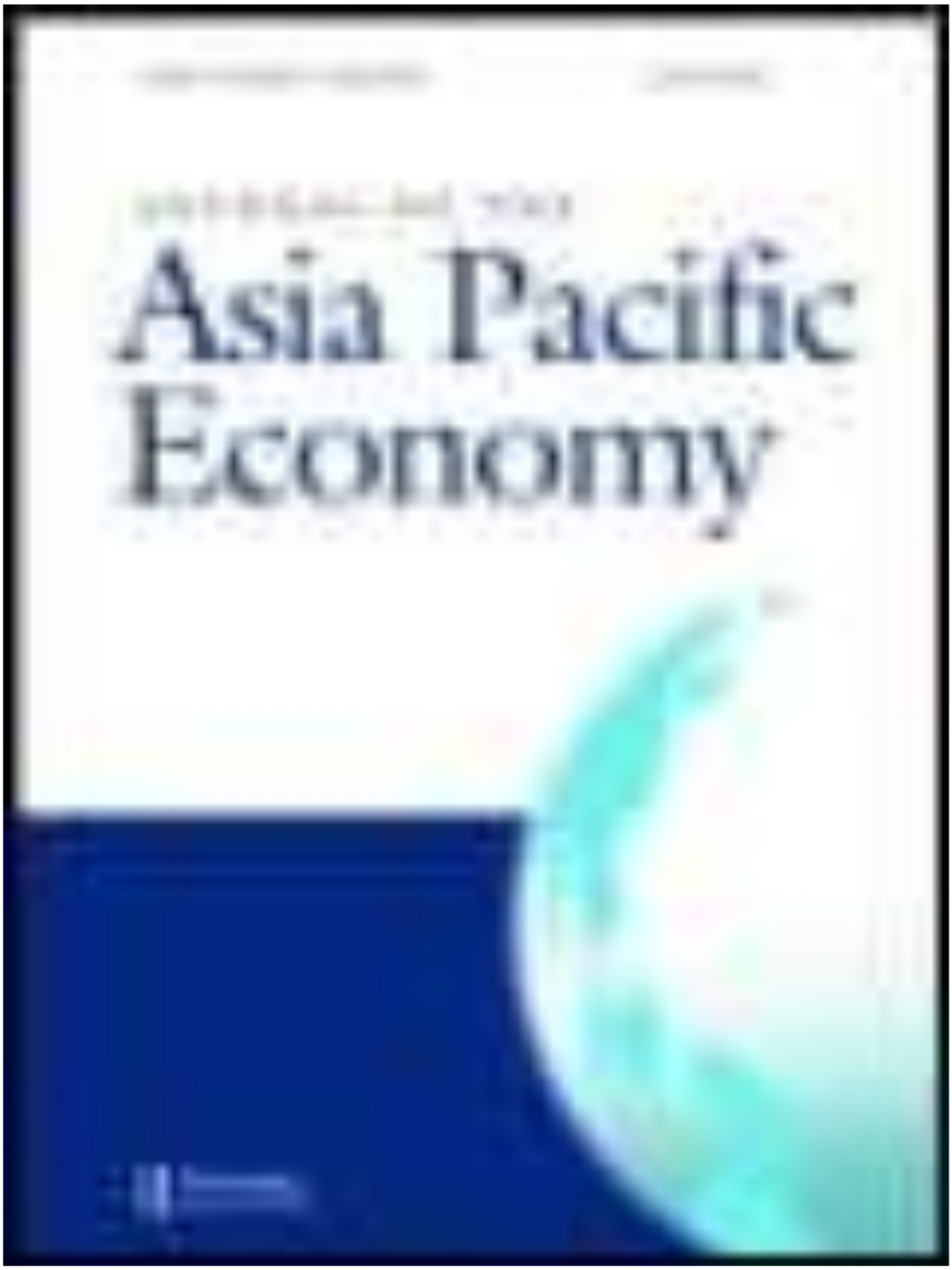
# Ownership and technological capabilities in indonesia’s automotive parts firms.

