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Drivers of Innovation in the Malaysian Services Sector: An Analysis Based on Firm-Level Data

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Abstract: Innovation in the services sector has not received much attention in Malaysia though, as the dominant sector, its potential role in the innovation-driven economy as envisioned by the New Economic Model is immense. This paper draws from data sourced from a national-level innovation survey of service establishments to investigate firm-level drivers of innovation. Though both the definition of innovation and the variables likely to drive it were proscribed by the survey data, the findings are of interest, even if not comprehensive. Nearly half of the 303 firms (drawn from five major service subsectors) in the sample were innovating with the majority reporting improvements in quality or cost in both service products and processes. Developments of major new service lines and the filing of patents and copyrights were less common. Innovators were more likely to be firms that collaborated in R&D with other firms or agencies, firm that accessed technology from parent companies and those that were in a supplier-relationship with MNCs. Communications firms were the least innovative while there were no significant differences in innovative behaviour among firms in the other four subsectors. Important policy implications are discussed based on these findings.

Keywords: Incremental innovation, radical innovation, supplier relationship, R&D, MNC

JEL classifications: *L8, O14, O31, O32*
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1. Introduction

Malaysia is commonly seen as being caught in the "middle-income trap" - positioned between low-wage economies and highly innovative countries - without a viable growth strategy to elevate itself (NEM, 2010: 34). The New Economic Model (NEM) announced in March 2010 and the 10th Malaysia Plan, 2011-2015 (Malaysia, 2010) that came in its wake are the official

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policy responses to the growth dilemma. They envision a Malaysia that is knowledge-based and innovation driven. Both documents emphasise the need to aggressively promote innovation in the private sector. While manufacturing is singled out for a special role, the potential contribution of the dominant services sector in the innovation driven economy as outlined in the New Economic Model is immense.

The services sector is admittedly a mixed bag ranging from informal to highly specialised, knowledge-intensive activities such as information and communication technologies. It also encompasses the large government, medical and education services. All this makes analysis of innovation in the sector rather intractable. The services sector has emerged as the dominant sector in the economy, both in terms of contribution to the gross domestic product (GDP) and employment. In 2008, services generated 57 per cent of all employment and contributed 55 percent of the GDP of which 47.6 per cent was generated by non-government services. Approved investments in services amounted to RM50.2 billion in 2008 of which 11 per cent were foreign investments (PMO, 2009). At the end of the 9th Malaysia Plan (2006-2010), services had recorded the fastest annual growth rate (6.8 per cent) - and had raised its share of the GDP to 58 per cent. Despite these impressive gains, productivity growth in the services sector lagged behind the manufacturing sector and the national average. Between 2009 and 2010, for example, productivity in services grew at 4.7 per cent, outpaced by the national average of 5.8 per cent and productivity growth in the manufacturing sector at 9.4 per cent (MPC, 2011).

Understanding innovation in services is important on several counts. First, despite its impressive growth and contribution to both GDP and employment, the slower productivity gains suggest deficiencies in both capital and human resource efficiencies. To the extent that innovation drives productivity, this should be a cause for concern. Second, any reliance on innovation to lift the economy from the "middle-income" trap must necessarily include innovation in the large and dominant services sector. After all, there are strong linkages between services and manufacturing. Both sectors are closely integrated in a modern economy such that the competitiveness of manufacturing is crucially dependent on the productivity and efficiency of services (Czarnitzki and Fier, 2002). At one end, traditional services such as wholesale trade, transportation and logistics provide support not only to manufacturing but other sectors of the economy as well. At the other, knowledge-intensive services such as telecommunications, software, and engineering serve as catalysts to innovation in almost all sectors of the economy (Europe Innova, 2011; Sissons, 2011). Third, even if the rate of innovation is not directly increased through internal effort, globalisation and the widespread use of information and communication technologies will change the nature of human resources required by this sector

that houses the biggest proportion of our workforce. Employees in the service subsectors need to upgrade their skills to eliminate the reputation of the services sector as a repository of unskilled workers. If workers are not upgraded to support the transformation of services, the sector will stagnate, trapping a large part of the work force in low income brackets. Such a development would surely be a cause for anguish to concerned scholars like the late Osman-Rani.

This article contributes to the understanding of innovation in the services sector in Malaysia. Compared with works on the manufacturing sector in Malaysia, there is a dearth of studies on innovation in services. The authors are unaware of any published work based on firm-level data.

