**Engaging Small and Medium
Enterprises in Production
Networks: Firm-level Analysis of
Five ASEAN Economies**

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Abstract

The Association of Southeast Asian Nations (ASEAN) small and medium enterprises (SMEs) are under scrutiny for their engagement in production networks following recent emphasis on increasing intra-regional trade, rebalancing, and inclusive growth in Asia. Using a data set covering 5,900 firms in five ASEAN economies at different stages of development, this paper analyses the participation of SMEs in production networks, determinants, and policy implications. It finds that although large firms dominate production network engagement in ASEAN economies, there are signs that SMEs have modestly increased their participation since the late-1990s. This is linked to firm-specific factors (e.g., firm size, foreign ownership, skills, technological capabilities, and access to credit) as well as a supportive business environment. Tackling residual supply-side and policy constraints can further the participation of ASEAN SMEs in production networks.

JEL Classification: F10, F23, O14

Contents

1. INTRODUCTION

The Association of Southeast Asian Nations (ASEAN) economies are home to a large small and medium enterprises (SME) sector which is seen as the backbone of national economic development through job creation, exports, and poverty reduction. Data on the contribution of SMEs to ASEAN economies is scare and often contentious (due to different definitions used and timeliness). SMEs account for the majority of firms and a large share of employment in ASEAN economies. Harvie and Lee (2002) provide a reasonably reliable snapshot for the late-1990s showing that on average SMEs made up 91.8% of enterprises and 50.5% of employment in ASEAN economies (estimated from Harvie and Lee 2002, Table 1.2, p. 6). However, the contribution of SMEs in ASEAN economies to international trade remains limited (their average export share is only 14.3%) relative to the sector's size or employment contribution. Some variation in SME export shares among ASEAN economies is visible with Viet Nam, Singapore, and Malaysia having higher figures than others.[1] It is possible that the average SMEs export share in ASEAN economies may be somewhat understated if indirect exports through subcontracting or input supply are taken into account (Tambunan 2009). Nonetheless, with SMEs in more advanced East Asian newly industrialized economies (NIEs) like the Republic of Korea (43%); Tapei,China (56%); and the People's Republic of China (PRC) (40–60%) contributing more to exports, there seems considerable room for advancement of SMEs in ASEAN economies' trade.

SMEs have returned to the spotlight in ASEAN due to fundamental changes in East Asia's trade pattern associated with production networks and a regional division of labor. A sizable body of research has measured international production fragmentation and analyzed implications for East Asia (see, for example, Ng and Yeats 2003; Athukorala and Yamashita 2006; Kuroiwa and Heng, eds. 2008; Kuroiwa, ed. 2009; Koopman, Powers, Wang, and Wei 2010; and WTO IDE-JETRO 2011). The research has used various approaches such as trade data (including trade in intermediate inputs), a combination of trade data with input-output tables, and case studies. It has been found that the region's trade is increasingly made up of growing intraregional trade in intermediate inputs. Production activities are being geographically fragmented across countries and linked by a dense network of trade in intermediate goods. Large multinational corporations (MNCs), which use the region as a international production base, have spearheaded the process of production fragmentation.

Greater SME participation in production networks through closer linkages with MNCs are viewed as a potent means of accelerating technology transfer, spillovers, and economic development (Hobday 2001; Lim and Kimura 2010). Nonetheless, concerns have been expressed that the internationalization of SMEs remains only an emerging trend with some variation among countries (Harvie and Lee 2002; Tranh, Narjoko, and Oum, eds. 2010). Multiple market failures are said to exist in relation to SME development and local entrepreneurship which may be mitigated by appropriate policies (Tambunan 2009; Lim and Kimura 2010). Against the backdrop of lackluster growth in the US and the euro area, the ASEAN and East Asia Summits in 2011 have emphasized the role of SMEs as a vehicle for accelerating intra-regional trade, rebalancing towards domestic and regional demand, and inclusive growth in

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[1] According to Harvie and Lee (2002), SME export shares for ASEAN economies are as follows: Viet Nam (20%), Singapore (16%), Malaysia (15%), Indonesia (10.6%), and Thailand (10%).

Asia[2]. The available literature and on-going policy debates thus point to several issues for further study: (1) how much do SMEs engage in production networks? (2) what factors influence SME participation in production networks? and (3) what policy implications can be drawn for SME support?

This paper attempts to address these issues drawing on recent empirical literature on international trade, industrial organization, and technology. Highlighting the notion of heterogeneity of firms in international trade, this literature points to certain firm-level characteristics (such as size, skills, and technological capabilities) as shaping firm-level participation in production networks. For convenience, internationalization of SMEs in relation to production networks can be defined in terms of three types of activities (see OECD 1997; Hollenstein 2005): direct exporting or importing (which is usually the most frequent type of international activity); indirect exporting as subcontractors to large firms or input suppliers (which is somewhat common); and foreign direct investment (FDI) in overseas locations by SMEs (which is more risky than home market production or trade). This paper looks only at the direct and indirect exporting behavior in SMEs in ASEAN economies due to a lack of data on FDI by SMEs.

There are a few firm-level econometric studies (covering production networks or exporting) in ASEAN economies (see Table A1 for a summary of results) and it is difficult to draw general conclusions for three reasons. First, the coverage of countries and sectors is somewhat limited in these studies. Typically, studies have looked at a single country and a specific sector within manufacturing (e.g., electronics). There are a couple of multi-country, multi-sector studies (Harvie, Narjoko, and Oum, 2010; Wignaraja 2011) and one multi-country single sector study (Rasiah 2004). Second, most work is based on small samples of enterprises. With the notable exception of Van Dijk (2002), nearly all the studies have less than 1,000 firms and two draw on less than 200 observations. It is difficult to generalize the findings from small sample studies. Third, there is insufficient comparative firm-level analysis. Although a couple of studies deal exclusively with SMEs in production networks (Harvie, Narjoko, and Oum 2010; Rasiah, Rosli, and Sanjivee 2010), none compare the behavior of SME exporters with large firms or SME exporters with indirect SME exporters.

This paper attempts to remedy these gaps. It covers five ASEAN economies (Malaysia, Thailand, Indonesia, Philippines, and Viet Nam) and a wide range of industrial sectors. Second, the data set used here is a large one from the World Bank comprising 5,900 manufacturing enterprises (including 70% SMEs), which were randomly selected using a comprehensive questionnaire. Third, the analysis is based on two alternative econometric models, one for all firms in production networks (direct and indirect exporters) and one for sustained exporters only. Each model was estimated separately for SMEs and all manufacturing firms. In line with the standard Organisation for Economic Co-operation and Development (OECD) definition, SMEs are defined here as enterprises with fewer than 100 employees (see OECD 1997). To the best of our knowledge, this is the most comprehensive analysis of its kind attempted for ASEAN economies.

The structure of the paper is as follows. Section 2 reviews the literature. Section 3 sets out the empirical methodology. Section 4 describes the dataset and provides information on the issue of

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[2] The vision of ASEAN leaders builds on the Strategic Action Plan for ASEAN SME Development 2010–2015 which covers mandates stipulated in the ASEAN Economic Community (AEC) Blueprint. The major deliverables under the plan are: (i) a commom curriculum for entrepreneurship in ASEAN, (ii) a comprehensive SME service center with regional and subregional linkages in ASEAN economies, (iii) an SME financing facility in each ASEAN economy, (iv) a regional program of intership schemes for staff exchanges and visits for skills training, and (v) regional SME development funding for supporting intra-ASEAN business leaders.

how much do SMEs engage in production networks. Section 5 presents t-test and econometric results to highlight the issue of the factors influencing SME participation in production networks. Section 6 explores selected policy influences on enterprises. Section 7 concludes and draws policy implications for SME support.