*by* Abdusy Syakur Amin -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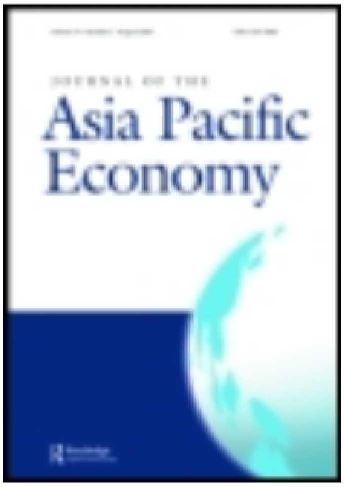


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# Ownership and technological capabilities in Indonesia's automotive parts firms

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This paper seeks to examine how local automotive parts firms' technological capabilities have evolved vis-à-vis foreign firms, following increased liberalization from the late 1990s. The evidence amassed shows that there were no obvious statistical differences in human resource and process technology capabilities between foreign and local firms in 2006. Although foreign firms enjoyed superior product technologies with access to their subsidiaries, local firms have invested more in research and development technology to compete with them. The results confirm that the liberalization experience has driven rather than discouraged stronger initiatives in local firms to raise technological capabilities, though foreign firms still enjoy higher export intensities.

**Keywords:** technological capabilities; ownership; export; automotives; Indonesia

**JEL classifications:** F23, L62, O31, O53

## 1. Introduction

General Motors started automobile manufacturing in Indonesia when it opened an assembly plant in Tanjung Priuk (Jakarta) in 1928. However, it was not until the 1950s that there was any government effort to support automobile manufacturing under the Benteng Industrialization Programme, though it produced little positive results (Aswicahyono *et al.* 2000). Hansen (1971) found the industry to be small and technologically primitive in the late 1960s, arguing that the annual market size of 10,000–15,000 units was too small to support an efficient plant. The supplier base was also extremely weak. The government launched 10-year localization plans targeted at domestic capability building. The ones over the period 1969–1998 focused on deleting imports and supporting domestic manufacturers through high tariffs and quotas. The liberalizing currents from 1998 led to the introduction of the Automotive Policy Package, which drove down tariffs and ended special incentives for localization.

Foreign direct investment (FDI) began to participate in Indonesian automotive manufacturing investment inflows since the early 1970s when the Ministry of Industry and the Ministry of Trade enacted a decree to promote the assembly of completely built-up (CBU) units from completely knocked-down (CKD) units. The decree provided lower tariffs on CKDs compared with CBUs to stimulate foreign firms to relocate assembly operations in the country. Despite the fluctuating performance since, the localization policy

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assisted the development of automotive manufacturing in Indonesia. However, while employment and output have continued to expand, imports by the industry have continued to exceed exports (Syakur 2009).

The continued reliance on automotive imports raises critical questions about the viability of automotive manufacturing in Indonesia. The localization policies from the 1970s were targeted at reducing imports and building domestic capabilities, though critics argue that they offered an outlet for rent seeking (Robison 1986, Hill 1987, 1996, Doner 1991, Booth 1998). Rasiah (2009a) highlighted serious basic and high-tech infrastructure problems faced by electronics firms in Batam-Karawang. Despite the difference in approaches and conclusions, both neoclassical and radical analysts generally considered the Suharto regime as having underperformed in raising FDI as well as stimulating technological catch-up.

Since the end of the Suharto regime in 1998, the political structure in Indonesia has increasingly become democratic with decentralization and proportional representation gaining ground as the political basis for allocational decisions. The liberalization that ensued after the Asian financial crisis of 1997–1998 but in particular after Indonesia enforced the Trade-Related Investment Measures agreement on 1 January 2000 has ended the use of government tariff and fiscal instruments to promote localization. The environment for foreign ownership and competition from abroad has risen since 2000. Indeed, domestic automobile sales rose dramatically over the period 1999–2005 (Syakur 2009). It is thus useful to examine how local automotive firms' technological capabilities have evolved vis-à-vis foreign firms now that the fiscal playing field has largely been levelled.

Rasiah (2009b) provided some evidence to argue that the technological capabilities of automotive component firms located in Indonesia are higher than those of the firms located in Malaysia, suggesting that greater liberalization has driven rather than discouraged 'creative destruction' in the former. However, little ownership-based evidence exists on the state of technology in automotive firms in Indonesia. This paper seeks to fill this void by using the technological capability typology to examine differences in technological capabilities between foreign and local firms in Indonesia. The rest of the paper is organized as follows. Section 2 discusses the theoretical guide. Section 3 presents the methodology. Section 4 discusses the statistical results. Section 5 presents the conclusions.

## 2. Theoretical guide

Two key concepts and the theory behind them are critical for this paper. The first is technological capabilities. Total factor productivity was excluded, as it is a residue that is a poor proxy of technology (see Rasiah 2009c). The second is ownership. Given the significance of foreign technology – through either imports of knowledge or direct ownership – it is important to examine the role of multinationals in the development of technological capabilities and economic performance. Because foreign ownership has been significant in the development of the automotive industry in Indonesia, the paper examines the theory and evidence of technological capabilities and economic performance in foreign and local automotive firms.

