Host-site support, foreign ownership, regional linkages and technological capabilities: evidence from automotive firms in Indonesia

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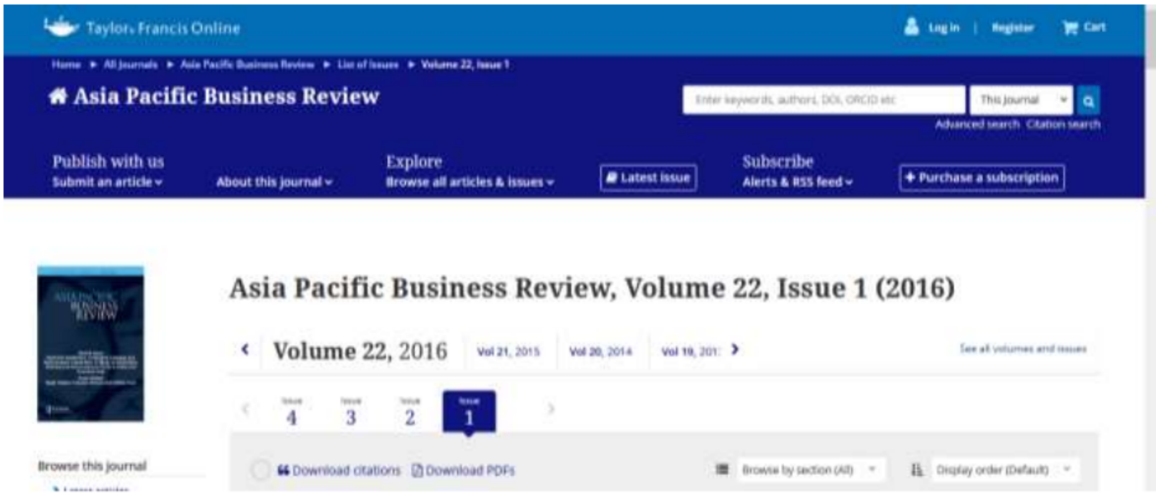
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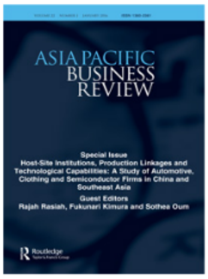

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Host-site support, foreign ownership, regional linkages and technological capabilities: evidence from automotive firms in Indonesia

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This study analyses the influence of host-site institutional support, foreign ownership and regional production linkages on firm-level technological capabilities using data from automotive firms in Indonesia. The results show that host-site institutional support and foreign ownership are positively correlated with technological capabilities. In addition, regional linkages show a significant and positive link on technological capabilities. However, regional linkages and foreign ownership explain more strongly technological capabilities than host-site institutional support in automotive firms in Indonesia. This evidence suggests that the supporting high-tech environment require further strengthening to stimulate higher technological capabilities in the automotive industry in Indonesia.

Keywords: automotive firms; institutional support; Indonesia; regional linkages; technological capabilities

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Introduction

The automotive industry is a key contributor to national economic growth, particularly in large industrialized countries. The global automotive industry produced approximately 70 million units each year since the turn of the millennium (Ulengin et al. 2010). While the USA, Japan and Germany are the major automobile producers of national brands in the world, others such as Korea, China and India have increasingly become important.

A number of developing countries introduced policies to promote automotive assembly as an engine of industrialization, as well as to save foreign exchange through import-substitution. Indonesia is no different as through import substitution foreign assemblers were attracted to the country. A localization policy was continued strongly during Suharto's long presidency that stimulated even the introduction of Indonesia-based models by foreign firms, such as Toyota. The introduction of regional production strategies and a strong domestic market helped Indonesia sustain growth in automobile production despite the liberalization that followed as President Habibie succeeded President Suharto.

The growing technological capabilities enjoyed by automotive firms in Indonesia were identified by Rasiah and Amin (2010). It will be interesting to identify the drivers of such technological capabilities. Hence, this study seeks to examine the influence of host-site institutional support, foreign ownership and regional linkages on firm-level technological capabilities in the automotive industry in Indonesia. The rest of the essay is organized as follows. The next section discusses the development of the industry in Indonesia followed by the theoretical considerations and methodology. The subsequent section analyses the results. The final section presents the conclusions.