2. LITERATURE REVIEW

An established body of trade, industrial organization, and technology literature points to the overwhelming importance of firm-specific factors, on which competitive advantages are built. As background to this study of the role of SMEs in production networks, key aspects of the theoretical and empirical literature are discussed here.

2.1 Theory

Four main strands of theory can explain trade and production network activity of firms, which is the focus of this paper. The neo-Hecksher-Ohlin model and Vernon's concept of the product cycle provided the early rationale for studies highlighting the importance of firm-specific advantages (i.e., differences in skills, technologies, and tastes) in the operation of industry-level determinants of comparative advantage (e.g., Lall 1986; Wilmore 1992; and Wakelin 1998).

The fragmentation of production approach—found in a seminal work by Jones and Kierzkowski (1990) and Arndt and Kierzkowski (2001)—refined these insights. It showed how increasing returns and the advantages of specialization of factors within firms encouraged the location of different stages of production across geographical space connected by service links. Products traded between firms in different countries are components rather than final goods.

Furthermore, the "new new" trade theory of Melitz (2003) and Helpman et al. (2004) emphasized firm heterogeneity in international trade (i.e., that firms are considered different in terms of efficiency and fixed and variable costs when involved in trade). Accordingly, only a few highly efficient firms are able to export and invest overseas as they are able to make sufficient profit to cover the large trade costs required for overseas operations.

Finally, the technological capability and national innovation systems approach reveals a different channel through which firm behavior affects export performance. Focusing on innovation and learning processes in developing countries, proponents emphasize the acquisition of technological capabilities as a major source of export advantage at firm-level (Bell and Pavitt 1993; Lall 1992; Iammarino et al. 2008). The underlying evolutionary theory of technical change emphasizes that difficult firm-specific processes and complex interactions with institutions are needed to absorb imported technologies efficiently (Nelson and Winter 1992).

Implicit in most of the above theories is the notion that SMEs are at a disadvantage in participation in production networks compared with large firms. SMEs face, to a higher extent than large firms, resource constraints (in terms of finance, information, management capacity, and technological capability).[3] In addition, SMEs suffer disproportionately from external barriers like market imperfections and regulations. Accordingly, the probability of SMEs joining production networks (as direct exporters, indirect exporters, or overseas investors) is lower than that of large firms. Furthermore, justification exists for public policies to support the entry of SMEs in production networks. In the main, such support should be geared to an enabling environment that opens access to markets, reduces bureaucratic impediments against SMEs,

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[3] For further discussion of resource constraints and external barriers faced by SMEs as well as appropriate policy interventions, see Levy, Berry, and Nugent 1999; and Hallberg 2000.

and provides appropriate SME institutional support services (eg., technological, marketing, and financial support).

2.2 Empirical Studies and Hypotheses

The relationship between firm size and exports at enterprise-level has attracted considerable interest in a growing econometric literature (see, for instance, Kumar and Siddharthan 1994; Zhao and Li 1997; Wignaraja 2002; and Srinivasan and Archana 2011). There have also been econometric studies of SMEs and exports (e.g., Lefebvre and Lefebvre 2001). A very few recent econometric studies have begun to explicitly look at the link between SMEs and production networks (e.g., Harvie, Narjoko, and Oum 2010; Kyophilavong 2010; and Rasiah, Rosli, and Sanjivee 2010). Several studies report that the characteristics of firms vary widely within industries. Firms which are involved in exports or production networks are larger, more efficient, and have higher levels of skills than other firms. Relevant studies will be discussed below in order to formulate hypotheses for empirical testing in this paper.

Firm size. Most studies are based on the conventional assumption that large firms are more competitive than SMEs in international markets (see Zhao and Li 1997; van Dijk 2002; Srinivasan and Archana 2011). A positive relationship between size and exports is thus reported. Similar arguments can be made about participation in production networks through direct and indirect exporting. Owing to scale economies, larger firms may have lower average and marginal costs, which would increase the probability of participation in production networks. Furthermore, large firms have more resources to meet the fixed costs of entry into production networks (e.g., information, marketing, and technology expenses). A few studies, however, report no relationship or a negative one. This conflicting result can be partly attributed to the non-linear nature of this relationship (Kumar and Siddarthan 1994; Lefebvre and Lefebvre 2001). It may be that economies of scale and fixed costs are significant in the early stages of joining production networks but less relevant in the longer term. For instance, SMEs may join together in industrial clusters and collectively overcome the disadvantage of firm size. Alternatively, some SMEs might concentrate on niche markets and emerge as leading enterprises. As a result of the above discussion, the following hypothesis is proposed. *Hypothesis 1—firm size is expected to have a positive effect on participation in production networks up to a given threshold, but may not matter later on.*

Foreign ownership. A joint venture with a foreign partner (or 100% foreign equity) facilitates participation in production networks, as it enables SMEs to reap the ownership advantages of parent companies (Wilmore 1992; Nguyen 2010; Srinivasan and Archana 2011). First, access to the superior marketing connections and know-how of parents enables direct and indirect exporting. Second, access to parents' accumulated learning experience of export production as well as access to sophisticated technologies and management experience improves technical efficiency. The transfer of such ownership-specific advantages depends on whether the foreign firm has a controlling interest in the domestic venture. A controlling interest typically can occur with minority foreign equity in a project rather than total foreign equity. In most of the previous literature on firm-level exporting and participation in production networks, it has been consistently observed that foreign ownership matters. These arguments lead to the following proposition. *Hypothesis 2—foreign ownership is positively related to participation in production networks because it provides access to superior marketing, technology, and management expertise.*

Human Capital. Within a given activity, a higher level of human capital contributes to a firm's export performance. Higher levels of human capital are generally linked with development of more effective business strategies and more rapid technological learning that can provide a

competitive edge at enterprise-level (van Dijk 2002; Dunas-Caparas 2006). SMEs with a stock of high-quality human capital are expected to be more likely to engage and perform well in production networks as this is essential for forging close supplier-relationships with large exporters, effective technology transfer, and efficient production of orders (Harvie, Narjoko, and Oum 2010). Although human capital at all levels is important, workers' education and the chief executive officer (CEO)'s education and experience are particularly significant for SMEs involved in production networks. A literate workforce made up of high school graduates is more productive and adaptive to new technology than one that is not. Furthermore, a CEO with a college degree or vocational training as well as work experience may have a better business attitude (i.e., in terms of risk taking or willingness to implement new business ideas). In very small firms, with few high school-educated workers, much of the firm's human capital may be reflected in the quality of the CEO's education and experience. Accordingly, *hypothesis 3* can be written as*: higher levels of human capital—in terms of secondary level educated workers or well-educated and experienced CEOs—is positively related to participation in production networks.*

Technological Capabilities. Previous empirical studies indicate that firm-level technological capabilities contribute to export performance (Zhao and Li 1997; Hobday 2001; Rasiah 2004; Wignaraja 2002 and 2011). Building technological capabilities in developing country firms, particularly SMEs, is not just a simple function of years of production experience. Rather, it requires conscious investments in creating skills and information to operate imported technology efficiently. Such investments involve a spectrum of technological activities such as technology search, quality management, engineering, and R&D activities (Kumar and Siddarthan 1994; Lefebvre and Lefebvre 2001). Importing technology through foreign licenses is an important mechanism for transfer of new technologies and internal capability building. Furthermore, foreign buyers and subcontractors view internal quality standards (e.g., International Organization for Standardization [ISO] certification) as increasingly compulsory for SMEs to qualify as potential suppliers. Developing new products (or modifying existing products) and taking out patents to protect intellectual property rights also facilitate export competitiveness in SMEs. These considerations suggest *hypothesis 4—SMEs that have acquired high levels of technological capabilities are more likely to succeed in production networks*.