This paper has two main objectives. First, to give an overview of the types of innovation (defined based on our data source) taking place in the services sector. Second, we attempt to identify firm-level drivers of innovation. Based on the findings, we draw some policy conclusions. Bearing in mind that the definition of innovation and the variables likely to drive it were proscribed by the survey data, the findings should be treated as indicative rather than comprehensive.

2. Innovation in Services: An Overview

The study of innovation in services has traditionally suffered universal neglect. In a widely-cited paper, Baumol (1967) dismissed innovation in services because he held that its inherent nature made productivity gains unlikely relative to the goods-producing sectors of the economy.[1] Pavitt (1984) reinforced this view by labelling services a supply-dominated sector where innovations were merely adoptions and adaptations of new ideas elsewhere. Not surprisingly, therefore, innovation surveys — when they were first conducted — focused primarily on the manufacturing sector even in Europe (Tether and Howells, 2007). And when they were extended to include the services sector, innovation was defined and measured largely as it was in the manufacturing sector. Thus, data on expenditures on R&D, the number of staff employed exclusively for R&D, the number of patents obtained, the introduction of new products, services or processes etc were relied upon as evidence of innovative activities (Hipp and Grupp, 2005; Cunningham, 2007). This approach missed important differences in the nature of innovation in services thereby understating its occurrence.

More recent studies have highlighted key differences between innovation in services and manufacturing. For instance, much of the innovation in services is non-technological in nature and occurs by way of (sometimes ad hoc) incremental changes in processes, products and organisation without the need for formal research and development (Edler *et al.,* 2003; Hipp and Grupp, 2005; Gago and Rubalcaba, 2007). This, in turn, makes identifying such innovations problematic since they are not single or unique events.

Additionally, inputs to innovation in services are "softer" taking the form of investments and expenditures on ICT, software, training, marketing and customer relations among others rather than formal expenditures on R&D that characterise innovation in manufacturing. Furthermore, trademarks, designs, and copyrights, rather than patents, are more relied upon to protect innovations than in manufacturing (Edler *et al*., 2003; Uppenberg and Strauss, 2010; Den Hertog, 2010). It might be added that even formal R&D in many service industries differs in scope and complexity from research in manufacturing often requiring less formal infrastructure such as dedicated R&D laboratories and workers.

Numerous definitions of service innovation have been proposed (see, for example, Johne and Storey, 1998; Menor, *et al.,* 2002). Den Hertog (2010:19) offers the following: "A service innovation is a new service experience or service solution in one or several of the following dimensions: new service concept, new customer interaction, new value system/business partners, new revenue model, new organisational or technological service delivery system."

The definition of innovation used in this paper is, however, proscribed by the data collected via the *Productivity and Investment Climate Survey 2*. The survey was conducted by the Malaysian government in collaboration with World Bank in 2007[2] for the reference year 2006. It was a representative, nationwide survey and yielded 303 useable responses for the purposes of this paper. The questionnaire relied on traditional measures to capture innovation and was modified to suit services primarily by replacing the word "product" with "service". Thus, the data suffer from many of the limitations discussed above and likely understates innovation in services.

For the purposes of the paper, an innovating firm was defined as one that answered in the affirmative to one or more of five questions.[3] Clearly, this puts the focus on product and process innovations leaving out aspects of organisational and managerial innovations. Evidence from Singapore (Wan *et al.,* 2005) and Taiwan (Wang and Tsai, 2013), for example, suggest that these may be important as well.

Product innovation in services refers to changes in the service being provided, either in the sense that an entirely new service is being offered or an existing service has been extensively improved to better meet client needs. Process innovation, on the other hand, refers to meaningful changes that improve a part or all of the process of production or delivery of the service to the client (Utterback and Abernathy, 1975; Ettlie and Reza, 1992). The neglected innovations in organisational and managerial aspects refer to significant changes in the practices that support the provision of a service. While these are not considered in this paper, they can be important, particularly in the services

sector (Wang and Tsai, 2013; Meroño-Cerdana, and López-Nicolas (2013); Fitjar *et al.,* 2013).

Further distinctions are made in the literature with regard to these innovations. Any of these innovations may be incremental or radical. The former represents marginal changes that enhance existing services while the latter refers to fundamental changes that bring about a clear departure from existing services (Utterback and Abernathy, 1975; Ettlie *et al*., 1984; Ettlie and Reza, 1992). But the data from the survey allow us to only hazard guesses regarding these distinctions.