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The automotive industry in Indonesia

The development of the automotive sector in Indonesia has certainly benefited from a reformist agenda over the past decade, although still shaped to a degree by the legacy of government policies dating back to the 1970s. At that time, the government introduced strict controls over the domestic automotive industry, including the banning of imported completely built up (CBU) vehicles. Foreign companies were also prevented from investing directly in assembly and distribution activities within the industry. Since then, Indonesia has become a more welcoming place for foreign automotive manufacturers thanks to the removal of foreign ownership restrictions and other deregulation measures during the 1990s (KPMG 2014).

In 1983, government attempted to rationalize the automotive industry by requiring car assembler to reduce the number of car brands and models they assembled to achieve economies of scale. However this regulation was not implemented effectively because of strong rejection from vested interests in the industry. Another decree was stipulated in 1983 on compulsory use of locally made components. However, this decree was not successful due to the lack of technology, capital and skills in technical areas of the small- and medium-scale manufacturers. In 1993, government terminated the deletion programme and replaced it with the incentive programme. Indonesian government introduced harmonized system under WTO system in 1999. In this harmonized system, the local content programmes were removed and Indonesia signed the 'trade-related investment measures' (TRIMS).

Automotive production has developed rapidly in Indonesia since 1980 with the number of car and motorcycle parts producers expanding by three folds and four folds respectively. Although Indonesia's prominence as an automotive player is low in comparison to some of its neighbours, the potential market for automotive producers and importers in the country is expected to expand. Growth is expected to be driven by an expanding middle class and a broadening economic base.

Theoretical considerations

Technological capabilities (TC) form the main concept of this article, and the key relationships that will be examined in this article are TC, and host-site institutional support (HI) and foreign ownership (FO), and TC and regional linkages (RL). The influence of the control variables of age and size on the dependent variables is also examined.

Institutional support and technological capabilities

The importance of institutional support to stimulate innovation was first articulated by industrial policy exponents (Smith 1776; Hamilton 1791; List 1885). North (1990) referred to institutions as the 'rules of the game' and organizations and entrepreneurs as 'the players'. Williamson (1985) associated institutions with governing structures that mould economic activity, like a nation's financial institutions, or the way firms tend to be organized and managed. The fundamental difference in the definition of institutions by evolutionary economists is the specificity of a blend of institutions effecting technical change, which is conditioned by the location, industry-type and timing of strategies by firms and organizations (Nelson 2008a, 2008b).

Host-site institutions and meso organizations associated with generating and supporting the appropriation of knowledge are critical to stimulate firm-level technological upgrading. In the developed countries, including in Korea, Taiwan and

Singapore, the government is a major financier of public goods, such as R&D, including knowledge generation through the provision of R&D grants (OECD 2013). Lall (2001) was to assert that economies that failed to develop their innovation capabilities became losers in the globalization process.

Where foreign firms have been instrumental in galvanizing technology transfer to national firms, they are unlikely to relocate frontier R&D activities at host sites unless it involves the exploration or development of rare host-site resources, or when the host site is endowed with strong research-based universities. Also, there is evidence of multinationals undertaking R&D in pharmaceuticals in South Africa owing to the availability of rare flora and human capital, and off-shoring of electronics R&D to benefit from strong high-tech support institutions in Taiwan (Ernst 2006). These developments obviously depend on the motives of the multinationals as well as the nature of activity they are engaged in (see Cantwell and Mudambi 2001). Also, in the integrated circuits industry, there is only evidence of MNCs' frontier R&D activities being relocated at host-sites endowed with strong research universities, e.g. Samsung Semiconductor and Taiwan Semiconductor Manufacturing Company in the USA (Gartner 2013).

Although employees in firms gain significant parts of their knowledge through training and learning by doing in firms (Marshal 1890; Penrose 1959), universities and R&D laboratories are important silos of knowledge that firms access through hiring graduates, contract training projects and R&D activities to generate new products and processes. However, as the evolutionary economists have argued both market and non-market institutions are equally important in explaining the drivers of university–industry R&D collaboration (Nelson and Winter 1982; Nelson 2008a, 2008b). Especially in high-tech industries, firms rely extensively on both the hiring of competent engineers and scientists to undertake R&D activities and working jointly with universities and R&D laboratories to carry out commercialization (Nelson 1993).