### *Technological capabilities*

The specific categories, phases and processes of technological change were analysed lucidly by Rosenberg (1975). Rosenberg and Firschtak (1985) defined technological capability as a process of accumulating technical knowledge or a process of organizational learning. Dahlman *et al*. (1987) emphasized the underlying concept of trajectory of deepening capability, moving from technology-using production capabilities to innovation-driving capabilities. They developed a sequence of capabilities, running from production capability via investment capability to innovation capability, which is consistent with Lall's (1992) taxonomy of technological capabilities.

Technological capability must enable the enterprises to undertake a range of productive tasks, extending from pre-investment analysis to product and process engineering, manufacturing and the introduction of new technologies as they appear. Technological capability can be assessed in terms of a firm's ability to (1) identify its technological needs and to search the technology to fulfil the need; (2) operate, maintain, modify and improve the selected technology; and (3) promote technological learning. This may be done through the firm's internal learning mechanisms and by utilizing external learning mechanisms, for example through collaboration with government's research technology or by networking with other firms.

The development of technological capabilities need not be through the ability to undertake leading-edge innovation (Lall 1992). Technological capabilities include a much broader range of effort that every enterprise must itself undertake in order to absorb and build upon the knowledge that has to be utilized in production. This involves buying some skills and information from the market and providing others in-house, the choice depending on the technology, market condition and firms' strategies.

However, the transfer of new technology to developing countries through machinery and equipment, operating instructions, patents, designs or blueprints does not guarantee that the technology will be properly used (Kim 1997). Elements of a technology embedded in a process or equipment are accompanied by additional 'tacit' elements which the recipient must learn as well. Only when such learning and adaptation have taken place can technology transfer be considered to have been successful, i.e. used at or near the best-practice level of technical efficiency for which it was designed. Technology mastery is not an automatic or a passive process. In particular, there must be adequate 'receptors' of technology, who invariably are qualified technical personnel. If not available before the occurrence of transfer, they must be developed rapidly by on-the-job training and other means.

Technological capability is more than the simple sum of the education and training of firms' employees. It includes the learning that individuals undergo in the course of working in the enterprise and the way in which the firms combine and motivate individuals to function as an organization. To some extent any enterprise that tries to use a new technology acquires some capabilities as an automatic result of production process. Such passive learning goes some way to developing the necessary capabilities. In simple industries, for example the assembly of imported kits or garment manufacture for the domestic market, this may be all that is needed. The skills are easily learned on the job, and there are few linkages with supplier that involve technical problem and complex exchange of information. Product designs are provided by foreign suppliers of kits for assembly or are easily adapted to local tastes in garment.

However, as the technology becomes more complicated or market demands become more rigorous, such passive learning becomes inadequate. Even in garment manufacture, much effort is required to raise the quality and productivity, improve layout and introduce new supervisory practices, before an efficient producer for the local market becomes a competitive exporter. For more complex industries, an enterprise must be prepared to sustain a longer and more demanding process to reach even static, best-practice level established by producers in advanced countries.

International technology transfer research also provides various typologies of technological capabilities. Bell (1987) grouped technology flows into three categories: flow A, which consists of capital goods and technological, engineering and management services; flow B, which consists of the skills and know-how to operate and maintain the newly established production technology; and flow C, which consists of the knowledge and expertise for implementing technical change or the know-why. In this framework, flow A leads to improvement in production capability; flow B contributes to technological capabilities at the basic, routine level; and flow C enables the firm to generate dynamic technical and organizational changes.

Lall (1992) outlined a functional categorization of technological capabilities based on the task facing a manufacturing firm. The task and associated capabilities are characterized into two groups: investment capabilities and production capabilities. These are further divided into three levels. The first level is simple and experience based; the intermediate level is adaptive and duplicative in nature but is research based; and the advanced level is innovative and risky but is also research based. Figueiredo (2002) and Ariffin and Figueiredo (2004) refined Lall's classifications to take account of the industry specificity of technology.

Wei (1995) integrated Lall's (1992) functional categories with Bell's (1987) technology flow classification. He concluded (1) that not all technology flows generate technological capability and (2) that linkages with local supplier and other groups within the local economy are critical for enhancing the capabilities.