Age. The older the firm, the more accumulated experience in production and tacit knowledge, which is likely to facilitate participation in production networks. Alternatively, mature firms may become complacent with an over-reliance on accumulated experience and set in past ways. Meanwhile, younger firms may be at an advantage in joining production networks for two reasons. First, younger enterprises may use relatively modern technology, which increases productivity and product quality (Van Dijk 2002). Second, they may be more proactive in learning about business and technological opportunities in production networks. For instance, younger firms may be more nimble in seeking out new sources of information and external knowledge such as market information from buyers of output or technical know-how from equipment suppliers. Younger firms may be more flexible in combining external and internal information to realize opportunities in production networks. Bearing in mind these different possibilities, the following hypothesis is put forward: *hypothesis 5—firm age needs to be controlled for when looking for relationships between factors affecting firm-level participation in production networks*.

Access to credit. Access to credit for working capital and investment is typically a binding constraint on SMEs involvement in production networks (Harvie, Narjoko, and Oum 2010). Capital markets in developing countries are highly segmented into a formal bank sector and informal sources due to various market imperfections associated with underdevelopment. Credit from commercial banks is usually cheaper than finance from informal credit sources but requires

substantial information about balance sheets and collateral. Many SMEs find it difficult to provide the requisite financial information and collateral and instead rely on internally generated funds or more expensive informal sources. This puts them at a cost disadvantage compared to well-organized SMEs with an established record with commercial banks. The following hypothesis emerges: *Hypothesis 6—SMEs with access to bank credit are more likely to join production networks than other firms.*

3. EMPIRICAL METHODOLOGY

In order to examine the firm-level characteristics shaping SMEs' and all manufacturing firms' participation in production networks, the following general equation is estimated:

$$\boldsymbol{Y} = \beta \boldsymbol{X} + \varepsilon \,, \tag{1}$$

where $\boldsymbol{Y}$ is the vector denoting participation in production networks at the firm-level, $\boldsymbol{X}$ is the matrix of explanatory variables, β is the matrix of coefficients, and ε is the matrix of error terms.

Participation in production networks is captured by a binary variable reflecting different activities by firms in such networks, particularly SMEs. The Probit model in two alternative forms was used here. In the first, the dependent variable takes a value of 1 if a firm undertakes any form of activity in a production network (i.e., as an exporter, an indirect exporter, or some combination of the two) and 0 for a wholly domestic-market oriented firm. In the second, the dependent variable is 1 if the firm's primary mission is to export (defined as more than total sales being exported globally) and 0 otherwise. The first captures all involvement of firms in production networks regardless of the intensity of exporting or indirect exporting behavior of a given firm. While this definition is inclusive, it encompasses a range of participation in production networks from occasional and limited involvement of firms to more sustained involvement. Accordingly, the second was formulated to represent a more focused mission of sustained involvement in production networks through exports. It is interesting to examine whether the determinants are the same for both models. Our approach refines previous work which did not distinguish between different activities undertaken by SMEs in production networks. For instance, Havie, Narjoko, and Oum (2010) simply define SME participation in production networks according to whether it is a supplier, importer of intermediate goods, or exports some of its products.

The hypotheses were described in section 2. The explanatory variables in $\boldsymbol{X}$ in equation (1) are described below and Table 1 has a summary.

Firm size is represented by the number of employees. This is commonly used in empirical work as other measures like value-added or output are more susceptible to variations in macroeconomic conditions. To provide additional insights, a size-squared variable was also added to some of the models.

Foreign ownership is captured by a dummy variable which takes a value of 1 if the firm has any foreign equity. The standard measure—share of foreign equity—seems to suffer from some noise and may be correlated with number of employees.

Human capital is proxied by the following variables: (i) a dummy variable which is 1 if the average production worker has high school education; (ii) four dummy variables to capture different levels of educational attainment of the CEO from primary schooling to college education; and (iii) the number of years of work experience of the CEO. In line with the hypothesis on human capital, these variables attempt to capture the average quality of education of workers and the CEO. In addition, the CEO's experience is included. Most

unfortunately, data was not available from the World Bank surveys on the share of engineers and technicians in employment to capture technical-level skills.

Table 1: Description of Variables

Variable	Description
Independent	
Size	No. of permanent workers
Size squared	Square of the no. of permanent workers
SME	Firm has fewer than 100 employees (1–99)
Foreign ownership	1 if firm has foreign ownership; 0 otherwise
Workers HS	1 if average production worker has high school (HS) education; 0 otherwise
GM primary	1 if general manager/CEO's highest level of education is primary school; 0 otherwise
GM secondary	1 if general manager/CEO's highest level of education is HS; 0 otherwise
GM vocational	1 if general manager/CEO's highest level of education is vocational; 0 otherwise
GM college	1 if general manager/CEO's highest level of education is college; 0 otherwise
GM experience	No. of years of work experience of the GM/CEO
Foreign license	1 if firm uses technology licensed from foreign-owned company (excluding software); 0 otherwise
ISO	1 if firm has a form of internationally-agreed certification (e.g., ISO 9000, 9002); 0 otherwise
Patent	1 if firm has registered patent; 0 otherwise
Age	No. of years in operation
Access to credit	1 if firm has credit line/loan from financial institution; 0 otherwise
Philippines	1 if firm is located in the Philippines; 0 otherwise
Indonesia	1 if firm is located in Indonesia; 0 otherwise
Viet Nam	1 if firm is located in Viet Nam; 0 otherwise
Malaysia	1 if firm is located in Malaysia; 0 otherwise
Thailand	1 if firm is located in Thailand, 0 otherwise
Dependent	
1. All firms in PN	1 if more than 0 % of sales are exported (directly or indirectly); 0 otherwise
2. Sustained exporter	1 if more than 40 % of sales are directly exported; 0 otherwise

Technological capabilities are represented by several variables: (i) a dummy variable which is 1 when a firm has a technology license; (ii) a dummy variable which is 1 when a firm has a form of internationally agreed quality certification (e.g., ISO 9000 or 9002); and (iii) a dummy variable which is 1 when a firm has registered a patent. Technological capabilities are hard to measure and empirical work has either used aspects of technological activity (e.g., quality certification, patents, etc.) or a composite index of technological capability made up of different technical functions performed by enterprises to assimilate imported technologies. The chosen variables were the only technology variables included in the dataset for Philippines, Indonesia, and Viet Nam. Accordingly, these were included and a composite index could not be constructed.

Age is represented by the number years in operation of the firm. This is more accurate than number of years since establishment as there can be a lag between the legal incorporation of a firm and the start-up of plant operations.

Access to credit is proxied by a dummy variable which is 1 if a firm has a credit line/loan from a formal financial institution.

In addition, four country dummy variables were included to capture country-specific effects of the five ASEAN countries.