The survey encompasses five service subsectors: information technology; communication services; accounting and related professional services; advertising and marketing; and business logistics. These are all market-oriented services; large subsectors such as public services, health and education that provide substantial services outside the market are left out.

2.1 Extent of Innovation

Of the 303 firms surveyed, 150 or 49.5 per cent of the sample reported some form of innovative activity (as defined previously) in 2006 (Table 1). Thus, about half the firms was involved in some form of innovative activity — a finding consistent with studies elsewhere (Evangelista and Savona, 2003; Edler *et al.,* 2003; Uppenberg and Straus, 2010). Most innovation were recorded in the information technology and communications subsectors while the proportion of innovating firms was about the same in the three subsectors**.** Higher level of innovative activity in both these sectors seem to conform to patterns observed elsewhere (Hipp and Grupp, 2005), but the large share of innovating firms in the communications subsector in Malaysia must be treated with caution, given the small sample size and the somewhat formal definition of innovation adopted in the survey.

Table 1: Proportion of service firms involved in innovation

Subsector	Total	Nos. Innovating	% Innovating
Information technology (IT)	39	26	66.7
Communication services (CS)	10	6	60.0
Accounting and related professions (AP)	117	57	48.7
Advertising and marketing (AM)	26	12	46.2
Business logistics (BL)	111	49	44.1
Total	303	150	49.5

Source: Productivity and Investment Climate Survey 2, 2007

2.2 Forms of Innovation

Improvements in quality or cost were reported by the majority of innovating firms followed by technology that changed the way the main service was produced (Table 2). These clearly fall within the realm of incremental innovation in both production and processes. Not surprisingly, smaller proportions of firms developed a major new service line or filed for patents or copyrights, which could be tentatively viewed as suggesting a low incidence of radical innovations. The low number of copyright and patent applications capture the lower propensity for technology-based innovation in services. As noted by Edler *et al.* (2003: 4), in the context of EU service companies, though "[the] resources which the sample devotes to the innovation process are significant … [e]xternal sourcing is … more important than internal research and experimental development … Due to these characteristics of the innovative process, the role of IPR for the innovation process is obviously only of minor importance."

Table 2: Forms of service innovation

Forms of Innovation	Nos. Innovating*	% Innovating
Process or service improvements in quality or cost	83	53.3
Filed patents/utility models or copyrights	18	12.0
Developed a major new service line	55	36.7
New technology changing the way the main service is produced	67	44.7

Note:*Number of firms exceeds 150 because multiple responses are possible
Source: Productivity and Investment Climate Survey 2, 2007

3. Covariates of Innovation: A Survey of the Literature

There have been many attempts to model service innovation; Den Hertog and Bilderbeek (2009) provide a useful survey and conclude that a comprehensive conceptual model on service innovation or a general model that applies equally to services and other sectors has yet to emerge. Given the wide range of activities within services and the fact that service functions are spread, albeit in different degrees, across all economic sectors, this conclusion is not surprising.

Since our primary aim was not to chart the course of innovation within firms, the lack of a coherent theoretical framework did not concern us. Instead, we focused on the empirical literature to identify firm-level factors positively associated with innovation. While many covariates have been hypothesised to influence innovation in service sector firms, we were constrained by variables available from the survey. The covariates that had empirical justification were entered as dummy variables and included the following.

3.1 Age of Firm

Little is known about the effect of the age of a firm on its ability to innovate. It is reasonable to expect, *a priori*, that a better established firm is more likely to innovate since it is a risky venture requiring substantial capital investments, a knowledge of the market preferences and the resources to translate research findings into products, processes or service. All these attributes are more likely achieved with age. However, a study by Criscuolo *et al*., (2009) found that in the services sector in the UK, younger firms were more likely to initiate both product and process innovations and adopt new managerial and organisational practices. This was in contrast to the manufacturing sector where it was discovered that the more established firms led the innovation drive. They attribute this, in part, to the lack of barriers to entry in many knowledge-intensive services that allow younger entrants to quickly convert their innovations to new products and processes.