Rasiah (2004, 2009b) modified Lall's (1992) concept of capabilities to focus on just technological capabilities, establishing in the process a typology by taxonomies and

Table 1. Typology of technological capabilities.

| Knowledge depth | HR | Process | Product |
|---|---|---|---|
| (1) Simple activities | On-the-job and in-house training | Dated machinery with simple inventory control techniques | Assembly or processing of component, CKD and CBU using foreign technology |
| (2) Minor improvements | In-house training and performance rewards | Advanced machinery, layouts and problem solving | Precision engineering |
| (3) Major improvements | Extensive focus on training and retraining; staff with training responsibility | Cutting-edge inventory control techniques, SPC, TQM, TPM | Cutting-edge quality control systems (QCC and TQC) with OEM capability |
| (4) Engineering | Hiring engineers for adaptation activities; separate training department | Process adaptation: layouts, equipment and techniques | Product adaptation |
| (5) Early R&D | Hiring engineers for product development activities; separate specialized training activities | Process development: layouts, machinery and equipment, materials and processes | Product development capability. Some firms take on ODM capability |
| (6) Mature R&D | Hiring specialized R&D scientists and engineers wholly engaged in new product research | Process R&D to devise new layouts, machinery and equipment prototypes, materials and processes | New product development capability, with some taking on OBM capability |

Note: CKD, completely knocked-down; CBU, completely built-up; SPC, statistical process control; TQM, total quality management; TPM, total preventive maintenance; QCC, quality control circles; TQC, total quality control; OEM, original equipment manufacturing; R&D, research and development; ODM, original design manufacturing; OBM, original brand manufacturing.
Source: Developed from Lall (1992), Rasiah (1994, 2004) and Figueiredo (2002, 2003).

trajectories (see Table 1). This framework takes account of the concepts of taxonomies and trajectories advanced by Dosi (1982) and Pavitt (1984). It also allows the measurement of the different types of technological capabilities – human resource (HR), process technology (PT) and product technology – which this paper uses as the guide for examining technological capabilities in the automotive firms in Indonesia.

### *Ownership*

Ownership is a critical variable because of the significance of foreign capital in the emergence and subsequent development of automotive production in developing economies such as Indonesia. Local firms operating in developing sites typically enter automotive manufacturing either through licensing technology from multinationals from abroad (e.g. Hyundai from Korea and Proton from Malaysia) or through subcontract relations with subsidiaries at host sites (e.g. Astra from Indonesia and Cofap, Freio Varga and Metal Leve from Brazil). An assessment of ownership is important to examine differences in technological capabilities in automotive manufacturing in Indonesia given that foreign firms have participated in the industry for over three decades.

Hymer (1976) stated that multinationals exist because of the economic advantages oligopolistic conduct offers them and argued that the choice of relocation of operations abroad is strongly influenced by host-site advantages. Dunning's (1988) eclectic framework of ownership, location and internalization provided an outline to explain internationalization of operations and hence the motives behind their conduct at host sites. The importance of motives in the conduct of multinationals was further advanced by Narula and Dunning (2000) and Cantwell and Mudambi (2005). The flow of knowledge from foreign to local firms can take place through greenfield direct ownership, brownfield acquisitions, joint ventures, licensing, turnkey projects, purchase of capital goods, technical agreement and cooperation and movement of human capital (Dunning 1981, Rasiah 1994, Katz 2006).

Using Rasiah's (2004) typology, the choice of technology by foreign and local firms varies with taxonomies and trajectories. Because cutting-edge HR practices and PT are essential to compete internationally in Indonesia's liberal environment, foreign and local firms may not show much differences in technological capabilities once controlled for the product type (see Rasiah 2009b). Given that machinery and equipment are largely acquired from complementary rather than competing firms, and HR practices and process techniques largely evolve outside the domain of intellectual property rights, with buyers often providing these technologies to suppliers to ensure quality standards, not much differences can be expected between foreign and local firms.

Vernon's (1966) argument on national factors is still important in explaining the internationalization of innovation activities, as the OECD (1998) and Amsden *et al.* (2001, p. 5) have shown evidence of low incidence and intensity of research and development (R&D) investment outside national borders. This also suggests that local firms tend to undertake more R&D activities than foreign firms once the requisite institutional support evolves, as the latter can still rely on R&D support from home sites. However, this does not mean that foreign firms will not at all undertake R&D activities at host sites. Government incentives and grants and the development of specialized expertise at particular sites have been instrumental in the growth of R&D activities by foreign firms in Singapore and Bangalore.