4. DESCRIPTION OF THE DATA

4.1 Data and Sample Characteristics

A major constraint facing research on SMEs in ASEAN economies is the dearth of data at sectoral level and the use of different definitions of what is an SME (e.g., sales, employment, assets, and value of equipment).[4] Accordingly, this paper relied on firm-level data. Enterprise-level data for manufacturing enterprises from the World Bank's *Enterprise Surveys* (conducted at infrequent intervals in given countries) were used for the investigation of the role of SMEs in production networks in ASEAN economies. This is the only relatively detailed and recent firm-level dataset currently available for these countries. The data are not publicly available but it is possible to apply to the World Bank for access for research purposes. The data for Malaysia and Thailand are for 2006, while the rest are for 2008. Stratified random sampling with replacement was the sampling methodology used.[5] Face-to-face interviews using a common questionnaire were conducted with business owners and senior managers of electronics firms.

The surveys provide cross-section firm-level information on direct and indirect exports, employment, ownership, human capital, technology, access to credit, and aspects of the policy regime. Table 2 provides a snapshot of the enterprise dataset for the five ASEAN economies according to firm size, ownership, and sector. The dataset largely consists of a total of 5,900 manufacturing firms with reasonable samples of over 1,000 firms for each ASEAN country. A majority of the total sample (69.3%) consists of SMEs (i.e., those with fewer than 100 employees), which is useful from the perspective of this paper. SMEs as a percentage of total number of firms varies by country: Malaysia (62.7%), Thailand (51.6%), Philippines (78.2%), Indonesia (82.1%), and Viet Nam (65.3%). About a

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[4] For instance, in Malaysia SMEs are defined by sales, employment, and type of industry. In Indonesia, different government agencies seem to have different definitions of what constitutes an SME.

[5] This means that all population units are grouped within a homogenous group and simple random samples are selected within each group. This method allows computing estimates for each of the strata with a specific level of precision while population estimates can also be estimated by properly weighting individual observations. The strata for Enterprise Surveys are firm size, business sector, and geographic region within a country. In most developing countries, small and medium-sized enterprises form the bulk of the enterprises. Large firms are oversampled in the firm surveys as they tend to be engines of job creation. For more details of the sampling methodology see www.enterprisesurveys.org/methodology.

quarter of the total sample has some proportion of foreign equity. The share of firms with foreign equity as a percentage of total number of firms is highest in Thailand and Malaysia and lowest in Indonesia.

Table 2: Sample Characteristics

	All firms	Malaysia	Thailand	Philippines	Indonesia	Viet Nam
Number of all firms	5,900	1,082	1,043	1,310	1,422	1,043
By sector, % of distribution						
Garment	11.4	8.2	15.2	10.8	11.6	11.2
Textile	7.6	3.5	12.8	0.2	12.5	9.6
Machinery and Equipment	3.6	8.5	8.0	0.2	0.5	2.7
Electronics/Electrical Appliances	2.3	8.9	8.7	9.6	0.4	1.8
Rubber and Plastic	15.0	25.3	24.7	13.4	10.5	3.0
By size, % of distribution						
SME	69.3	62.7	51.6	78.2	82.1	65.3
Large	30.7	37.3	48.4	21.8	17.9	34.7
By ownership, % of distribution						
Foreign	25.5	30.5	59.9	23.3	6.8	14.0
Domestic	74.5	69.5	40.1	76.7	93.2	86.0

Source: Author's calculations

4.2 SMEs in Production Networks

Table 3 provides information on the number of firms in production networks (i.e., direct and indirect exporters), SMEs in production networks as a percentage of all SMEs, and large firms in production networks as a percentage of all large firms. A further breakdown of SMEs between small (1–49 employees) and medium (50–99 employees) is also provided. The following can be observed:

- A minority of the sample firms (37.3% of the total) are in production networks. More developed ASEAN economies such as Malaysia and Thailand have particularly high representation in production networks (nearly 60% of their firms participate). Viet Nam (36.4%) comes next. The Philippines (26.9%) and Indonesia (14.5%) have relatively low participation in production networks.

- Large firms are the major players in production networks with 72.1% of all large firms participating. Most of the large firms in Malaysia and Thailand are involved in production networks and over half the large firms in the remaining three countries.

- SMEs are minor players in production networks as only 22% of SMEs as a percentage of all SMEs participate. SME participation rates vary considerably across ASEAN countries. As much as 46.2% of all SMEs in Malaysia and 30% of all SMEs in Thailand are involved in production networks. In Viet Nam the figure is 21.4% and in the Philippines 20.1%. Indonesia seems an outlier with only 6.3% of all SMEs involved in production networks.

- A small fraction of SMEs in production networks are 100% global exporters. The vast majority of such SMEs engage in either a mix of global exports and indirect exporting, or purely indirect exports. Accordingly, only 18.2% of SMEs in production networks in all the countries are 100%

global exporters. The figures by country are as follows: Malaysia (14.1%), Thailand (16.4%), Philippines (27.2%), Indonesia (15%), and Viet Nam (19.2%).

Table 3: Role of SMEs and large firms in Production Networks

	All Countries	Malaysia	Thailand	Philippines	Indonesia	Viet Nam
Number of firms in PN	2203	646	619	352	206	380
PN firms as a percentage of all firms, %	37.3	59.7	59.3	26.9	14.5	36.4
SMEs in PN (1–99 employees) as a percentage of all SMEs, %	22.0	46.2	29.6	20.1	6.3	21.4
Large firms in PN as a percentage of all large firms, %	72.1	82.4	91.1	51.1	52.0	64.6

Source: Author's calculations.

Figure 1 shows the percentage of exports from SMEs and large firms in total exports. SMEs make a limited contribution to exports (23%) in all countries compared with large firms (77%). Unfortunately, time series data on exports by firm size are not available from the World Bank surveys. Methodological difficulties notwithstanding, a rough indication may be obtained by comparing this figure for the late-2000s for the share of SME exports with the estimate by Harvie and Lee (2002) for the late-1990s. This crude comparison suggests that the percentage of SME exports in ASEAN economies rose from 14.3% to 23% between the late-1990s and the late-2000s. The country-level pattern of SME export shares is broadly reflective of the picture of SME participation in production networks. Malaysia (28.1%) and Thailand (34.7%) are among the leaders in terms of SME export shares. The Philippines, unexpectedly, has a similarly high SME export share (33.4%) which may partly reflect the high proportion of SME numbers in the country sample. Viet Nam has an SME export share of 16.8%, while Indonesia has 9.3%.

**Figure 1: Share of SME and Large Firm Exports in Total Exports**
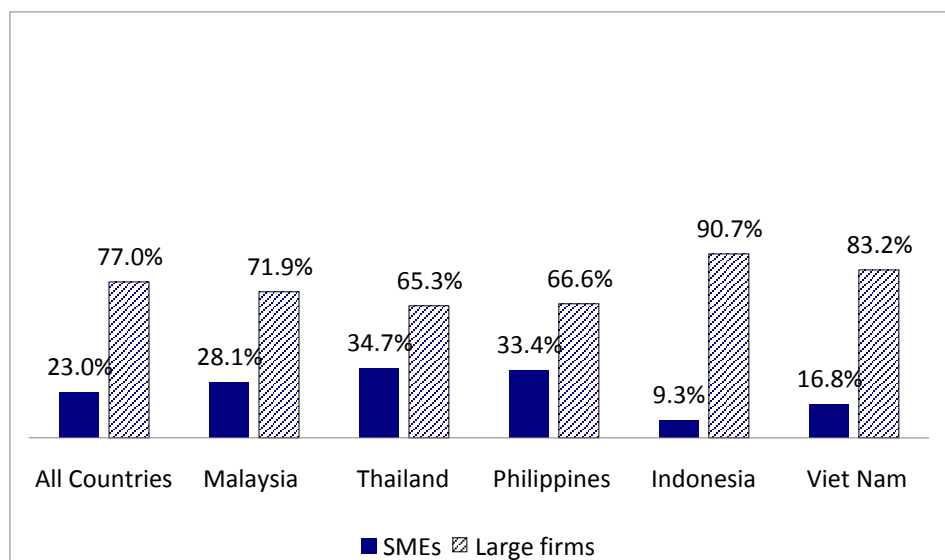
Source: Author's calculations.