A dummy was used to separate older firms (those operating for 15 or more years) from younger ones. Since innovation is often a long process, an arbitrary cut off of 15 years was used, in order to give established firms a sufficiently long time horizon to initiate and benefit from innovation.[4]

3.2 Firm Size

The size of a firm has traditionally been viewed as a positive influence on innovation (Schumpeter, 1942). Bigger firms enjoy scale economies that justify the large investments necessary for setting up formal R&D infrastructure (Cohen and Levinthal, 1989; Crespi and Zúñiga, 2010). This view has since been challenged even in manufacturing (Acs and Audretsch, 1990). In services, it has been pointed out that innovation processes are more informal, diffused and less input-intensive. Thus, it is easier to attain the critical mass necessary to sustain innovation. Additionally, services offer more opportunities to small-and-medium-sized enterprises (SMEs) and is dominated by such firms relative to the manufacturing sector (Rubalcaba, 2011). In Malaysia, about 99 per cent of all service establishments were SMEs (cited in UNDP, 2007: 4). Similarly, in our sample, about 85 per cent of the firms employed no more than 150 workers and can therefore be considered as SMEs.[5] This predicts a weaker link between firm size and innovation in the services sector. A dummy was used to separate large firms (>150 employees) from SMEs.

3.3 Foreign Ownership

Foreign ownership has often been linked to higher innovation. Certainly, with respect to the manufacturing sector, it is widely held that foreign–owned

firms are more involved in innovation than their local counterparts (UNDP, 1994; UNDP/WB, 1995; Rasiah, 1995; Narayanan and Lai, 2000). A similar finding was reported for Latin American countries (Crespi and Zúñiga, 2010). However, foreign ownership may well be capturing the effects of other conditions that spur innovation such as access to technology and operating in a competitive environment. Some studies indicate that once these effects are controlled, foreign ownership may not be independently and significantly related to innovation (Sadowski and Sadowski-Rasters, 2006). About 19 per cent of our sample firms had some degree of foreign equity participation. A dummy captured joint-venture firms and those with any degree of foreign equity participation.

3.4 Market Power and Competition

As with any other sector, market power or the lack of competition can discourage innovation. A subsector characterised by market segmentation and a few dominant firms is less likely to nurture innovative firms. Furthermore, in Europe, some subsectors in services such as business and finance were found to have a greater propensity to embrace new corporate strategies, introduce new products, improve product quality and protect intellectual property through copyrights and so on. In contrast, less of such tendencies were observed in services such as transport and traditional communications. This has led to the belief that there are differences in innovation behaviour across service subsectors (Rubalcalba, 2011).

Among the five service subsectors covered in the survey, the communication subsector is highly regulated and dominated by seven main players. Foreign participation and entry of new firms are restricted. This suggests that there is an absence of competition in what appears to be an oligopolistic market structure. In contrast, other subsectors have a larger number of firms and are easier to enter. Taking these factors into consideration, we expect less innovation in communications compared with others. Four dummies were created to capture differences in the subsectors with communications serving as the reference group.

3.5 Exposure to Export Markets

It might also be expected that firms that export part of their services have a stronger incentive to innovate since they are exposed to foreign competition. In Latin America, manufacturing firms operating in export markets were reportedly more innovative (Crespi and Zúñiga, 2010) while in Germany, both product and process innovations were more common among exporting firms in services

relative to non-exporting firms (Licht *et al.,* 1999). A dummy was created to separate firms with some export-orientation from those that produced primarily or entirely for the domestic market. A firm exporting more than 10 per cent of total sales was assumed to be exposed to more competition than firms serving exclusively (or predominantly) domestic markets. The export threshold used is admittedly low because there were very few firms that were exporting services. In the sample, only 16.8 per cent of firms exported more than 10 percent of their services during the reference period.

3.6 R&D Infrastructure

Despite the observation that much innovation in services occurs outside of a formal R&D framework, data on R&D remains a significant indicator of innovation in the sector. For example, the annual growth rates of spending on R&D in services in Europe have exceeded that recorded over the last decade. This could be capturing the impact of several developments - better data collection, rising investments in more complex technologies within services and increased outsourcing of R&D activities by manufacturing firms (Rubalcalba, 2011).

In the survey, no information was collected regarding R&D facilities but there was information on firms that had staff exclusively for R&D. This indicates the presence of some formal innovation activity. It is logical to expect that firms with dedicated R&D staff will demonstrate a higher propensity to innovate.