While it is important that host-site organizations participate in generating knowledge that is essential for firms, it is also critical that they are cohesively integrated with firms (Mytelka 2001). Lundvall (1988), Edquist (2004) and Nelson (2008a, 2008b) discussed the importance of interdependence and interactions between economic agents. While this is a broad concept that addresses all the economic agents, for the purpose of measurement in this article we limit it to coordination links between high-tech organizations and firms. In the case of Taiwan, it will be important to capture the links between firms and the high-tech organizations. Connectivity and coordination is critical for knowledge flows – beyond simply codified information that markets can coordinate. If firms are to upgrade to participate at the frontier of product technologies, then technological innovation that is produced by R&D laboratories will become important. Basic research is generally done in universities, and developmental research that is undertaken in-house or at publicly financed laboratories will be important. Also, training is a critical pillar in institutional support that is important for automotive firms to strengthen their technological capabilities. Hence, although Indonesia is still a developing economy the link between host-site institutions and firm-level technological capabilities is still expected to be positive and statistically significant.

Technological capabilities and regional linkages

The rapid expansion of East and Southeast Asia has attracted the formulation of regional theories on agglomeration of production. Regional trade and investment linkages in East Asia can be first traced to Akamatsu (1962).

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Akamatsu (1962) had pioneered the first regional trade and invest'ment linkages theory using the flight of a flock of geese to explain economic growth and structural change (see Rasiah, Kimura, and Sothea 2014). This regional model explains the movement of investment and trade sequentially with wedges of geese following the leading goose, i.e. Japan. For a while, it appeared a powerful theory as the following Korean and Taiwanese geese emerged. However, the supplanting of Japanese lead firms by Korean and Taiwanese firms undermined its usefulness. Nevertheless, the basic underlying rationale of regional economic integration and its effect on integrating economies is still relevant today.

The specificity of the automotive industry has also encouraged regional specialization among the major economies so that cars are still assembled in the Southeast Asian countries of Indonesia, Malaysia, Philippines, Thailand and Vietnam. Automotive firms have shown a tendency not only to assemble particular models in particular locations, but also to source particular components and completely knocked down parts from particular locations (Rasiah, Kimura, and Sothea 2014). The introduction of the ASEAN Industrial Cooperation (AICO) Scheme in 1996 has stimulated such inter-border complementation initiatives especially among automotive firms (ASEAN 2000).

Although technological advancement and increasing liberalization have made global trade and investment swifter and cheaper, geographical distance have continued to play an important role in the automotive industry. Continuous economic integration in the ASEAN Free Trade Area (AFTA), and the greater ASEAN members of China, Japan, South Korea and Taiwan, has been driven considerably through cooperation from all ASEAN member countries. Hence, it is worth testing if growing RL is reflected in the TC of automotive firms among countries in the lower rungs of the technology ladder, such as Indonesia.

FDI and technological capabilities

The theory of foreign direct investment (FDI) posits that multinationals enjoy asset-specific (tangible and intangible) advantages over local firms (see Dunning 1958; 1974; Hymer 1976). Whereas the portfolio theory of FDI of Hymer (1976) emphasized ownership and host-site advantages that explain international operations, Dunning emphasized ownership, localization and internationalization (OLI) elements in the relocation process. Access to superior resources in parent plants abroad is one factor considered to explain this advantage. The relocation of such an activity to developing economies allows multinationals to internalize such resources. In contrast to Vernon's (1966; 1971) argument that MNCs would retain production of new products at parent sites, Helleiner (1973) showed evidence of the decomposition of production especially in light manufacturing to suggest that MNCs instantaneously relocate particular production components abroad without waiting for them to mature. However, there has remained a doubt that the most novel aspects of R&D will be relocated abroad (see Amsden and Tschang 2003). Nevertheless as Caves (1974) had argued, MNCs bring the potential to provide competition, technology diffusion, trade linkages and demonstration effects on national firms.

Largely a consequence of competition between firms and national policies to stimulate supplier linkages, there has been growing participation of MNCs in the development of national suppliers as well as R&D off-shoring in developing economies (see Dunning 1994; Rasiah 2004; Cantwell 1995; Hobday 1996; Prasada 2000; UNCTAD 2005; Ernst 2006). Hence, it is likely that foreign MNCs may show higher technological capabilities than national firms.

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Methodology and data

The analytic framework focuses directly on the statistical relationship between technological capability and high-tech institutional support, and technological capability and regional production linkages. The dependent variable examined in this article is technological capability. In the first model, the focus is on examining the influence of host-site institutional support on technological capabilities, while in the second the focus is on the influence of regional production linkages on technological capability.