Hence, this paper examines two hypotheses: one, local and foreign firms are not expected to show significant differences in HR and PT intensities, and two, local firms are expected to show a higher R&D intensity than foreign firms. Given the 38-year history of industrial promotion and around 30 years of promotion of localization in the automotive industry, along with the reasonable size of the domestic market, one can expect that local firms will be capable of hiring relocating employees and absorbing the non-proprietary aspects of technology from multinationals.

## 3. Methodology and data

Four items critical to the analysis are undertaken in this section. Firstly, the paper defines technological capability and the explanatory and control variables. Secondly, the paper uses a data-set collected by the authors with support from the Ministry of Industry, Ministry of Trade, Central Statistics Agency, Indonesian Association of Automobile Producers (GAIKINDO), Indonesian Association of Automotive Parts and Component Producers (GIAMM) and Hak Kekayaan Intellectual. Thirdly, the critical variables are specified. Fourthly, the statistical framework of the analysis is established.



### *Technological capability and the explanatory and control variables*

The dependent variables of technological capabilities and the explanatory and control variables are specified in this subsection.

#### *Technological capabilities*

Following the typology presented in the theoretical guide, three types of technological capabilities are examined in this paper, viz. HR, PT and R&D. Firm-level technologies include HR practices, machinery and equipment, inventory and quality control systems and R&D expenditure and personnel. Because there are no prior reasons to attach greater significance to any of the proxies used, the normalization procedure used is not weighted. The following technological intensities are specified.

*Human resource.* HR capability was estimated as follows:

$$\mathrm{HR}_i = 1/3[\mathrm{TE}_i, \mathrm{CEHRP}_i, \mathrm{SI}_i],$$

where $\mathrm{TE}_i$, $\mathrm{CEHRP}_i$ and $\mathrm{SI}_i$ refer to training expense as a share of payroll, cutting-edge HR practices (estimation formula: a score of 1 was added to any one of the cutting-edge practices of small group activities, team working, quality control circles, stock sharing and performance-based rewards and promotions) and skill intensity (estimation formula: professionals, technicians, machinists and skilled workers divided by the total workforce) of firm $i$. Because the proxies were evenly weighted, HR was divided by 3 to take account of the three proxies used.

*Process technology.* PT capability was estimated as follows:

$$\mathrm{PT}_i = 1/3[\mathrm{PTE}_i, \mathrm{IQCS}_i, K/L_i],$$

where $\mathrm{PTE}_i$, $\mathrm{IQCS}_i$ and $K/L_i$ refer to process technology expenditure, cutting-edge inventory and quality control systems and capital intensity (fixed capital divided by workforce) of firm $i$ respectively. PTE was calculated by dividing process technology expenditure with sales. A score of 1 was added to anyone of the cutting-edge practices of just in time, quality standards or International Organization for Standardization (ISO) 9000 series, statistical process control, total quality management, defect tolerance rate in parts per million and total preventive maintenance. Further, $K/L$ was calculated by dividing fixed assets value with employment. Because the proxies were evenly weighted, PT was divided by 3 to take account of the number of proxies used.

*R&D capability.* R&D (RD) intensity was measured as follows:

$$\mathrm{RD}_i = 1/2[\mathrm{RDexp}_i, \mathrm{RDemp}_i],$$

where $\mathrm{RDexp}_i$ and $\mathrm{RDemp}_i$ refer to R&D expenditure in sales and R&D personnel respectively of firm $i$. Because the proxies were evenly weighted, RD was divided by 2.

### *Explanatory variables*

The two explanatory variables, i.e. export intensity (and export incidence) and foreign ownership, are defined in this subsection.

*Export intensity.* Export intensity was measured as follows:

$$\text{Export intensity} = X_i / Y_i,$$

where $X_i$ and $Y_i$ refer to the export and the gross output of firm $i$ in 2006. Because foreign automobile firms in Southeast Asia use production networks to supply the bulk of domestic assembly demand from within borders, local automotive firms are likely to show higher export intensities.[1] The incidence of export experience was also calculated separately for use in descriptive statistics and two-tailed $t$-tests. Export incidence was calculated as

$\mathrm{Xinc}_i = 1$ if firm $i$ exports,
$\mathrm{Xinc}_i = 0$ otherwise.

*Foreign ownership.* Foreign ownership (FO) was estimated in two ways. The first, i.e. FO1, is used for the descriptive two-tailed $t$-tests and was measured as follows:

$\mathrm{FO1}_i = 1$ if the share of foreign equity in total equity is 50% or more,
$\mathrm{FO1}_i = 0$ otherwise.

