Column 6 of Panel A indicates that a 10% increase in the share of external links over all available information sources produces a 3.76% point increase in a firm's probability of finding a new buyer in other regions, for example, a buyer from Europe or USA for firms in Southeast Asia. This marginal effect is statistically significant at 1%.

In sum, Panel A in Table 4 suggests that several measures of industry upgrading are associated with a shift in information sources from available internal resources to external links. We have three further results:

1 less costly incremental innovation is not associated with shifting resource allocation between internal and external information sources

2 only costly product innovation is associated with a change in allocation of information sources from internal to external links and

3 both intensive and extensive margins of foreign market participation are associated with a shift in resource allocation from internal resources to external links.

These results are sizable and statistically significant.

3.2 Impacts of increasing the shares of trade vs. learning links

As shown above, changing resource allocation from internal to external information links could play an important role in successful costly product innovation and foreign market participation. Industry upgrading measures are associated with a shift in information sources from internal resources to external links, which comprise information sources from trade partners (i.e., trade links) and non-trade partners (i.e., learning links). This paper also investigates what type of external link is more effective for industry upgrading. Panel B in Table 4 shows the relative importance of increases in shares of trade and learning links for outcomes. The baseline variable is the share of internal resources over all available information sources. Column 1 of Panel B in Table 4 reveals that increasing the shares of both trade and learning do not have a statistically significant impact on a firm's changing product design and packaging. An increased share of learning links is negatively correlated with such incremental innovation, but the marginal effect is not statistically significant. Column 2 of Panel B in Table 4 shows that a 10% increase in the share of learning links results in a 1.73% point increase in the probability of product innovation based on technology new to the firm. This is statistically significant at the 1% level. However, the same is not true for an increase in the share of trade links. This suggests that costly innovation is associated with a shift of information sources toward learning with non-trade partners. It also suggests that the learning effect explains the impact of an increased share of external links on costly product innovation.

Contrary to this result, increases in shares of both trade and learning links over all available information sources can explain the increase in the probability of foreign market participation. Column 3 of Panel B in Table 4 shows that a 10% increase in shares of both trade and learning links generates a 3.93% point and a 1.53% point increase, respectively, in exports to developed economies. In terms of the intensive margin of exporting, marginal effects between external links are higher for trade links. Column 4 of Panel B in Table 4 shows the result of a firm engaging in a global supply chain by finding a new foreign buyer. This result is similar to that of extensive margins, but the marginal effects are greater compared with those in Column 3. A 10% increase in the shares of both trade and learning links implies a 6.21% point and a 3.46% point increase, respectively, in a firm's likelihood of finding a new foreign buyer. This reveals that investment in trade links is more effective than that in learning links when a firm aims to engage in a global supply chain to find a foreign buyer. Finally, Columns 5 and 6 of Panel B in Table 4 also show the extensive margins of exports. The size of the marginal effects of the explanatory variables in Column 5 suggests that a 10% increases in shares of trade and learning links lead to a 9.29% point and a 2.51% point increase, respectively, in finding a new buyer in East Asia for firms in Southeast Asia. Even though learning links are effective and statistically significant, the benefit of investment in trade links is higher than of that in learning links. This is true when we consider market creation in European or US markets for firms in Southeast Asia. The 10% increases in shares of trade and learning links generates a 6.22% point and a 3.37% point increase, respectively, in finding a new buyer in Europe or USA. These results are also statistically significant and sizable.

In summary, Panel B in Table 4 highlights that trade and learning links exert differing impacts on the two measures of industry upgrading examined in this study: product innovation and foreign market participation. Learning is effective for engaging in costly product innovation, but trade does not play sizable role. On the other hand, resource allocation toward trade links could improve the probability of a firm's intensive and extensive margin of exporting as well as that of a firm engaging in a global supply chain network by shipping products to foreign firms. Learning from non-trade partners also affects firms' propensity to increase foreign market participation, but the impacts of learning from non-trade partners are smaller than those from trade links.