Technological capability (TC) was estimated using the following six proxies:

$$TC - f(CIQT, AC, PD, RD, TE, PAT)$$

where *CIQT* refers to cutting-edge inventory and quality control techniques (*CIQT*) of statistical process control (*SPC*), quality control circles (*QCC*), any one of the international standards organization (*ISO*) series, total preventive maintenance (*TPM*), integrated materials resource planning (*MRP2*) and total quality management (*TQM*). A score of 1 was added for presence of each of these techniques; *AC* refers to the presence of adaptive capabilities (*AC*) on processes, layouts, machinery and products. A score of 1 was added for the presence of each of them; *PD* refers to the presence of product development (*PD*), which is counted as 1 if it exists and 0 otherwise; *RD* refers to R&D expenditure as a share of sales; *TE* refers to training expenditure as a share of payroll; and *PAT* refers to the number of patents taken in the USA.

High-tech institutional (*HI*) support was estimated using the following five proxies:

$$HI - f(RDG, TTI, RU, RDSE, IRD)$$

where *RDG* refers to R&D grants enjoyed by the firm from the host government (Yes = 1; No = 0); *TTI* refers to Likert-scale rating (1–5) of the presence of technical strong training institutions; *RU* refers to Likert-scale rating (1–5) of the presence of research universities; *RDSE* refers to Likert-scale rating (1–5) of the presence of strong supply of R&D scientists and engineers; and *IRD* refers to Likert-scale rating (1, 5) of the presence of incentive for R&D activities.

Regional production linkages (*RL*) is also used as an explanatory variable. *RL* was estimated using the following formula:

$$RL = \frac{RS}{TS} + \frac{RP}{TP}$$

where *RS/TS* refers to percentage share of intermediate sales in total sales to firms in East and Southeast Asia; and *RP/TP* refers to percentage share of intermediate purchases in total purchases from East and Southeast Asia.

Foreign ownership (*FO*), Size (*S*) and age (*A*) were used as the control variables, and were measured as follows:

FO = foreign equity in total equity.
A = age of the firm.
S = workforce.

Tobit regression model was used to investigate the relationship between TC and HI, and TC and RL controlling for FO, size and age using the following equation:

$$TC = \alpha + \beta_1 HI + \beta_2 FO + \beta_3 A + \mu \quad (1)$$

$$TC = \alpha + \beta_1 RL + \beta_2 S + \beta_3 A + \mu \quad (2)$$

A stratified random-sampling procedure based on size was adopted to gather data from the automotive firms in Indonesia. The survey questionnaire was sent to automotive firms in 2013. Although data on employment, sales, exports, R&D expenditure and training expenditure were drawn from the years 2000, 2006 and 2011, the analysis is confined to 2011. The empirical analysis is based on 93 automotive firms, which amounted to 68.9% of the population of automotive firms in Indonesia.

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Results and analysis

First, the descriptive statistics of the dependent and independent variables are presented.

The mean and median of the variable *TC* are 12.06 and 11.90, respectively. The standard deviation for *TC* is 2.09. The Jarque-Bera statistics show that the distribution for the variables *TC, HI, FO, S* and *A* are normal ($p > 0.05$).

The mean and medians of the logarithm of *HI* are 0.85 and 0.84 with the highest score achieved is 0.95, while the lowest is 0.77. The firms in the sample show mean and median of the logarithm of ages 3.10 and 3.13 years respectively with a minimum age of 1.94 years and a maximum age of 3.71 years. The mean and median of foreign ownership are 0.67 and 0.66 with maximum and minimum of 0.89 and 0.52. The mean and median of the logarithm of *S* are 6.24 and 6.13 respectively. The standard deviation for *S* is 1.00 with maximum and minimum of 9.00 and 4.00.

Before analysing the relationship between technological capabilities and institutional support, and technological capabilities and regional production linkages, we checked for heteroskedasticity problems using the White test as a cross-sectional regression model is deployed here. Tables 1 and 2 show the results. The *p*-value of *F*-statistic for first equation and second equation are 0.2639 and 0.8030, which fail to reject the null hypothesis, and hence they do not suffer from heteroskedasticity problem.

For testing the multicollinearity problem in models among independent variables, the auxiliary regressions of independent variables are estimated to calculate their variance inflation factor (*VIF*). The *VIF* is calculated for each independent variable by doing a

Table 1. Equation (1): White test for heteroskedasticity.

F-statistic	1.312156	Prob. $F(9,37)$	0.2639
Obs*R^2	11.37162	Prob. χ^2 (9)	0.2511
Scale exp. SS	7.448134	Prob. χ^2 (9)	0.5906

Source: Authors (2014).

Table 2. Equation (2): White test for heteroskedasticity.