3.7 Incentives for R&D

Incentives or public support for private R&D is justified on at least three grounds (Czarnitzki and Fier, 2002). First, there is the well discussed "market-failure' argument which suggests that because the private return to R&D is lower than the social return, R&D will remain at a socially sub-optimal level without public support. Second, firms may simply lack the resources to finance important R&D, or even if well-endowed, may be unable to do it fast enough or adequately. Third, firms without internal resources may find it expensive to finance R&D by borrowing from external sources because the rate of return required by an investor utilising his own funds is often lower than the rate of return expected by the external lender.

Malaysia offers a wide range of incentives for R&D but very few firms in the sample reported receiving these incentives. Nevertheless, it was important to evaluate the impact of incentives. A dummy isolated recipients firms from non-recipients.

3.8 Sourcing Technology for Innovation

Access to new technology and R&D is a basic ingredient for innovation and firms that successfully translate the knowledge and results of R&D into innovation become the innovators (Czarnitzki and Fier, 2002). If technology is not endogenously available, service firms have several options: affiliates of foreign firms can secure technology from parent establishments, while firms without affiliation can collaborate with outside institutions to strengthen their research capabilities, subcontract out R&D projects or buy the relevant technology. In a study of service firms in South Korea, Kang and Kang (2013) found a positive association between research collaboration and innovation, although the relationship took an inverted U-shape; technology purchases, on the other hand, was negatively related to innovation below a certain threshold but turned positive after that threshold was breached.

All four modes were reported by the surveyed firms. We hypothesised that firms involved in collaborative research, or had gained technology from parent plants, or subcontracted out R&D projects or purchased technology would experience a higher level of innovation. Evidence on purchased technology was drawn from royalty payments paid by the firms. Each mode was captured by a dummy variable.

3.9 Supply Relationships with MNCs

A large number of SMEs serve as vendors, suppliers and ancillary service providers to large scale enterprises. One estimate suggests that 90 per cent of the SMEs in manufacturing may be functioning as original equipment manufacturers (OEM) for larger firms (The Sun, 8 December, 2001). Some studies on the manufacturing sector suggest significant gains in technology and expertise among firms that have established supplier links with multinational corporations (MNCs) (UNDP, 1994; Rasiah, 1994).

Less has been documented about the role of SMEs in services but there is little doubt that many provide ancillary services to big firms. Nearly 15 percent of the firms in our sample sector reported supplier links with MNCs that led to some technology transfer. Such firms may be expected to be more innovative not only because they benefitted from new technology but also because they are required to meet the more exacting service standards of MNCs.

4. Main Characteristics of Firms in the Sample

Table 3 contains a list of characteristics of innovating firms, relative to non-innovators. Several points are worth noting. A higher proportion of innovating firms reported having collaborative ties with outside parties (excluding parent companies),[6] receiving technology from parent establishments and gaining

technology in their role as suppliers of multinational corporations. Thus, much of the innovation in the services appears to be led by firms directly or indirectly associated with multinational firms.

Proportionately, more innovating firms were younger, export-oriented and larger than non-innovating firms. Also, a larger percentage had dedicated R&D staff and received government incentives to undertake R&D.

Interestingly, proportionately more innovators had subcontracted out R&D activities and paid royalty fees as well. This implies that at least some of the innovation reported by innovating firms occurred outside the firm.

Finally, as noted before, there were larger concentrations of innovative firms in the information technology and communications subsectors.

Table 3 : Major characteristics of firms in the sample

	All firms (%)	Non-innovators (%)	Innovators (%)
Age of firm>15 years	60.0	64.7	54.7
Exporting>10% of sales	16.8	13.7	20.0
Firm size > 150 employees	15.5	11.8	19.3
Foreign owned or joint venture	18.8	17.0	20.7
Staff exclusive for R&D	4.6	2.0	7.3
Subcontracted out R&D projects	3.3	1.3	5.3
Paid royalties	6.3	5.2	7.3
Collaborated in R&D with others	37.6	9.8	66.0
Technology transferred from parent	26.1	6.5	46.0
Supplier to MNCs	14.5	2.0	27.3
Received govt. incentive for innovation	1.7	0.7	2.7
Information technology	12.9	8.5	17.3
Communications	3.3	2.6	4.0
Accounting & related activities	38.6	39.2	38.0
Advertising & marketing	8.6	9.2	8.0
Business logistics	36.6	40.5	32.7
Sample-size	303	153	150

Source: Productivity and Investment Climate Survey 2, 2007

5. Econometric Model and Results

A preliminary Chi-square test of association[7] suggested a statistically significant association ($p<0.10$ or better) between innovating firms and age of firm, size of firm, having staff exclusively for R&D, doing collaborative research with outside establishments, receiving technology from parent plants, being a supplier to MNC's and subcontracting out R&D services.