3.3 Impacts of increasing the shares of local vs. global links

Panel A in Table 4 presents data demonstrating that an increase in the share of external links raises a firm's probability of engaging in costly innovation and exporting. We also show how increases in resource allocation toward trade and learning links with external information sources explain a firm's propensity to industry upgrading. Now, this paper examines how differences in local and global information sources affect industry upgrading. This paper has presented two categories of external links: trade and learning links. We now introduce a spatial dimension to these classifications: local vs. global links. Accordingly, external links are constructed by 2 × 2 links to detect whether international links are more important than locally available information. Panel C in Table 4 presents the results of our investigation of this question. If international knowledge capital flows encourage product innovation (e.g., Grossman and Helpman, 1991) and foreign market penetration (Arkolakis, 2010), we expect that global links to have greater impacts on measures of industry upgrading as compared with local links.

Column 1 of Panel C in Table 4 shows that none of the external linkage variables examined have significant impacts on incremental innovation. Shifting resource allocation from local to global links does not have an impact on a firm's changing design or packaging. Column 2 of Panel C in Table 4 indicates that an increased share of learning links (as shown in Panel B) impacts product innovation mainly through local knowledge sources, not international knowledge flows. A 10% increase in the share of local learning links over available information resources results in an approximately 2% increase in the probability of a firm developing a new product with technology that is new to it. Increasing the shares of trade links across spaces or global learning links does not explain firms' propensity to engage in costly product innovation. Column 3 of Panel C in Table 4 shows that the intensive margin of exporting is mainly associated with global links. In particular, a 10% increase in the share of global learning links generates a 6.43% increase in the probability of increased exports to developed economies. This marginal impact for global learning links is higher than that for global trade links.

Impacts of international knowledge capital flows through non-trade partners can affect measures of extensive margins of foreign market participation. The remaining columns of Panel C show this effect. Column 4 of Panel C shows that a 10% increase in the share of global learning links means a 6.18% increase in a firm's probability of finding a new foreign buyer. Finding a new foreign buyer within a country is also associated with a shift in information resources toward local trade links. A 10% increase in the share of local trade links results in a 9.95% increase in a firm's engagement in a global supply chain by finding a new foreign buyer. The marginal impact of local trade links is larger than that for global learning links. Columns 5 and 6 also highlight that the probabilities of finding a new buyer in either East Asia or Europe and the USA are associated with an increase in the share of global learning links; that is, a 10% increase in the share of global learning links generates a 10.37% increase in a firm's probability of finding a new buyer in East Asia, while a 10% increase in the share of global learning links generates a 6.75% increase in a firm's probability of finding a new buyer in other regions such as the USA or Europe. Finally, Column 5 of Panel C reveals that in each surveyed country, an increase in the share of local trade links also plays a role in a firm acquiring new foreign buyers.

In summary, findings from Panel C in Table 4 highlight the relative importance of international knowledge capital flows as a form of encouragement for firms to engage in foreign markets, including intensive and extensive margins of exports as well as finding a new foreign buyer. Contrary to the theoretical prediction, product innovation on the basis of technology new to the firm does not stem from global information spillovers. Only local knowledge spillovers from non-trade partners explains the propensity for product innovation.

3.4 Allowing heterogeneous slopes: local vs. foreign firms

Here, we discuss our final question: How do local firms and foreign affiliates utilise external links? We expect that each foreign affiliate has received vertically transferred managerial capital (or knowledge capital or technology capital) from a parent headquarters. Furthermore, we suppose that parent firms in foreign countries transfer information and technology to affiliate firms in the surveyed countries. Such vertical transfers of managerial and knowledge capital from foreign countries can affect

how surveyed firms utilise information from other parties. In contrast, local firms in Southeast Asia do not receive such managerial and knowledge inputs from foreign countries unless they establish JVs with foreign firms. Therefore, local firms and foreign affiliates in the surveyed countries display heterogeneous technologies involved with transforming incoming information into outcomes.[4] This paper compares the slope of local firms' main regressors with that of foreign affiliates to examine whether the former have lower managerial capital than the latter for utilising external information sources.

We regress outcome measures of industry upgrading to our main regressors (i.e., the share of external links) and the interaction term between the share of external links and local firms' dummy variable, which equals to one if firms have local ownership only; otherwise, it equals to zero. An interaction term between these variables provides information regarding how local firms' slopes of external links differ from those of foreign affiliates. That is, local firms show greater efficiency than foreign affiliates in achieving firm-level upgrading by utilising external links if the interaction terms possess positive coefficients. Foreign firms show greater efficiency than do local firms in utilising external links to achieve upgrading if the interaction terms possess negative coefficients. Table 5 presents the results for allowing heterogeneous slopes of the impacts of external links for both local firms and foreign affiliates.