The foreign ownership measure is used in the Tobit regressions and was measured as follows:

$\mathrm{FO2}_i$ = Foreign equity/total equity.

Interviews show that foreign supplier firms in Indonesia are technologically superior to local firms, but the latter have invested more in R&D to compete both domestically and in regional foreign markets.[2] The assembly plant of Toyota is an exception, where the Kijang (Innova) model is reported to have been developed in Indonesia.

### *Control variables*

Size, wage and age were the control variables included in the Tobit regressions.

*Size.* Size could not be measured on the basis of employment because econometric convergence could not be achieved, and hence it was measured as a dummy:

$S_i = 1$ when $S > 250$ employees,
$S_i = 0$ otherwise,

where $S_i$ refers to the size of firm $i$.

*Wage.* Wage was introduced as the labour market variable in the equation, since its skill intensity and cost can have a bearing on the choice of technology. It was measured as follows:

$W =$ Monthly salary in US dollars divided by the employment of firm $i$,

where $W$ refers to the mean monthly wage per employee of firm $i$ in 2006.

*Age.* Age was measured as follows:

$A_i =$ years in operation of firm $i$,

where $A_i$ refers to the age of operation of firm $i$.

### *Data used*

The primary data for the paper were collected in 2006 through a questionnaire survey of automotive supplier firms in Indonesia. The survey was conducted in the Greater Jakarta region, which accounted for around 80% of all automotive suppliers and 90% of automotive employment, production and exports from Indonesia (GAIKINDO 2007, GIAMM 2007, Hak Kekayaan Intellectual 2007). Unless otherwise stated, all primary data of automotive firms refer to 2006.

The firms were selected randomly but structured by ownership, size and location from the Greater Jakarta region. The response rate was 77.5% from the 120 firms selected for the survey. The breakdown of the respondents is shown in Table 2.

### *Statistical instruments*

This section introduces the two statistical exercises carried out in the paper, viz. two-tailed $t$-tests to examine simple differences in means and Tobit regressions to evaluate differences after controlling for explanatory and other variables. Tobit regressions were preferred over ordinary least squares regressions because the dependent technological capability variables are censored on the right and the left sides of the data-sets, so that they take a minimum possible value of 0 and a maximum possible value of 1:

$$\text{Tobit: HR} = \alpha + ß_1 X/Y + ß_2\text{FO} + ß_3 S + ß_4 A + ß_5 W + \mu, \quad (1)$$

$$\text{Tobit: PT} = \alpha + ß_1 X/Y + ß_2\text{FO} + ß_3 S + ß_4 A + ß_5 W + \mu, \quad (2)$$

$$\text{Tobit: RD} = \alpha + ß_1 X/Y + ß_2\text{FO} + ß_3 S + ß_4 A + ß_5 W + \mu. \quad (3)$$

The specifications passed the multi-colinearity tests as shown in Appendix 1 and the Cook-Weisberg test for heteroscedasticity.

Table 2. Automotive parts and component firms, Indonesia, 2006.

| | |
|---|---|
| Registered | 135 |
| Mailed | 120 |
| Responses | 93 |
| Response rate (%) | 77.5 |

Source: Authors' survey (2008).

## 4. Statistical results

The statistical results are examined by three categories: descriptive, two-tailed differences in means and Tobit regressions controlling for other effects. The analysis in the next two subsections go deeper to examine the components of HR, PT and R&D.

### *Descriptive statistics*

The results of the univariate tests of means and standard deviation by ownership are shown in Table 3. Foreign firms show significantly higher $X/Y$ and R&D personnel (RDP) means than local firms. Local firms enjoy a fairly higher $K/L$ and R&D expenditure (RDE) means than foreign firms. There are no obvious differences in the HR and PT means, and only a marginally higher RD mean is enjoyed by local firms over foreign firms.

### *Statistical differences*

Foreign firms largely enjoyed higher export intensity, export incidence and productivity means than local firms (see Table 4). The export incidence difference between foreign and local firms was statistically highly significant. Almost all foreign firms enjoyed export experience by benefiting from production networks with assembly firms spread across Southeast Asia. The share of foreign suppliers exporting in 2006 was 98.3%, whereas only 57.1% of local firms enjoyed export experience. The mean export intensity of foreign firms of 24.3% was significantly higher than the 14.7% of local firms, though it was only statistically significant at the 10% level. Interviews show that Korean and American assemblers have adopted the typical Japanese practice of specializing in particular components, CKDs and CBUs and then engaging in regional trade across Southeast Asia.

