The Indices in Measuring the Domestic Market Penetration of Japanese Affiliates in ASEAN and China

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Abstract—**This paper aims to construct indices to gauge the degree of Japanese affiliates in penetrating the domestic market of ASEAN (namely Indonesia, Malaysia, Philippines and Thailand) and China for 13 manufacturing sub-sector industries. The indices with a probability value in the range of 0 and 1 are formed based on the theory of multiplier. The Bayesian network which uses a prior-to-posterior probability analysis in examining nonlinear relationships between variables for a small sample of observations was chosen as the analytical tool for this study to validate the indices. These indices can be used to benchmark sales performance and changing production networks of Japanese affiliates in ASEAN and China.**

Keywords-Foreign direct investment; Bayesian Network; indices

I. INTRODUCTION

The international standing of Japanese foreign direct investment (FDI) as a role of modernization and industrialization has gained great attention of investors, policy makers and researchers. Japan, together with USA and European Union had been named as one of the three triad members of FDI sources in the late eighties and nineties. Japanese affiliates have reconfigured their production network within Asia to enhance competitiveness by taking the advantage of resource abundance, low production cost and potential market share. Japan has invested in ASEAN (namely Indonesia, Malaysia, Philippines and Thailand) since 1980s. The rise of China as a giant market has attracted investment not only from Japan but also from the rest of the world. There is a growing literature on Japanese FDI in China [1, 2, 3, 4, 5, 6, 7, 8, 9], ASEAN [10], and Asia [11, 12, 13, 14, 15, 16]. The widespread concern on issues concerning Japanese affiliates are not only limited to sales performance but also whether the increased Japanese FDI in China is at the expense of ASEAN and also whether Japanese affiliates has successfully met their targeted market share in both domestic markets of ASEAN and China. This study aims to construct indices to gauge the Japanese

affiliates' performance in capturing the domestic market share of ASEAN and China. The indices are formed for 13 manufacturing industries which cover 3 sub-periods (i.e. 1996-2000, 2001-2005 and 2006-2009) based on the data collected from the Ministry of Economy, Trade and Industry (METI), Japan. The indices will be validated by Bayesian Network (BN) analysis. The estimated indices can provide insights on production networks, motives, and business progress of Japanese affiliates in both ASEAN and China at industrial level rather than aggregate level. The paper begins with theoretical and conceptual frameworks in Section II. Section III presents the methodology. Section IV presents the results and discussion and the last section provides the conclusions of the study.

II. THEORETICAL AND CONCEPTUAL FRAMEWORK

The proposed indices of the study are based on the theory of multiplier. The multiplier is a ratio of the change of two different variables which can be expressed in (1):

$$\triangle Y / \triangle I = 1 / (1 - MPC) \tag{1}$$

where Y and I are the economic variables, MPC is the marginal propensity to consume. With $0 < MPC < 1$ and the principle of acceleration [17, 18], the multiplier must have a positive value. We rearrange (1) as follows:

$$\triangle Y = [1 / (1 - MPC)] \triangle I \tag{2}$$

As a rule, the multiplicand ($\triangle I$) includes both initial increment of I and all induced increments. The induced increments of I is the additional I induced by the increase in income resulting from the increase in consumption generated by the initial investment [19]. We apply the theory of multiplier to develop the conceptual framework for the study. We generalize that the initial investment will lead to additional investment which induced by the increase in consumption resulting from the firms' capability in producing more variety of goods at reasonable price. The induced increments also include the increase in income generated by the initial investment which ultimately increases consumption. We allow the scenario of the