Table 5 Allowing for heterogeneous slopes: local firms vs. foreign affiliates

		(1)	(2)	(3)	(4)	(5)	(6)
		Design or packaging changes	*New product with new technology*	*Increase in exports to developed countries*	*Finding a new foreign buyer in each country*	*Finding a new buyer in East Asia*	*Finding a new buyer in EU or US*
A	*Internal vs. external*						
	Share of external links	–0.0552	0.146	0.243*	0.276	0.398*	0.243
		(0.218)	(0.0983)	(0.139)	(0.211)	(0.210)	(0.218)
	Local*share of external links	–0.0754	–0.00383	–0.0866	0.161	–0.0995	0.196
		(0.246)	(0.115)	(0.161)	(0.251)	(0.258)	(0.256)
B	*Trade vs. learning*						
	Share of trade links	–0.837*	–0.741***	0.163	1.409***	1.827***	0.951**
		(0.483)	(0.244)	(0.262)	(0.493)	(0.546)	(0.449)
	Share of learning links	0.0996	0.300***	0.246	–0.0255	0.0677	0.0495
		(0.241)	(0.100)	(0.161)	(0.232)	(0.235)	(0.233)
	Local*share of trade links	1.372**	0.774***	0.345	–1.142**	–1.356**	–0.439
		(0.533)	(0.269)	(0.335)	(0.564)	(0.630)	(0.544)
	Local*share of learning links	–0.277	–0.162	–0.111	0.445*	0.195	0.372
		(0.260)	(0.110)	(0.178)	(0.263)	(0.269)	(0.265)

Notes: The control variables are firm age, firm size, R&D dummy, MNCs dummy, JVs dummy, industry and country.
Reference group for MNCs and JVs is local firms. Thailand is reference country for Indonesia, The Philippines, and Vietnam. Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Source: ERIA Establishment Survey (2008)

Table 5 Allowing for heterogeneous slopes: local firms vs. foreign affiliates (continued)

		(1)	(2)	(3)	(4)	(5)	(6)
		Design or packaging changes	*New product with new technology*	*Increase in exports to developed countries*	*Finding a new foreign buyer in each country*	*Finding a new buyer in East Asia*	*Finding a new buyer in EU or US*
C	*Local vs. global*						
	Share of local trade links	0.0422 (0.796)	–1.393*** (0.452)	0.455 (0.479)	2.397*** (0.675)	1.582** (0.778)	1.131* (0.675)
	Share of local learning links	0.169 (0.292)	0.327*** (0.116)	0.138 (0.174)	–0.214 (0.283)	–0.0873 (0.293)	0.146 (0.282)
	Share of global trade links	–1.326* (0.748)	–0.307 (0.204)	–0.0625 (0.330)	0.652 (0.540)	1.922*** (0.745)	0.745 (0.560)
	Share of global learning links	–0.166 (0.532)	0.124 (0.177)	0.547** (0.271)	0.697* (0.422)	0.498 (0.530)	–0.0342 (0.419)
	Local*share of local trade links	0.216 (0.866)	1.398*** (0.478)	–0.236 (0.552)	–1.813** (0.771)	–1.543* (0.891)	–0.770 (0.788)
	Local*share of local learning links	–0.294 (0.317)	–0.189 (0.121)	–0.155 (0.200)	0.641** (0.321)	0.0391 (0.357)	0.0831 (0.325)
	Local*share of global trade links	2.530*** (0.829)	0.448* (0.246)	0.819* (0.458)	–1.126 (0.757)	–1.228 (0.870)	–0.253 (0.740)
	Local*share of global learning links	–0.361 (0.646)	–0.160 (0.231)	0.314 (0.368)	–0.145 (0.534)	1.086 (0.728)	1.498** (0.582)
Other firm-level controls		✓	✓	✓	✓	✓	✓
Industry		✓	✓	✓	✓	✓	✓
Country		✓	✓	✓	✓	✓	✓
Observations		411	411	411	411	411	411

Notes: The control variables are firm age, firm size, R&D dummy, MNCs dummy, JVs dummy, industry and country.
Reference group for MNCs and JVs is local firms. Thailand is reference country for Indonesia, The Philippines, and Vietnam. Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Source: ERIA Establishment Survey (2008)

Panel A in Table 5 shows the relationship between the share of external links and measures of firm-level upgrading ranging from incremental innovation to intensive and extensive margins of exports. We focus on an interaction term between a local firm dummy variable and the share of external links in Panel A. The interaction terms in Columns 1–6 of Panel A do not show significant impacts. Some columns have sizable marginal effects with large standard errors. The results of Panel A in Table 5 therefore suggest that local and foreign firms do not have different slopes for the impact of the share of external links on outcomes.