As expected, the technology variables of HR and its components of TE, SI and CEHRP were statistically insignificant, thereby reflecting the impact of competition and its consequent effect on the diffusion of best practices in HR activities. The PTE component of PT activity was statistically significant at 5%, whereas the other components of IQCS and $K/L$ showed no statistically meaningful difference. Interviews showed that local firms invested more in acquiring process technology compared with foreign firms that transferred

Table 3. Descriptive statistics, automotive firms, Indonesia, 2006.

| | Foreign | | | | Local | | | |
|---|---|---|---|---|---|---|---|---|
| | Min | Max | Mean | *SD* | Min | Max | Mean | *SD* |
| $X/Y$ (%) | 0.00 | 100.00 | 24.30 | 28.10 | 0.00 | 82.00 | 14.67 | 21.80 |
| TE (%) | 2.00 | 3.00 | 2.35 | 0.48 | 2.00 | 3.00 | 2.31 | 0.47 |
| SI (%) | 81.00 | 90.00 | 85.19 | 1.39 | 85.00 | 95.00 | 85.72 | 1.78 |
| CEHRP | 2.38 | 3.75 | 2.77 | 0.26 | 2.38 | 3.13 | 2.76 | 0.20 |
| HR | 0.44 | 0.57 | 0.48 | 0.02 | 0.45 | 0.52 | 0.48 | 0.02 |
| PTE (%) | 2.00 | 5.00 | 3.15 | 0.76 | 2.00 | 5.00 | 3.49 | 0.76 |
| IQCS | 0.33 | 0.80 | 0.60 | 0.10 | 0.47 | 0.73 | 0.58 | 0.08 |
| $K/L$ ('000RP) | 0.01 | 261.65 | 19.52 | 38.42 | 0.25 | 2027.03 | 66.48 | 323.66 |
| PT | 0.21 | 0.40 | 0.30 | 0.04 | 0.24 | 0.41 | 0.31 | 0.04 |
| RDE (%) | 2.00 | 5.00 | 3.11 | 0.74 | 2.00 | 5.00 | 3.41 | 0.68 |
| RDP | 2.00 | 80.00 | 14.96 | 14.24 | 2.00 | 26.00 | 9.67 | 5.89 |
| RD | 0.13 | 0.38 | 0.23 | 0.05 | 0.18 | 0.37 | 0.25 | 0.04 |
| *N* | | | 54 | | | | 39 | |

Source: Computed from the authors' survey (2008) using SPSS 11.50.

Table 4. Two-tailed $t$-tests of means, automotive firms, Indonesia, 2006.

| | FO | LO | $t$ |
|---|---|---|---|
| $X/Y$ (%) | 24.30 | 14.70 | 1.76*** |
| $X$ incidence | 98.28 | 57.14 | 5.93* |
| TE (%) | 2.35 | 2.31 | 0.44 |
| SI (%) | 85.19 | 85.72 | 1.62 |
| CEHRP | 2.77 | 2.76 | 0.33 |
| HR | 0.48 | 0.48 | 0.15 |
| PTE (%) | 3.15 | 3.49 | 2.12** |
| IQCS | 0.60 | 0.58 | 1.03 |
| $K/L$ | 19.52 | 66.48 | 1.06 |
| PT | 0.30 | 0.31 | 0.60 |
| RDE (%) | 3.11 | 3.41 | −1.99** |
| RDP (%) | 14.96 | 9.67 | 2.19** |
| RD | 0.23 | 0.25 | −2.26** |

Note: *, ** and *** refer to statistical significance at 1%, 5% and 10%, respectively.
Source: Computed from authors' survey (2008) using SPSS 11.50.

a considerable proportion of such technologies from their parent plant and subsidiaries abroad. Nevertheless, as expected the overall PT showed no obvious differences as local firms installed similar best practices to compete.

Whereas foreign firms showed a significantly higher RDP mean than local firms, which was statistically significant at 5%, the converse is the case with RDE. The combined effect of the two components has left local firms with a statistically significant (at 5%) but marginally higher RD mean than foreign firms. Foreign firms appear to hire bigger numbers of R&D personnel, but local firms seeking to catch up with their foreign competitors have been investing more in R&D activities.

Foreign firms clearly enjoy higher export experience and intensities than local firms. The statistical differences involving technological capabilities are not very obvious with local firms enjoying higher PTE, RDE and RD means, while foreign firms enjoy higher RDP means. It will be useful to examine if these differences remain after controlling for export intensity, size, wages and age – which is carried out in the next subsection.