multiplicand to be negative, not the multiplier of $1/(1 - MPC)$, to be negative if the negative induced investments outweigh the positive initial increment investment from the government of the host country. This reveals crowding-out effects. The concerns in past literature have been considered in developing the conceptual framework of this study. First, the positive value of the multiplier without a point of reference does not reveal the level of the acceleration effects. The findings from [20] pointed out that MPC may exceed unity and cause the true multiplier to be larger than the ordinary multiplier. Second, the length of time which involves the transaction periods, income periods, plan adjustment periods and equilibrium adjustment periods, will affect the value of the multiplier [21]. Third, the leakages and injection in the circular flow model of economy [21, 22] illustrate the difficulty in estimating the value of the multiplicand. Fourth, the empirical models in the past literature review which involve multivariate analysis were subject to the availability of the disaggregated data of a country. Fifth, due to different stages of economic development, different variables have been chosen to be included in the empirical model. Sixth, the quality of labor force, wage rate, political stability, legal system and business cycle of an economy are generic to all potential investors in China and ASEAN, not just pertinent to Japanese investment [1, 7, 23]. These factors may help in explaining the increase in Japanese investment or sales of Japanese affiliates in a country, but, parallel to this line of literature, some of these variables contribute insignificantly to higher investment or sales of Japanese affiliates [2, 3, 9, 11, 15, 24]. Furthermore, these factors hardly explain the out-performance of some Japanese investment in a country as compared to U.S. However, these concerns have been addressed by employing the appropriate analysis method which will be presented in Section III. For simplification and consistency in developing the indices across countries and industries, this study employs the ratio of the domestic sales to investment of the Japanese affiliates in ASEAN and China. As the share of Japanese investment varies across industry, the ratio of domestic sales returns on investment in manufacturing sub-sector industry to total domestic sales returns of investment in total manufacturing industry (3) is more appropriately used in this study.

$$r = (R_i / I_i) / (R / I) \qquad (3)$$

where R_i and R are the Japanese affiliates' domestic sales in manufacturing sub-sector industry i and Japanese affiliates' total domestic sales in manufacturing industry respectively; I_i and I are the Japanese affiliates' investment in manufacturing sub-sector industry i and Japanese affiliates' total investment in manufacturing industry respectively. In order to benchmark the acceleration effects, we assume that the ratio (r) in (3) with value more than 1 indicates high acceleration effect and value less than 1 indicates low acceleration effects. The ratio (r) is not calculated based on the changes of a time period as it is difficult and almost impossible to determine the appropriate adjustment time period for different industry and country. However, the Bayesian influence could overcome this problem. Hence, the indices are estimated for 3 sub-periods which cover 1996-2000, 2001-2005 and 2006-

2009 rather than annually. To have a parsimonious model, Fig. 1 presents the conceptual framework and Table 1 outlines the evaluation framework of the estimated indices.
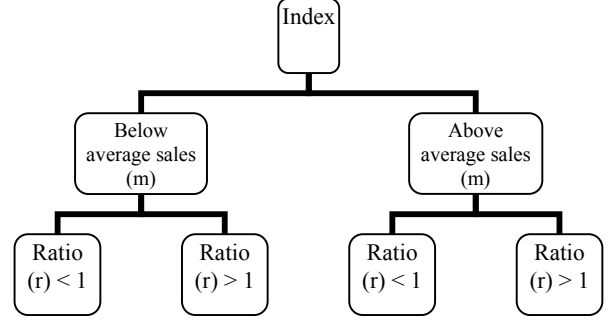

Figure 1.   Conceptual Framework

TABLE I.   EVALUATION FRAMEWORK OF THE ESTIMATED INDICES

-1.0 < p < -0.5	-0.5 < p < 0	0 < p < 0.5	0.5 < p < 1.0
Decrease significantly		Increase significantly	
Decreasing gain in market share		Increasing gain in market share	
Supplier network become less prominent		Supplier network become more prominent	
Decreasing difference in production capacity and factor endowments		Increasing difference in production capacity and factor endowments	
Decreasing economic of scale		Increasing economic of scale	
FDI as secondary entry mode		FDI as primary entry mode	

III.   METHODOLOGY

The Bayes Theorem in estimating the indices for Japanese affiliates' market penetration is expressed in (4).