As shown in the previous section, Panel B in Table 5 deconstructs external links into two categories: trade links and learning links. We estimate the interaction terms between

these two categories and a local dummy variable. Marginal effects of the two interaction terms provide a framework for examining how local firms use trade and learning links more efficiently for firm-level upgrading. Panel B in Table 5 presents two results. First, it confirms that local firms can utilise trade links more efficiently than can foreign affiliates to achieve both incremental and costly innovations (Columns 1 and 2). Second, local firms are less efficient than foreign affiliates in their use of trade links to expand their extensive margins of exports as well as to engage in a global supply chain by finding a new foreign buyer (Columns 4 and 5). Although the marginal effect of the interaction term between the local firm dummy variable and the share of trade links in Column 6 of Panel B is not statistically significant, the marginal effect displays a sizably negative sign.

Finally, we investigate why local firms and foreign affiliates display different slopes for the impacts of local and global links on outcomes. Panel C in Table 5 indicates that significant differences exist between local firms and foreign affiliates in their utilisation of local and global trade links, and that these differences have an impact on outcomes. We have three main pieces of evidence for the varied impacts of local and global trade links. First, both the marginal effects of interaction terms between the share of local trade links and the local firm dummy as well as the those of the interaction terms between the share of global trade links and the local firm dummy display significant and sizable positive signs. This indicates that local firms can utilise global and local trade links more efficiently than can foreign firms if they achieve incremental and costly product innovation (Columns 1 and 2 of Panel C). Second, local firms can utilise global trade links more efficiently if they increase exports to developed economies (Column 3 of Panel C). The impacts of increases in the share of global trade links on increases in intensive margins of exports are larger for local firms than for foreign affiliates. Third, local firms are less efficient in their utilisation of local trade links to engage in foreign markets. Columns 4 and 5 of Panel C show that the marginal effects of the interaction term between the share of local trade links and the local firm dummy variable on finding a new foreign buyer and a new buyer in East Asia is significantly negative. These results indicate that local firms cannot effectively transform information resources from local trade partners into an ability to find a new buyer within or across borders.

In addition to these results on local and global trade links, local and global learning links were determined to play a role in local firms' ability to engage with foreign markets. Column 4 of Panel C reveals that the marginal effects of the interaction term between the share of local learning links and the local firm dummy variable on finding a new foreign buyer is positive and significant. This indicates that local firms can more effectively transform information resources from local non-trade partners to engage in global supply chain by finding a new foreign buyer within a country. Column 6 of Panel C also reveals that the marginal effects of the interaction term between the share of global learning links and the local dummy variable on finding a new buyer in other regions (e.g., the European Union or the USA) is also positive and significant. This indicates that resource allocation toward international knowledge spillovers is more effective for local firms when they find a new buyer in Europe or USA.

In summary, Table 5 finds that local firms and foreign affiliates experience different impacts from external information sources. This in turn implies that local firms and foreign affiliates utilise different technologies to transform available external information sources into industry upgrading. What do such differences entail? Vertical knowledge spillovers for foreign affiliates could make a significant difference. Since vertical

knowledge spillovers regarding managerial and knowledge capital from foreign headquarters may create the heterogeneous slopes discussed above, local firms are less likely to utilise either local or global trade links when engaging in foreign markets. On the other hand, both local and global learning links are more complementary to local firms that do not have vertical knowledge spillovers of managerial input from foreign countries.[5]

Furthermore, in the context of local firms and multinationals in Southeast Asia, benefits stemming from the acquisition of external information sources for innovative activities are occasionally more essential for local than foreign-owned firms. The combination of knowledge diffusion from both trade and non-trade partners is more relevant to industry upgrading by local firms. Local firms need to augment their incomplete internal resources available for product innovation using information from external knowledge sources. Therefore, local firms tend to create more open partnerships than do foreign affiliates, who receive managerial inputs from their foreign headquarters. Local firms in these countries are usually under severe financial, human, or technological capital constraints; have weaker R&D capabilities; and have fewer available internal resources as compared with foreign firms. On the other hand, local firms' expected search costs for local sources of knowledge are lower than those for foreign firms because local firms maintain social relationships with local business communities. Therefore, local firms have greater incentives to explore wide-ranging partnerships with capable entities.