### *Statistical analysis*

This subsection examines ownership-based statistical differences in technological capabilities after controlling for export intensity, size, wages and age. The results of the Tobit regressions passed the model fit ($\chi^2$) test.

The results confirm that there are no obvious differences in HR and PT activities between foreign and local firms (see Table 5). However, there are ownership-based differences in RD activities. Although the coefficient of FO is marginal it is statistically highly significant. Interviews show that local firms invest more than their foreign competitors located in Indonesia to compete. Foreign firms continue to enjoy significant technological support from their parent plants and subsidiaries abroad.

The results also confirm the positive effect of export orientation in R&D activities but show no differences when involving HR and PT capabilities. Deregulation in Indonesia particularly since 2000 has driven automotive firms to acquire similar HR and PT capabilities.

Table 5. Tobit regressions of technological capabilities, automotive firms, Indonesia, 2006.

| | HR | PT | RD |
|---|---|---|---|
| *X/Y* | −0.012 (−0.72) | −0.00 (−0.22) | 0.034 (2.01)** |
| FO | −0.001 (−0.006) | −0.001 (−0.46) | −0.003 (−2.68)* |
| *S* | −0.002 (−0.77) | −0.002 (−0.22) | −0.042 (−4.57)* |
| *A* | −0.000 (−1.11) | 0.000 (0.45) | −0.003 (−2.28)** |
| *W* | 0.001 (2.01)** | 0.001 (0.44) | 0.001 (1.70)*** |
| $\mu$ | 0.492 (85.93)* | 0.312 (26.15)* | 0.291 (24.51)* |
| *N* | 93 | 93 | 93 |
| LL | 242.47* | 176.40* | 171.23* |

Note: Figures in parentheses refer to '*z*' statistics; *, ** and *** refer to statistical significance at 1%, 5% and 10%, respectively.
Source: Computed from data collected from the UNU-MERIT (2007) survey using E-views 7.0 package.

The control variables of *S*, *A* and *W* were significant in the RD regressions. Smaller, newer and better-wage-offering firms show stronger participation in R&D activities than larger, older and low-wage-offering firms. Wages were also significant in the HR regressions, which obviously means that higher HR capabilities are associated with better-wage-offering firms.

## 5. Conclusions

The empirical results of the paper interestingly show that the deregulation that took place after the fall of the Suharto regime has brought benefits to local firms, as there were no obvious statistical difference in HR and PT capabilities between them and foreign supplier firms in the automotive industry in Indonesia. Despite the excesses that took place during the period of localization policies from 1971, sufficient capabilities seem to have evolved to enable local firms to compete with foreign firms in a more even playing field following deregulation from the late 1990s.

Ownership did not matter in HR and PT capabilities, as both the two-tail *t*-test of means and the Tobit regressions controlling for other variables did not show any statistically significant difference between foreign and local firms. Local firms enjoyed a slightly higher RD mean than foreign firms, but that seems to be because of higher investment in R&D by the former to offset the access the latter enjoys from abroad. Foreign firms enjoyed higher export intensities and export experience than local firms, which seems to be a consequence of regional production networks established by foreign multinational assemblers in Southeast Asia.

Because they are supplier firms, size did not seem to matter in HR and PT capabilities, while smaller and medium firms enjoyed higher R&D capabilities than large firms. Low wages also did not appear as a competitive instrument in the regressions where the only statistically significant result showed that better-wage-paying firms enjoyed higher HR capabilities.

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## Notes

1. Interview by authors with officials from GAIKINDO in Jakarta on 13 December 2008.
2. Interview by authors with officials from GAIKINDO in Jakarta on 13 December 2008.

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Appendix 1. Correlation coefficient matrix of independent variables, 2006.

| | *X/Y* | FO | *W* | *A* | *S* |
|---|---|---|---|---|---|
| *X/Y* | 1.000 | 0.109 | −0.039 | −0.042 | −0.016 |
| FO | 0.109 | 1.000 | −0.036 | 0.002 | 0.165 |
| *W* | −0.039 | −0.036 | 1.000 | 0.137 | −0.183 |
| *A* | −0.042 | 0.002 | 0.137 | 1.000 | 0.145 |
| *S* | −0.016 | 0.165 | −0.183 | 0.145 | 1.000 |

Note: None of the variables showed colinearity problems.
Source: Computed from the UNU-MERIT (2007) survey data using E-views 7.0 package.

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