Another dimension of SME exporting is provided in Figure 2 which shows the share of the top 25% of SME exporters in terms of export value. SME exports are highly concentrated in a relatively few firms in the ASEAN economies—the top 25% of SMEs accounts for 85.8% of SME exports in all countries.

Concentration in the top 25% SME exporters is highest in Indonesia (96.3%). This is followed by Thailand (85%), the Philippines (78.9%), Viet Nam (76.2%), and Malaysia (69.9%).

Figure 2: Share of Top 25% SME Exporters
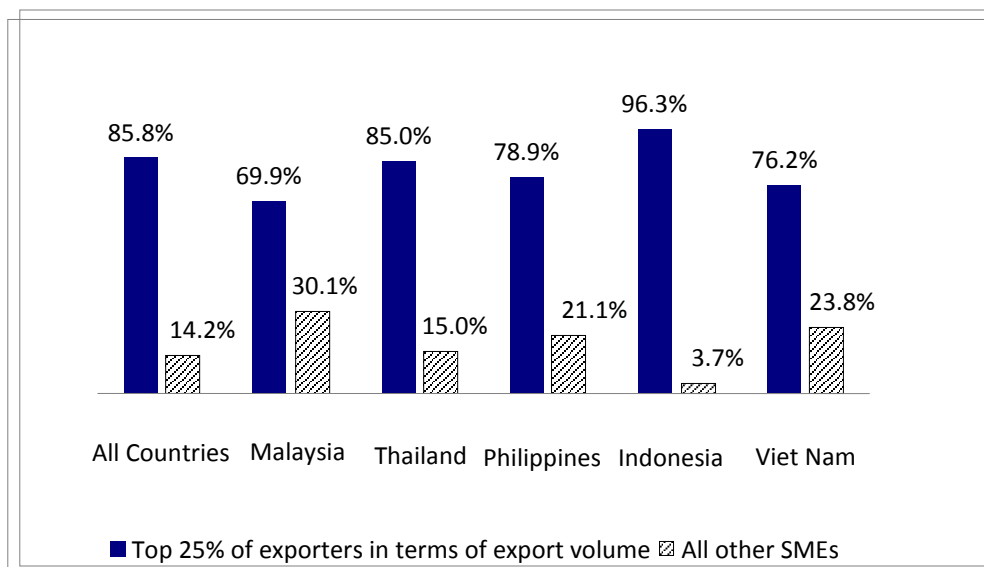
Source: Author's calculations.

Next, we turn to analysis of factors influencing SME participation in production networks.

5. T-TEST AND ECONOMETRIC RESULTS

5.1 T-test Results

Given the paucity of literature on SMEs in production networks in ASEAN economies, what initial inferences can be drawn about differences between SMEs in production networks and other SMEs (i.e., those not in production networks)? Table 4 shows the means values of characteristics of SMEs in production networks and other SMEs, along with their T-values. Five findings are noteworthy:

- SMEs in production networks are larger than other SMEs. SMEs in production networks in Malaysia (49.9 employees) are the largest and followed by Viet Nam (46 employees), Indonesia (42 employees), Thailand (41.7 employees), and the Philippines (40.3 employees). Meanwhile, other SMEs range from 39.6 employees in Malaysia to 16.5 employees in Indonesia.

- Underlining the link between size and foreign equity, there is a significant difference in the share of foreign equity between SMEs in production networks and other SMEs. SMEs in production networks in the Philippines have the highest average foreign equity share, 36.6%, compared with 26.8% in Indonesia, 23% in Malaysia, 20.2% in Thailand, and 10.8% in Viet Nam.

- There is a significant difference in high school education between SMEs in production networks and other SMEs in all the countries except Malaysia. Likewise, there is a significant difference in international agreed quality certification between SMEs in production networks and other SMEs in all the countries.

- SMEs in production networks are somewhat younger than other SMEs in three countries, but not significant. SMEs in production networks are older than other SMEs in Viet Nam and Indonesia, but the difference is only significant in Viet Nam.

Table 4: T-test on Key Variables for SMEs in Production Networks vs SMEs Outside Production Networks

	SMEs in PN	SMEs not in PN	(SMEs in PN- SMEs not in PN)
All Countries			
Size (mean)	43.5	25.0	+***
Foreign ownership, (mean %)	24.2	4.3	+***
Age (mean)	15.1	14.8	+
Workers HS, dummy (%)	68.8	38.2	+***
ISO, dummy (%)	27.5	8.9	+***
Malaysia			
Size (mean)	49.9	39.6	+***
Foreign ownership, (mean %)	23.0	5.9	+***
Age (mean)	18.1	19.4	-
Workers HS, dummy (%)	84.3	72.8	+
ISO, dummy (%)	27.0	12.4	+***
Thailand			
Size (mean)	41.7	30.7	+***
Foreign ownership, (mean %)	20.2	6.1	+***
Age (mean)	12.0	12.5	-
Workers HS, dummy (%)	90.4	89.3	+***
ISO, dummy (%)	29.1	11.5	+***
Philippines			
Size (mean)	40.3	25.4	+***
Foreign ownership, (mean %)	36.6	7.6	+***
Age (mean)	16.5	18.2	-
Workers HS, dummy (%)	55.1	33.0	+***
ISO, dummy (%)	35.4	15.5	+***
Indonesia			
Size (mean)	42.0	16.5	+***
Foreign ownership, (mean %)	26.8	1.1	+***
Age (mean)	17.0	15.0	+
Workers HS, dummy (%)	44.6	16.0	+***
ISO, dummy (%)	18.9	3.2	+***
Viet Nam			
Size (mean)	46.0	27.3	+***
Foreign ownership, (mean %)	10.8	4.3	+***
Age (mean)	9.2	7.8	+**
Workers HS, dummy (%)	42.5	3.9	+***
ISO, dummy (%)	17.8	6.2	+***

Significant at *** - 1%, **-5% and *-10% levels.

Source: Author's calculations.

5.2 Econometric Results

Analysis of means and t-tests provide some insights into the potential relationships between participation in production networks and enterprise characteristics but do not shed light on directions of causality. Thus a Probit model was used to estimate the equation specified in Section 3 using the two alternative dependent variables but with the same set of determinants. The results of the Probit regressions are shown in Table 5. Column 1 shows the results of the model for all SMEs in production networks, while the results for sustained SME exporters are in column 2. The results for all manufacturing firms are in columns 3 and 4.

Following diagnostic testing, we first consider the results for SMEs and then for all manufacturing firms. As indicated by a higher R^2, the all-SMEs-in-production-networks model better fits the outcome data than the sustained-SME-exporters model. Many of the firm-specific variables are significant, as hypothesized. The coefficient of firm size is positive and significant, as expected, in both models. Accordingly, firm size generally increases the probability of SMEs participating in production networks. It is interesting to examine predicted probabilities of the size variable holding all other variables at their means.[6] In the all-SMEs model (column 1) the probability of an SME participating in a production network for a firm with 1 to 25 workers is 10%, compared to 35% for one that has 75 to 100 workers. This result suggests that economies of scale can be important to overcome the initial fixed costs of entering such networks. The linearity of the size effect is investigated below with a larger enterprise sample in the all-manufacturing-firms model.