In order to test the strength and direction of these associations, a multivariate analysis was performed. The dependent variable in the equation is dichotomous and takes on a value of 1 if the firm innovates and 0, otherwise. In such cases, a binary choice model like *logit* is more appropriate on several considerations (see Aldrich and Nelson, 1984).[8] In the empirical exercise we only distinguish between an innovating and a non-innovating firm but did not attempt to measure the level or the sophistication of the innovative activity.

The logit model was of the following form:

$$\log[P/(1 - P)] = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots . + \beta_n X_n + \varepsilon$$

where P is the probability of a firm innovating and the Xs are explanatory variables hypothesised to influence the probability of innovating. The βs are the coefficients of the explanatory variables; and ε represents the stochastic disturbance term.

The left hand side term, $P/(1 - P)$, is interpreted as the ratio of the probability that a firm innovates to the probability that it will not. Alternatively, it may be viewed as the odds that a firm will innovate.

The Breusch-Pagan test did not detect any significant presence of heteroscedasticity. To check for multicollinearity, the variance inflation factor (VIF) was computed for each independent variable. As a rule of thumb, Gujarati (2003) suggests that if the VIF of a variable is larger than 10, multicollinearity exists while others (Belsley *et al.*, 2004) posit that it becomes a problem only when the value exceeds 20. In any case, the VIFs for none of the variables exceeded 1.5.

The results of the logistic regression analysis are shown in Table 4 below. The estimated coefficients represent the log of the odds of being an innovating firm. The overall specification of the model seems appropriate. If it is assumed that a computed probability takes on a value exceeding 0.5 in the case of an innovating firm, the model yields correct predictions for 80 per cent of the cases in the sample. This is further supported by the likelihood ratio test that rejects the null hypothesis that all the coefficients are zero at the 1 per cent level of significance.

Based on the significant coefficients, the results indicate that innovating firms were more likely to be firms that collaborated in R&D with other firms or agencies, firms that accessed technology from parent companies and firms that were in a supplier-relationship with MNCs. Interestingly, communications (the omitted or reference) subsector emerges as being the least innovative, relative to the other four, although Wald tests showed that there were no statistically significant differences in innovative behaviour among firms across these four subsectors.

Table 4: Results of the logistic regression analysis

Variable	Coefficient	Std. Error	z	p-value
Age of firm>15 years	-0.110	0.340	-0.32	0.747
Exporting>10% of sales	0.330	0.464	0.71	0.477
Firm size > 150 employees	0.362	0.459	0.79	0.430
Foreign owned or joint venture	-0.156	0.454	-0.34	0.731
Staff exclusive for R&D	0.648	0.939	0.69	0.490
Subcontracted out R&D projects	0.494	0.985	0.50	0.616
Paid royalties	-1.007	0.761	-1.32	0.186
Collaborated in R&D with others	2.508***	0.370	6.78	0.000
Technology transferred from parent	1.937***	0.474	4.08	0.000
Supplier to MNCs	1.548**	0.715	2.16	0.030
Received R&D incentives	-0.066	1.845	-0.04	0.971
Information	2.988***	1.125	-2.66	0.008
Accounting & related	2.439**	1.066	2.29	0.022
Advertising	2.148*	1.124	1.91	0.056
Business logistic	2.461**	1.046	2.35	0.019
Constant	-3.838	0.310	-3.61	0.000
LR Chi^2 (12) = 156.56				
Prob>Chi^2 = 0.000				
Pseudo-R^2 = 0.3727				
Total observations = 303				

Note: ***Significant at 1%; **significant at 5%; *significant at 10%
Communications is the omitted subsector

By taking the antilog of the individual coefficients we obtain the impact of each explanatory variable, *ceteris paribus,* on the odds of a firm innovating. This is intuitively easier to appreciate than the log of odds (Table 5).