F-statistic	0.587438	Prob. $F(9,69)$	0.8030
Obs*R^2	5.622367	Prob. χ^2 (9)	0.7770
Scale exp. SS	4.744077	Prob. χ^2 (9)	0.8560

Source: Authors (2014).

Table 3. Variance inflation factor for Equation (1).

Variable	R^2	VIF
HI	0.030746	1.031721
FO	0.064518	1.068968
A	0.057801	1.061347

Source: Authors (2014).

Table 4. Variance inflation factor for Equation (2).

Variable	R^2	VIF
RL	0.013871	1.014066111
S	0.084902	1.092779134
A	0.074911	1.080977074

Source: Authors (2014).

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linear regression of that predictor on all the other predictors, and then obtaining the R^2 from that regression. We estimated The VIF in two ways by using formula $(1/(1 - R^2))$ and Eviews. Both results in Tables 3 and 4 indicate that all *VIF*s are less than 5, thereby confirming the absence of multicollinearity problems in both equations.

In this section, we estimated influence of institutional support on technological capabilities with control variables of age and foreign ownership by using Tobit regression. Table 5 presents the results. The results show a statistically significant relationship between technological capability and institutional support (at 10% level), and they are positive. Also, the relationship between *FO* and *TC* was statistically significant and positive (at 5% level). Age was not significant. The constant is also insignificant, suggesting that the equation does not suffer from endogeneity problem. While institutional support has been important, foreign ownership enjoyed stronger relationship with technological capabilities.

Table 6 shows that the relationship between *RL* and *TC* is significant. The Tobit regression shows that *RL* is positively correlated with *TC* at 5% significance level. Regional trade linkages have been important in stimulating firm-level technological capabilities among automotive firms in Indonesia. In addition, the influence of size on *TC* is significant and positive but age is not significant, demonstrating the importance of scale

Table 5. Firm-level technological capability and host-site high-tech infrastructure, 2012.

Variable	Coefficient	Std. error	*z*-Statistic	Prob.
C	−2.810081	5.107501	−0.550187	0.5822
HI	10.41989	5.706882	1.825847	0.0679
A	0.775880	0.718136	1.080409	0.2800
FO	5.702213	2.620115	2.176321	0.0295
LL	−99.320			

Dependent variable: *TC*.
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing).
Covariance matrix computed using second derivatives.
Source: Computed from Indonesia survey (2014).

Table 6. Technological capability and regional linkages, automotive firms, Indonesia, 2012.

Variable	Coefficient	Std. error	*z*-Statistic	Prob.
C	0.213685	0.594591	0.359381	0.7193
RL	6.662869	2.130318	3.127641	0.0018
A	−0.002088	0.047927	−0.043560	0.9653
S	0.061945	0.022737	2.724350	0.0064
LL	33.85814			

Dependent variable: *TC*.
Method: ML – Censored Normal (TOBIT) (BHHH).
QML (Huber/White) standard errors and covariance.
Source: Computed from Indonesia survey (2014).

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in supporting technological capabilities. These results are robust as they do not suffer from endogeneity problems since the constant is statistically insignificant.

Overall, *RL* showed the highest relationship (at 1%) with technological capabilities among automotive firms in Indonesia compared to foreign ownership (5%) and host-site institutional support (at 10%). The results show that while all three explanatory variables of *RL, FO* and *HI* have been important in stimulating technological capabilities among automotive firms, the relationship is strongest with *RL* followed by *FO* and *HI*.

Conclusions

The statistical results show that the relationship between *HI* and *TC* is significant and positive suggesting that the provision of training institutes, R&D labs and universities, and R&D scientists and engineers has helped strengthen firm-level technological capabilities in the automotive firms in Indonesia. *FO* and *RL* are also important as it is positively correlated with *TC*. The results support a strong role for host-site institutional support as essential to stimulate firm-level technological upgrading. However, regional linkages were the strongest and correlated with technological capabilities followed by foreign ownership. The results show that firm-level technological capabilities in automotive firms in Indonesia are influenced by regional trade linkages and foreign ownership than by host-site supporting institutions.

The results also suggest that foreign automotive firms seeking to access regional markets for sales as well as suppliers have upgraded their technological capabilities at host-sites through both buyer–supplier trading links in East Asia and in-house development. While the positive role of regional trade – both imports and exports within East Asia – has been important, the government should strengthen high-tech institutional support through strengthening of automotive-related training, research at universities and public R&D labs and improving the incentive system to stimulate further upgrading of technological capabilities among automotive firms in Indonesia.

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