The foreign ownership variable has a positive and significant effect on the probability of SME participation in production networks in both models. Having any proportion of foreign equity corresponds to a 31% probability of an SME joining a production network in the all-SMEs model 1 (column 1). This is double the 15% figure for a wholly-domestically-owned SME. Access to the superior marketing connections and know-how of parents enables direct and indirect exporting by SMEs. Furthermore, access to parents' accumulated learning experience of export production as well as access to sophisticated technologies and management experience improves technical efficiency in SMEs.

The coefficient on workers high school education is positive and significant in both models. Having a high school-educated workforce increases the probability of an SME joining a production network from 14% to 21% in the all-SMEs model 1. Furthermore, the CEO's experience is positive and significant in the sustained-SME-exporters model. These results suggest that higher levels of human capital, particularly literate secondary-level educated workers and experienced CEOs, increase the probability of SME participation in production networks.

The coefficient on internationally agreed quality certification is positive and significant in both models. Having an internationally agreed quality certificate (like ISO) increases the probability of an SME joining a production network from 16% to 25% in the all-SMEs model 1. In addition, foreign licenses and registered patents are significant with the correct sign in the all-SMEs model. Accordingly, SMEs which have acquired higher levels of technological capabilities are more likely to succeed in production networks. This requires SMEs to undertake conscious investments in skills and information to operate imported technologies rather than simply learning by doing. Capability building in SMEs involves a range of technological activities including actively acquiring new technologies through foreign licenses, implementing international quality standards, and developing new products supported by patent protection.

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[6] The same assumption is made for all the probabilities given in the text. A complete set of results on predicted probabilities is available on request.

Table 5: Probit Estimates

Binary Variable: 1 if part of production network, 0 otherwise

	SMEs only		All firms	
	All firms in PN	Sustained exporter	All firms in PN	Sustained exporter
	All	All	All	All
	[1]	[2]	[3]	[4]
Firm Size	0.012***	0.010***	0.002***	0.001***
	(0.001)	(0.001)	(0.000)	(0.000)
Firm Size squared			-0.000***	-0.000***
			(0.000)	(0.000)
Foreign Ownership	0.547***	0.500***	0.566***	0.533***
	(0.071)	(0.081)	(0.050)	(0.053)
GM has primary education	0.329	0.070	0.167	0.131
	(0.415)	(0.499)	(0.285)	(0.365)
GM has secondary	0.482	0.086	0.372	0.256
	(0.404)	(0.487)	(0.273)	(0.351)
GM has vocational degree	0.538	0.156	0.516*	0.387
	(0.407)	(0.491)	(0.276)	(0.354)
GM has college degree	0.515	0.159	0.595**	0.564
	(0.403)	(0.484)	(0.272)	(0.349)
GM's experience	0.003	0.007**	0.003	0.005**
	(0.003)	(0.003)	(0.002)	(0.002)
Workers have HS education	0.255***	0.162**	0.181***	0.053
	(0.059)	(0.071)	(0.045)	(0.050)
Firm uses foreign licenses	0.196***	0.093	0.169***	0.027
	(0.073)	(0.087)	(0.055)	(0.061)
Firm is ISO certified	0.311***	0.144*	0.403***	0.100*
	(0.071)	(0.084)	(0.049)	(0.053)
Firm has registered patents	0.218***	0.055	0.331***	0.063
	(0.073)	(0.090)	(0.056)	(0.062)
Access to credit	0.094*	-0.005	0.141***	0.045
	(0.054)	(0.066)	(0.042)	(0.046)

	SMEs only		All firms	
	All firms in PN	**Sustained exporter**	**All firms in PN**	**Sustained exporter**
Firm Age	-0.004*	-0.011***	-0.004*	-0.009***
	(0.003)	(0.003)	(0.002)	(0.002)
Philippines	0.260**	0.143	-0.201**	-0.166*
	(0.110)	(0.126)	(0.080)	(0.085)
Indonesia	-0.130	-0.322**	-0.399***	-0.391***
	(0.117)	(0.143)	(0.082)	(0.091)
Viet Nam	0.425***	0.060	0.156*	-0.099
	(0.112)	(0.133)	(0.080)	(0.087)
Malaysia	0.841***	0.526***	0.634***	0.452***
	(0.094)	(0.107)	(0.068)	(0.070)
Pseudo-R-squared	0.205	0.146	0.267	0.178
N	3903	3903	5641	5641

* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Robust standard errors in parentheses

Thailand was used as reference.

All firms in PN: 1 if more than 0 % of sales are exported (directly or indirectly); 0 otherwise

Sustained exporter 1 if more than 40% of sales are directly exported; 0 otherwise

Source: Author's calculations.

The firm age variable is negative and significant in both models, thereby rejecting the hypothesized positive sign. While age may be a proxy for many influences, this result suggests that younger firms are likely to be more nimble in learning new market and technological information and more flexible in combining internal and external knowledge in an efficient manner. Both of these traits are likely to facilitate younger firms joining production networks.

Access to commercial bank credit is positive and significant in the all-SMEs model. This suggests that, in the presence of capital market imperfections, well-organized SMEs with collateral and an established record with commercial banks are more likely to join production networks.

The significance of the coefficients on the country dummies suggests that some differences exist between the ASEAN countries. Malaysia is significant in both models. With opposite signs, Viet Nam is significant in the SMEs model, while Indonesia is significant the sustained-exporter model.

Turning to the two all-manufacturing-firms models (columns 3 and 4), the all-firms-in-production-networks model is likewise a better fit to the outcome data than the sustained-exporters model. The two all-manufacturing-firms models provide a somewhat better fit than the two SME models (compare the R^2 in columns 3 and 4 with columns 1 and 2). Interestingly, several variables (firm size, foreign ownership, workers high school education, international quality certification, and firm age) turn out as significant with the correct sign in both all-manufacturing-firm models. Hence, the key determinants of firm-level participation in production networks are remarkably stable across the four models, suggesting that the pattern for SMEs broadly holds for all manufacturing firms.

There are also some differences between the all-manufacturing-firms models and the SME models. Adding a size-squared variable in the all-manufacturing-firms model was useful in clarifying the size effect. The coefficient on size-squared is negative and significant, implying a non-linear relationship. It seems that economies of scale and fixed costs are important in the early stages of joining production networks, but less relevant over time as SMEs become important players in their own niche markets or form industrial clusters. Furthermore, the CEO's characteristics are more pronounced in the all-firms-in-production-networks model (column 3) with significant coefficients for college degrees and vocational education. Higher levels of CEO education are clearly required for more complex, scale economy-intensive operations associated with firm size in production networks. Finally, country characteristics matter but differ between the all-manufacturing-firm models with all four country dummies significant in the all-firms-in-production-networks model, but only two in the sustained-exporter model.

6. EXPLORING SELECTED POLICY INFLUENCES

The overall business environment in ASEAN economies is an important influence on SME participation in production networks. A myriad of reform policies, factor markets, and targeted SME policies are involved. These range from trade policies and customs regulations, business start-up regulations, export promotion initiatives, and special financing schemes to technology support measures.[7] It is hard to portray the overall business environment for SMEs in ASEAN economies and disentangle the different effects on firms. One practical method is to use available data on enterprise perceptions to examine the supportive nature of the policy regime facing SMEs in their quest to participate in production networks.