$$p(m|r) = \frac{p(r|m)p(m)}{p(r)} \qquad (4)$$

In line with the objectives of the study, the indices are estimated based on the probability of the Japanese affiliates to have vigorous sales (m) where the above average sales revenue are obtained within the entire sub-period, given the ratio (r) is more than 1. Therefore, we re-write (4) as follows:

$$p(m > average | r > 1, e)$$
$$= \frac{p(r > 1 | m > average, e)p(m > average, e)}{p(r > 1 | e)} \qquad (5)$$

Equation (5) encodes the nonlinear relationships between the discrete variables of m and r in an uncertain-reasoning problem which it updates the belief for the hypotheses of Japanese affiliates' sales performance given the evidence r and the current state of information e. The prior knowledge of e takes into account of the uncertainty of the adjustment period mentioned in Section II. The Bayesian network (BN) is a combination of prior knowledge and statistical data [25]. The posterior probability of $p(m|r)$ on the left-hand side of (5) is the probability of m > average given r > 1 with e. The $p(m > average, e)$ is the prior probability of m > average given e. The $p(r > 1 | m > average, e)$ is the likelihood of the observation of r > 1. The probabilistic influence performs

predictions and diagnostics in the probability metric which directly can serve as an index to aid management analysis and decision.

The advantages of BN in the literature of [26] states that BN can show good prediction accuracy even with small sample sizes. There is no minimum sample size required for BN analysis. The probability estimation as a measure of uncertainty is better than the estimation of expected value. BN can avoid overestimated data.

Due to consistency and availability of data, this study utilizes the quarterly data of Japanese affiliates' acquisition of tangible fixed assets (excluding lands) as Japanese affiliates' investments. Furthermore, mergers and acquisition is the survival strategy for Japanese FDI in the age of global competition [13]. All data are collected from METI.

IV. RESULTS AND DISCUSSION

The estimated indices for the domestic market penetration of Japanese affiliates in ASEAN and China are presented in Table II.

TABLE II.　DOMESTIC MARKET PENETRATION OF JAPANESE AFFILIATES IN ASEAN AND CHINA

Period	1996-2000	2001-2005	2006-2009
Food and tobacco	0.4 **0.182**	0.667 **0.445**	0.428 **0.399**
Textiles	0.601 **0.4**	0.438 **0.438**	0.625 **0.5**
Lumber, pulp, paper and paper products	NA **NA**	NA **NA**	0.4 **0.358**
Chemicals	0.571 **0.5**	0.421 **0.35**	0.563 **0.437**
Ceramic, stone and clay products	0.111 **0.333**	0.5 **0.421**	0.499 **0.375**
Iron and steel	NA **NA**	NA **NA**	0.313 **0.437**
Non-ferrous metals	0.6 **0.666**	0.4 **0.4**	0.5 **0.467**
Fabricated metal products	0.556 **0.223**	0.529 **0.375**	0.538 **0.437**
General-purpose, production and business oriented machinery	0.375 **0.715**	0.389 **0.5**	0.636 **0.466**
Electrical machinery	0.555 **0.364**	0.4 **0.55**	0.75 **0.601**
Transportation equipment	0.454 **0.364**	0.45 **0.769**	0.437 **0.563**
Precision instruments	-0.546 **0.686**	0.308 **0.556**	-0.4† **0.7†**
Miscellaneous manufacturing industries	0.75 **0.499**	0.35 **0.353**	0.2 **0.833**

Notes: † denotes estimation for 2006-2008 due to unavailability of data. The estimated indices for China are in bold. Negative sign indicates the domestic sales of Japanese affiliates is below the average domestic sales for the entire period given low acceleration effect (r < 1). NA denotes unavailability of data.

Undoubtedly, the indices vary across manufacturing sub-sector industry for both ASEAN and China. Furthermore, the estimated indices will not have the exact probability value of 1 as no country will allow complete access to an industry through FDI based on national security. The findings of the study imply the behavior of Japanese affiliates in adopting a "balanced act" investment strategy for ASEAN and China.