3.5 Falsification tests

This paper presents evidence that costly product innovation and increases in foreign market participation are associated with an increase in the share of external links. This is generally true for both local firms and foreign affiliates in Southeast Asia. The key mechanism behind the results can be stated as follows: Since both product innovations based on technology new to the firm and increases in intensive and extensive margins of exports are costly activities, the returns to investment gained by shifting information sources from internal resources to external links should compensate firms' costly industry upgrading. If this mechanism is accurate, less costly industrial upgrading within a firm will not necessarily require the costly investment of shifting resources from internal resources to external links We demonstrate this using the results of a firm's changing design or packaging, which is a cheaper incremental innovation. To check the robustness of this argument, we ran a regression for falsification tests using information about firm-level process improvements within production processes, for example, improving existing machines, installing new machines, improving product quality, reducing product defects and shrinking lead times.

Panel A in Table 6 shows the relationship between outcomes of process improvements and increases in the share of external links over all available resources. Table 6 shows the results of the marginal effects of our probit binary regression. We expect that costly investments in several categories of external links do not affect these process improvement proxies. Column 1 of Table 6 shows that the probability of improving existing equipment for the production process is not correlated with an increased share of external links. Column 2 also shows that an increase in the share of external links does not increase the probability of installing new machines for the

production process. Column 3 partially suggests the importance of shifting information resources from internal resources to external links when firms expect to improve their product quality. Since an increase in the share of external links is positively correlated with the probability of improving product quality, such required process improvements might be costly activities, contrary to our expectation. However, the marginal effect is statistically insignificant.

Table 6 Falsification tests

	Improved existing equipments	*Bought new machines or facilities*	*Product quality improved*	*Defects were reduced*	*Production cost decreased*	*Lead-time was reduced*
A *Internal vs. external*						
Share of external links	–0.104 (0.123)	0.0242 (0.117)	0.137 (0.0842)	0.0918 (0.0988)	–0.0938 (0.114)	–0.00789 (0.105)
B *Trade vs. learning*						
Share of trade links	0.385 (0.280)	0.0894 (0.276)	0.326 (0.206)	–0.0609 (0.233)	–0.293 (0.274)	–0.135 (0.248)
Share of learning links	–0.175 (0.127)	0.0140 (0.121)	0.108 (0.0854)	0.116 (0.101)	–0.0638 (0.120)	0.0114 (0.110)
C *Local vs. global*						
Share of local trade links	0.474 (0.327)	0.0980 (0.336)	0.139 (0.232)	–0.116 (0.289)	–0.422 (0.351)	–0.364 (0.318)
Share of local learning links	–0.125 (0.134)	0.0479 (0.131)	0.0621 (0.0892)	0.157 (0.110)	–0.167 (0.131)	0.0625 (0.120)
Share of global trade links	0.373 (0.444)	0.131 (0.424)	0.669* (0.364)	0.105 (0.332)	–0.270 (0.416)	0.291 (0.391)
Share of global learning links	–0.417 (0.278)	–0.164 (0.292)	0.278 (0.216)	–0.111 (0.245)	0.420 (0.289)	–0.363 (0.261)
Other firm-level controls	✓	✓	✓	✓	✓	✓
Industry	✓	✓	✓	✓	✓	✓
Country	✓	✓	✓	✓	✓	✓
Observations	411	411	411	411	411	411

Notes: The control variables are firm age, firm size, R&D dummy, MNCs dummy, JVs dummy, industry and country.
Reference group for MNCs and JVs is local firms. Thailand is reference country for Indonesia, The Philippines and Vietnam. Robust standard errors in parentheses.

Source: ERIA Establishment Survey (2008)

Now, we examine which external links play a role in improving quality upgrading. The remaining columns of Table 6 show that measures of process improvement within a production line are not associated with an increased share of external links, that is, shifting information sources toward external links does not reduce product defects, production costs or lead times. The evidence from the final three columns is also consistent with the main mechanism of the model: Less costly firm-level upgrading does not require the costly investment involved in learning from others.