Table 6 lists the main obstacles to conducting business in the ASEAN economies identified by the SMEs using information from the World Bank's Enterprise Surveys. These are grouped under three headings: incentive framework, supply-side factors, and other. The discussion below highlights SMEs' views of major obstacles facing them for all ASEAN economies and for individual

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[7] It is recognized that the developing industrial clusters involving SMEs and large firms are also an important means to promote SME entry into production networks. However, a lack of data on this aspect meant that clustering and cluster promotion could not be examined in this paper (see Fischer and Reuber 2003).

Table 6: Perceived Major or Severe Obstacles to Conducting Business, SME firms (% of SME firms)

	All Countries	Malaysia	Thailand	Philippines	Indonesia	Viet Nam
Incentives						
Tax rates	31.9	31.1	54.8	42.9	14.3	16.5
Tax administration	26.7	24.0	49.6	34.2	13.3	12.4
Customs and trade regulations	20.0	20.1	41.0	18.0	12.5	8.7
Business licensing and permits	16.7	16.4	25.4	22.1	16.5	2.8
Political instability/economic uncertainty	34.7	28.8	84.0	28.9	29.5	2.3
Supply side						
Transport	23.8	11.3	33.6	26.5	23.2	24.2
Electricity	29.6	17.9	42.4	30.6	30.2	26.7
Telecommunication	10.4	9.3	24.5	7.6	6.6	3.8
Access to finance/credit	34.6	22.1	44.3	28.5	38.6	39.4
Inadequately-educated labor force	28.0	24.1	60.2	16.8	15.4	23.7
Labor regulations	17.4	17.2	35.2	15.5	11.3	8.0
Access to land	16.0	11.1	11.7	9.6	19.2	28.3
Other						
Crime, theft and disorder	24.5	25.3	53.7	16.5	21.4	5.8
Corruption	30.1	20.6	59.7	37.4	23.4	9.5
Practices of competitors in informal sector	38.6	20.7	55.9	44.5	36.6	35.3

Source: Author's calculations.

economies. The data for Thailand should be interpreted with caution as the survey was conducted in 2008 during a period of political turbulence and uncertainty.

Contrary to expectations, the leading obstacle facing SMEs in all ASEAN economies falls under the heading of "other" and relates to the practices of competitors in the informal sector. Cited by 38.9% of all SMEs in ASEAN economies, such practices refer to a variety of negative activities including smuggling of goods and inputs, price fixing and other anti-competitive practices, and poaching of skilled workers. A high degree of trust among firms is increasingly regarded by MNCs as a critical ingredient for developing market-led production networks. Among other things, high levels of trust encourages positive collective behavior among firms—such as sharing of sensitive information, pooling of technical knowledge, and joint production and marketing activities—which is critical in technologically intense, efficient production networks. However, the data are suggestive of a general "trust deficit" among SMEs in ASEAN economies which impedes the development of production networks with greater SME involvement. Interestingly, Malaysian SMEs (20.7%) seem to view the practices of competitors much less seriously than the other ASEAN economies suggesting that higher levels of trust exist among its enterprises.

A variety of supply-side factors are viewed as an obstacle by SMEs. The usual constraint in most studies of SMEs—access to finance (34.6%)—follows closely as the second most important obstacle in ASEAN economies. This issue seems least severe in Malaysia (22.1%) and most severe in Viet Nam (39.4%) and Indonesia (38.6%). Both the high cost of borrowing and the availability of financing from commercial banks fall under this heading. Inter-country differences in access to finance partly reflect the influence of monetary policies and the development of capital markets. A lack of financing is a deterrent to some firms investing in new equipment, technologies, and marketing methods which are needed to participate in production networks.

Bottlenecks pertaining to physical infrastructure and worker skills also show up as impediments to SMEs joining production networks in ASEAN economies. Electricity costs (and some fluctuations in supply) were cited by 29.6% of SMEs in all ASEAN economies and the quality of transport systems (roads, rail, and ports) by another 23.8%. High electricity costs and the quality of transport systems appear to be less of a problem in energy producers (e.g., Malaysia and Indonesia) than in the three energy importers. Relative infrastructure gaps in energy-importing ASEAN economies was reflected in poorer connectivity and higher trade costs compared with energy producing economies.

An inadequately educated labor force was mentioned as a problem by 28% of SMEs in all ASEAN economies, but Thailand, Malaysia, and Viet Nam report higher figures than the other economies. This pattern may reflect skill shortages and rising wage costs in part associated with moves in the direction of full employment. Amidst a tightening labor market, labor regulations were perceived to be more of a problem for SMEs in Malaysia and Thailand than in the other ASEAN economies.

In contrast, access to land is generally not seen as an obstacle, with only 16% of SMEs in all ASEAN economies highlighting this issue. Within this overall picture, however, SMEs in Viet Nam (28.3%) may have some concerns in relation to access to land.

On the policy and incentive front, regulatory issues at the border seem to be a limited concern. For instance, only 20% of SMEs in all ASEAN economies cited customs and trade regulations as a concern. This may reflect the fact that tariffs are quite low in ASEAN economies and that customs administrations have been improved due to decades of gradual trade reforms. Thailand may be somewhat of an outlier, and the issue may relate to customs administration rather than trade regulations per se. Thus, customs and trade regulations generally do not seem to be an important impediment to SMEs participating in production networks.

There are mixed views about some behind-the-border regulatory issues. Business licensing and permits are not a widespread problem in ASEAN economies, with only 16.7% of firms pointing to this issue. Meanwhile, tax policy issues do matter. In this vein, high corporate tax rates were cited by 31.9% of SMEs and gaps in tax administration by another 26.7%. Tax policy issues directly affect enterprise profitability and the incentive to participate in production networks. These issues

appear to be a particular concern in the Philippines and Thailand and, to a lesser extent, in Malaysia.

According to 34.7% of SMEs in all ASEAN economies economic uncertainty is also a notable impediment. However, a closer look at the data indicates that this figure is partly attributed to Thailand (84%) being an outlier for an unusually long period of domestic political turbulence. With the exception of Viet Nam (2.3%), some concerns about economic uncertainty were also expressed in the other ASEAN economies.

Finally, corruption was mentioned by 30.1% of SMEs in all ASEAN economies and crime, theft, and disorder by another 24.5%, indicating that these are significant issues for SMEs.

Thus far, the availability of enterprise-level data on the five ASEAN economies has limited further exploration of supply-side factors influencing SME participation in production networks. The important area of business services markets and business service providers for SMEs has not been discussed. Fortunately, some data for Malaysia and Thailand only on SMEs' ranking of the affordability and quality of business services in the country was obtained from the World Bank's Enterprise Surveys. This is provided in Table 7 for six kinds of business services.

Table 7: SME Firms' Perception of Business and Support Services

Quality of business services available in their country (1 = very poor; 4 = very good)				
	Malaysia		**Thailand**	
	Affordable	**Quality score**	**Affordable**	**Quality score**
Business services available in the country – quality (average)	69.4%	3.2	42.6%	2.8
Engineering and design	57.4%	3.1	15.4%	2.8
Management and marketing	69.8%	3.1	8.4%	2.6
Accounting	81.9%	3.3	84.2%	3.0
Legal services	69.3%	3.1	35.1%	2.8
Insurance	78.6%	3.2	81.2%	3.0
IT services	59.4%	3.1	31.2%	2.8

Source: Author's calculations.

The main findings are as follows:

- On average, Malaysia seems to have more affordable and higher-quality business services than Thailand. Thus, 69.4% of SMEs in Malaysia said that business services were affordable, compared with only 42.6% in Thailand. Likewise, the quality of business services in Malaysia were ranked at 3.2 and those in Thailand at 2.8 (where 4 is very good).