The ascension of China to World Trade Organization (WTO) coupled with the liberal policies has attracted FDI from around the world. Therefore, the increase in the number of Japanese affiliates firms in China shows that Japan is taking the opportunity to penetrate the huge potential market share, diversify risk and make use of the economic scale production base [23, 24, 27]. The difference of indices between ASEAN and China is marginal which give support to the explanation of [24, 27] that cheap labor cost cannot be the only reason in explaining higher investment from Japanese affiliates in China rather than ASEAN.

It is noted that the indices have increased and become more promising from 2000-2005 to 2006-2009 for textiles, chemicals, non-ferrous metals, fabricated metal products and electrical machinery industries in ASEAN. In China, the estimated indices have declined in 2001-2005, bottoming out but slipping behind ASEAN in 2006-2009 for these industries. The Japanese affiliates have gradually gained the momentum in penetrating Chinese market in textiles and electrical machinery industries from 1996-2000 to 2006-2009 [27]. The results imply that the early mover's advantage of Japanese affiliates in electrical industry has created a competitive market in both ASEAN and China. This is supported by [8, 13], who reported that Japanese affiliates dominate the electrical machinery industry in Asia. Japanese affiliates gain market share due to the difference in capability of domestic firms and Japanese affiliates in host country. The domestic firms with small-scale and labor-intensive production and Japanese affiliates with large-scale and technology intensive production reduces the rivalry gap which eases the Japanese affiliates to penetrate the domestic market of host country. The low competitive environment at the early stage has created a large opportunity for Japanese affiliates to establish brand loyalty. Furthermore, the early entrance of Japanese affiliates has gained favorable treatment from the local government of the host country. Therefore, the availability of infrastructure and supporting facilities may not be critical for the Japanese affiliates in both ASEAN [12] and China.

The estimated indices illustrate a decreasing trend for food and tobacco, ceramic, stone and clay products, and transportation equipment from 2001-2005 to 2006-2009. However, the estimated indices for these industries are greater than the estimated indices in 1996-2000 except for the transportation industry in ASEAN, for which the estimated index is 0.017 point below the 1996-2000 estimated index. There is a small and stable fluctuation of the estimated indices for transportation equipment throughout the period of 1996 to 2009 in ASEAN. In China, the estimated indices for transportation equipment increases from 0.364 to 0.769 and fall slightly to 0.563 throughout the period. In the early 1990s, the Japanese affiliates' automotive industry acquired strong reputation for quality and reliability [23] and have generally avoided establishing vehicle manufacturing centers in China due to imitative behavior of close rivals [1, 15]. This shows that moving overseas production to tap the domestic market in both ASEAN and China is less imperative for Japanese investors in transportation equipment industry [1]. Reference [15]

reported that it takes time to develop the Japanese-style tight supplier network which required relation-specific investment for Japan automobiles assemblers in ASEAN region. Hence, high local procurement to meet the local content requirement could reduce the sales of Japanese automobile industry in ASEAN [23, 27]. This postulates that transportation equipment industry remains as a secondary choice of Japanese affiliates in penetrating the domestic market of ASEAN and China.

The market penetration by Japanese affiliates in ASEAN for precision instruments and miscellaneous manufacturing industries become less impressive as the estimated indices demonstrate a decreasing trend with value less than 0.5 from 2000-2005 to 2006-2009. In contrast, the estimated indices for Chinese market penetration by Japanese affiliates in these industries portray an increasing trend with value more than 0.5 for the same period. This may imply that Japanese affiliates have more opportunity in capturing the Chinese market share for these industries. The negative sign of the estimated indices for precision instruments industry in ASEAN may suggest that exports from Japan to ASEAN as the entry mode is more favorable [28].

From 1996-2000, 2001-2005 to 2006-2009, the estimated indices for general purpose, production and business oriented machinery illustrate a clear divergent trend where the upward trend of the estimated indices in ASEAN is offset by a downward trend of the estimated indices in China. This shows that ASEAN has more market opportunity for Japanese affiliates to gain higher sales revenue in this industry.