We now examine whether process improvements are associated with an increased share of specific external links. Panel B in Table 6 shows no statistical relationship between the probability of achieving process improvements and increased shares of trade or any category of learning link. All columns support the robustness of our argument: Less costly improvements do not require costly investment in allocating firm resources toward information sources from trade and non-trade partners. Finally, Panel C in Table 6 shows whether increasing the shares of either domestic or international knowledge flows from trade or non-trade partners has a significant impact on process improvements. We examine the improvement of product quality (Column 3) of Panel C in Table 6, which shows that the probability of product quality improvements is only positively associated with an increased share of global trade links.

This column shows that a 10% increase in the share of information sources from international trade partners results in a 6.99% increase in the probability of a firm achieving product quality improvement. Although increased shares of international links with trade partners may raise product quality, no relationship was observed between other measures of process improvement and increased shares of either domestic or international links with trade and non-trade partners.

In sum, the evidence from Table 6, obtained by conducting falsification tests using the proxies of firm-level process improvements, supports the robustness of our main results. Local firms and foreign affiliates do not need to invest in shifting their information sources toward external links if they only require less costly process improvements. Product quality improvements are the exception.

4 Conclusions

This paper investigates how shifting information sources toward external information links affects firm-level industry upgrading as measured by product innovation and foreign market participation. The following empirical findings from firms in Southeast Asia are new to the literature:

1 Shifting information sources from internal resources to information from external partners has a substantial impact on costly product innovation and firm engagement in foreign markets.

2 Shifting information sources toward non-trade partners plays a significant role in firms' engagement in both costly product innovation and foreign market participation.

3 The impacts of shifting information sources toward trade partners on intensive and extensive margins of exports are substantially larger than those of shifting sources toward non-trade partners.

4 Domestic and international knowledge flows play differing roles for firm-level industry upgrading.

5 Since local firms do not receive vertically transferred managerial capital from parent firms, they are less likely to utilise local and global trade links when engaging in foreign markets.

Falsification tests conducted using process improvements also support our main argument.

The empirical results of this paper suggest that firms will be exposed to the greatest uncertainty and financial risk, thus necessitating diversified and innovative ideas as well as new technologies when they dedicate themselves to developing completely new products based on new technologies and when engaging in foreign markets. We can further refine our empirical methodology to obtain a more detailed dataset covering vertical flows of knowledge from parent firms to affiliates by examining firm-level upgrading by foreign affiliates in host countries. Accordingly, further investigation regarding knowledge and managerial input flows from parent firms to affiliates is needed in the future.

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Notes

1 See Markusen (1984) for knowledge capital, McGrattan and Prescott (2010) for technology capital and Bloom and Van Reenen (2007) for managerial capital. In the international context, Keller and Yeaple (2013) provide a framework of knowledge diffusion from parent to affiliates.

2 See also Amara and Landry (2005), Vega-Jurado et al. (2008), and Frenz and Ietto-Gillies (2009). Machikita and Ueki (2011) show that in-house R&D with local and foreign firms all help reduce the costs of product and process innovation as well as costs accrued in finding new suppliers and customers. Complementarities were also found between the number of internal and external categories of information sources. In addition, some studies emphasise the role of governments in promoting scientific and technological research at universities as well as the commercialisation of research results by fostering university-industry links in developing and emerging economies (e.g., Brimble and Doner, 2007; Hershberg et al., 2007).

3 The survey collects information regarding number of full-time employees rated on a scale of 10–2,000. The firms that responded to the survey were asked to confirm the number of full-time employees by selecting one of 11 choices. Employees is defined as the median value of each choice. For example, if the respondent chose 1–19 persons, Employees takes the value of ten.

4 An alternative explanation is the classic framework of 'absorptive capacity' (Cohen and Levinthal, 1990) and the dynamic aspect of organisational capability (Teece et al., 1997).

5 These empirical results partially reflect MNCs' current international division of labour in that their affiliates in developing countries hold the primary responsibility for producing existing products developed by their headquarters or R&D systems in the surveyed countries, which are based on established partnerships among MNCs. In other words, MNCs have difficulties in finding local firms capable of providing technologies or information that they lack. However, cooperation with local firms in production and incremental improvements allow MNCs to concentrate their resources into R&D and other innovative activities.