- Looking at individual services, there is little variation in the good quality of individual business services in Malaysia. But technology services (engineering and design services as well as IT services) are somewhat less affordable compared with other services.

- Meanwhile, Thailand shows notable variation in terms of affordability and quality of business services. Strikingly, engineering and design (15.4%), management and marketing (8.4%), and IT services (31.2%) are considered less affordable than other business services. In terms of service quality, marketing and management services (2.6%) are rated lower than other business services.

7. CONCLUSIONS AND POLICY IMPLICATIONS

This paper examined the role of SMEs in production networks in five ASEAN economies following the recent trend in the literature. Descriptive and econometric analysis of firm-level data was used to shed light on three important issues: (1) how much do SMEs engage in production networks? (2) what factors influence SME participation in production networks? and (3) what policy implications can be drawn for SME support? The research was based on a large World Bank multi-country enterprise dataset.

Our research suggests that large firms are the leading players in production networks in ASEAN economies in the late 2000s while SMEs are relatively minor. Nonetheless, the available information also hints at a modest increase in the participation of SMEs in ASEAN economies between the late-1990s and the late-2000s as measured by the share of SME exports. More developed ASEAN economies like Malaysia and Thailand, which are more established in production networks, have higher SME export shares than other ASEAN economies. The outcome of the econometric exercise suggests that size, foreign ownership, educated workers, experienced CEOs, technological capabilities, and access to commercial bank credit all positively affect the probability of SME participation in production networks. By contrast, age has a negative relationship.

The exploration of policy influences on SME business activity provides additional insights. A trust deficit seems to hamper the requisite intra-firm cooperation needed for effective SME participation in production networks. Supply-side factors—like lack of access to finance, high electricity costs, variable quality of transport systems, and inadequately educated workers—are an additional hindrance to SMEs. On the policy and incentive side, behind-the-border issues like high corporate tax rates as well as economic uncertainty also play their part. Finally, the limited evidence from Malaysia and Thailand suggests that the affordability and quality of business support services are an issue. Tackling these constraints at firm and country level would help to unleash the full potential of SMEs as players in production networks in the future.

Thus, our results suggest that exploration of SME participation in production networks is important as ASEAN economies further deepen their engagement with production networks and supply chains as a part of rebalancing. It also indicates that improving the quality of published data on SMEs in ASEAN economies and further empirical research into this area would be fruitful. Some limitations in the methodology employed in this paper may be addressed in future research. First, several factors that may also affect the participation of SMEs in production networks (e.g., trade policies, domestic regulations, infrastructure, and business support services) were considered in the descriptive part but not in the econometric exercise. Attempting to include such factors in future econometric work may provide additional insights. Second, the production network functions estimated are static as only cross-section data were available. Thus, the findings need to be interpreted with caution. Panel data analysis would be invaluable to highlight changes over time when the requisite data are available.

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APPENDIX TABLES

Table A1: Selected Studies on Determinants of Decision to Export and Participation in Production Networks in ASEAN Countries

Studies	Country	Sample	Estimation	Dependent variable	Results
Determinants of decision to export					
van Dijk (2002)	Indonesia	20,161 industrial plants (1995 survey data)	Tobit and Papke and Woolridge technique	Export value as share of sales (0 to 1)	Firm size (U-shaped), foreign ownership (+), age (-), human capital (+), R&D (+)
Rasiah (2004)	Malaysia, Thailand, Philippines	98 firms; all exporters	OLS	Logarithm of export value	Foreign ownership (+), process innovation (+), wage (+), network cohesion (+)
Dueñas-Caparas (2006)	Philippines	505 food, clothing, and electronic firms (2002 survey data)	Logit and Papke and Woolridge technique (3 sector models)	Export value as share of sales (0 to 1)	Food: Skilled workers/total workers (+), foreign affiliation (+) Clothing: employment size of firm/total size of sector (+), age (+), foreign affiliation (+), R&D/sales (+) Electronics: R&D/sales (+), training (+), foreign affiliation (+), capital stock/labor cost (+)
Nguyen and Nishijima (2009)	Viet Nam	1,150 firms (2004 data)	2-step efficient generalized method of moments (2SGMM-IV), limited information maximum likelihood estimator (LIML), instrumental variables tobit (IV-TOBIT)	Export value as share of sales (0 to 1)	2SGMM-IV: Value added per employee (+), input importer (+), firm size (+), capital intensity (+), foreign owned (+), competition intensity (+) LIML: Value added per employee (+), input importer (+), firm size (+), capital intensity (+), foreign owned (+),competition intensity (+) IV-TOBIT: Value added per employee (+), input importer (+),

Studies	Country	Sample	Estimation	Dependent variable	Results
					firm size (+), capital intensity (+), website use (+), foreign owned (+), competition intensity (+)
Wignaraja (2011)	PRC, Thailand, Philippines	784 electronics firms (524 from PRC, 166 from Thailand, 94 from the Philippines)	Probit (3 country models)	Exporter (1=Yes, 0=No)	Thai model: Technology Index (+), foreign ownership (+), age (+), Philippine model: Technology Index (+), foreign ownership (+), size (+), age (-), value of machinery and equipment per employee (+)
Determinants of participation in production networks by SMEs					
Harvie, Narjoko, Oum (2010)	Thailand, Indonesia, Malaysia, Philippines, Viet Nam, Cambodia, Lao PDR	912 firms; 780 SMEs from multiple sectors	Probit (13 models)	Participation in Production Network (1=Yes, 0=No)	Labor productivity (+), Foreign ownership (+), Interest Coverage (+), dummies for technology, business networks, technological capacity, innovation (all +), Country group (old ASEAN members): Malaysia, Thailand, Indonesia, Philippines (+)
Kyophilavong (2010)	Lao PDR	151 firms from multiple sectors	Logit	Participation in Production Network (1=Yes, 0=No)	Tertiary education (+), Met an international standard (+), established new divisions or plants (+), Production and price barriers (-)
Rasiah, Rosli, Sanjivee (2010)	Malaysia	103 firms from multiple sectors	Probit (3 models)	Production Network participation (1=Yes, 0=No)	Value added/worker (+), Size (+), X/Y (+)

Source : Author's compilation.

Table A2: Correlation Matrix

	exporter	size	size2	fordum	gmeduc	gmexp	labordum	forlicense	iso	patent	credit	age
exporter	1.0000											
size	0.3032	1.0000										
size2	0.0914	0.7780	1.0000									
fordum	0.3414	0.2157	0.0800	1.0000								
gmeduc	0.2085	0.1726	0.0360	0.2129	1.0000							
gmexp	-0.0247	0.0595	0.0241	-0.0801	0.0041	1.0000						
labordum	0.2737	0.1113	0.0196	0.2432	0.1436	-0.0941	1.0000					
forlicense	0.3155	0.2012	0.0781	0.4380	0.1225	-0.1275	0.3630	1.0000				
iso	0.3584	0.3179	0.1080	0.3086	0.2730	0.0301	0.2187	0.2889	1.0000			
patent	0.1006	0.0717	0.0118	0.0277	0.1219	0.0493	0.0810	0.0668	0.1321	1.0000		
credit	0.181	0.1365	0.0341	0.0719	0.1110	0.0057	0.1578	0.1899	0.1646	-0.0011	1.0000	
age	0.0437	0.1111	0.0351	-0.0509	0.0271	0.3415	0.0805	0.0261	0.0981	0.1564	0.0069	1.0000