From 1996-2000, 2001-2005 to 2006-2009, the trend of the estimated indices for the first eight manufacturing sub-sector industries in both ASEAN and China exhibit almost the similar pattern. On the other hand, the trends of the estimated indices for the respective last five manufacturing sub-sector industries are rather diverse and contrast between ASEAN and China. This might be due to the reason that the first eight manufacturing sub-sector industries are resource and labor based industry while the last five manufacturing sub-sector industries are labor and technology based industries.

The estimated indices for China in 1996-2000 are relatively low compared to ASEAN. A series of disputes and incidents between Japan and China in 1979 and 1982, 1985 and 1987 and 1995 and 1996 have inevitably had its toll on Japanese FDI in China [1, 7]. Hence, the motive of Japanese FDI is for cost reduction rather than market seeking [10, 13, 28, 29]. Furthermore, China has been inherently closed and inward-looking economy [30], but the economy has gradually become more liberalize after 1992. The risk-averse Japanese investors in China are therefore focusing on small and medium-sized labor intensive industry for low-end product during 1996-2000 [1, 23]. Based on the literature quoted in [11], Japanese companies were evidently very reluctant to commit new investment to Asia due in part to Japan's own poor economic situation in 1997 and 1998.

This study supports the view of [16] on Japanese affiliates' reconfiguration strategies in ASEAN region and China. The systematic and proactive approaches of geographic concentration strategy are proven by the results of this study where the establishment of Japanese affiliates is gradually increasing in China. This could be reflected by the estimated indices for China which outweigh the modest estimated indices for ASEAN from 1996-2000 to 2001-2005. This indicates that Japanese affiliates are concentrated in both ASEAN and China which allow them to enjoy the advantages of low cost of production in order to produce products at competitive price to cater for the domestic market demand.

The comparative advantages of resource abundance and low labor cost are not sufficient to sustain the sale of the Japanese affiliates [16] in ASEAN for precision instruments and miscellaneous manufacturing industries. This might cause the Japanese affiliates to reconfigure their production network to China which is less footloose in nature. This reflects that the Japanese FDI has gradually been focusing in the combination of cost-reducing and market-penetrating investment [13, 23, 27, 29]. The technology intensive and high-end product of general-purpose, production and business oriented machinery, precision instruments and miscellaneous manufacturing industries are highly impacted by the intensive competition by global players who are increasingly dominant in the market. Hence, in order to penetrate the ASEAN's market for precision instruments and miscellaneous manufacturing industries and Chinese market for general-purpose, production and business oriented machinery, Japanese affiliates should focus on key-product market strategy which required rapid technology development, constantly redefined market demand coupled with cost reduction and product differentiation [8, 16]. In addition, the literature documented in [5], pointed out that subsidiary performance is influenced by the success of commercialized transferred technology in local marketplaces. Generally, production network establishment and marketing strategy play different essential roles in penetrating domestic market for different country and industry [4, 12, 23, 27, 31].

V. CONCLUSIONS

The indices to gauge the degree of domestic market penetration of Japanese affiliates in ASEAN and China have been developed based on the theory of multipliers. This study employs BN to estimate and validate the indices for 13 manufacturing sub sector industries which cover the periods of 1996-2000, 2001-2005 and 2006-2009. The estimated indices revealed the following outcomes which are evidenced by the findings in the past literature and country reports. First, the estimated indices illustrate the motive of Japanese affiliates which changes from cost reduction to the combination of cost reduction and market-penetration investment. Second, the trend patterns of the estimated indices reflect 2 category of industries which are (a) resource and labor based industry, and (b) labor and technology based industry. Third, the estimated indices reveal the Japanese affiliates business strategy for different industry in penetrating the markets of ASEAN and China. Therefore, the estimated indices can be utilized by managers, investors and researchers for business performance evaluation. Due to the conditions imposed on the access of micro-level data, the

indices have been constructed for ASEAN as a whole and China. Further investigation into specific country of ASEAN and province of China for each manufacturing sub-sector industry are soundly warranted.

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