Table 5: The odds of a firm innovating

Variable	Coefficient	Odds (e^{β})
Age of firm>15 years	-0.110	0.896
Exporting>10% of sales	0.330	1.391
Firm size > 150 employees	0.362	1.436
Foreign owned or joint venture	-0.156	0.856
Staff exclusive for R&D	0.648	1.912
Subcontracted out R&D projects	0.494	1.639
Paid royalties	-1.007	0.365
Collaborated in R&D with others	2.508***	12.279
Technology transferred from parent	1.937***	6.935
Gained new technology as a supplier to MNCs	1.548**	4.700
Received R&D incentives	-0.066	0.936
Information	2.988***	19.838
Accounting & related	2.439**	11.465
Advertising	2.148*	8.564
Business logistics	2.461**	11.717

Note: ***Significant at 1%; **significant at 5%; *significant at 10%

Holding other factors constant, conducting collaborative research had the largest positive impact on the odds of being innovative; the odds of being innovative increases by about 12.3 for a firm in a collaborative relationship, as compared with a non-collaborating firm. Similarly, receiving technology from parent plants raised the odds of being innovative by 6.9 relative to a firm that did not have similar access. Also, firms acting as suppliers to MNCs gained expertise that encouraged innovation; the odds of being innovative increased by 4.7 relative to a firm that did not have such links.

By service subsectors, firms in information had the highest odds of being innovative when compared with the omitted category; as noted earlier the differences in innovation among firms in the remaining four subsectors, were not statistically significant.

It is worth noting that the coefficients for the payment of royalties, application for government R&D incentives and age of firms had negative signs, although they were not statistically significant.

Finally, we can establish the marginal effect of the significant variables on the probability of being innovative. For this a "reference firm" is needed. It was assumed that the reference firm is small, young, locally owned, operates within the communications subsector and serves only the domestic market. It has no dedicated R&D staff, has no access to technology from foreign affiliation and has no supply links with MNCs. It was further assumed that it does not contract out its R&D activities, does not collaborate in R&D with others, does not pay royalties to anyone and receives no government incentives for R&D. Entering these characteristics in the estimated equation, we obtain the odds of this firm innovating to be 0.0215.[9] The associated probability of innovating is 0.021.[10]

Now, if a firm was operating in the information subsector but otherwise shared all the other characteristics previously noted for the reference firm, the probability of innovating rises to 0.299 per cent. Thus, the marginal effect of being in the information subsector (holding all other variables constant) is that it raised the probability of innovation by 0.278 (ie. 0.299-0.021)[11] compared with the reference firm. Similar computations for the marginal effect of each significant variable, on the probability of innovating, relative to the reference firm, are shown in Table 6.

Of the three sources of technology accessed by firms in services, collaborative R&D exerted the strongest marginal effect on the probability of innovating, followed by technology gained from parent establishments. By subsectors, the marginal effect of being in information, and to a smaller extent, in business logistics and accounting & related professions raised the probability of innovation significantly.

Table 6: Marginal effect on the probability of innovating, relative to the reference firm

Variable	Probability of innovating	Marginal effect
Collaborated in R&D with others	0.2089	0.1879
Technology transferred from parent	0.1298	0.1088
Gained new technology as a supplier to MNCs	0.0917	0.0700
Information	0.2992	0.2782
Accounting & related	0.1981	0.1771
Advertising	0.1561	0.1351
Business logistics	0.2013	0.1803
Reference firm*	0.0210	-

Note: * See text for the definition of a reference firm

Also evident from Table 6 is that that the predicted probability of being innovative is highest for firms in information with a value of 0.299 (holding other variables constant), followed by firms in collaborative research (0.209). In contrast, being in the communications subsector was a disincentive to innovate as the predicted probability of being innovative was only 0.021, *ceteris paribus.*

6. Discussion and Policy Implications

Contrary to received wisdom, there is considerable innovative activity in the services with about half of the sample firms reporting innovation, although the nature and forms of innovation probably differ considerably, when compared with manufacturing. This is in line with evidence from the UK and other European studies (Cainelli *et al.,* 2006; Miles, 2006; Tether and Massini, 2007; Pro Inno Europe, 2009).

Process innovation was the most common and half the firms were involved in this. Product innovation that changed the way the new service was produced was next in importance with nearly 45 per cent of firms reporting such activity. Information on organisational and managerial innovation was unfortunately not collected. Much of the innovation could probably be categorised as incremental rather than radical although the data do not permit a firm conclusion on this point.

The findings suggest strong, positive associations between innovation and collaborative research (with outside parties) and access to technology (via parent firms, or through supplier links with MNCs). Thus, much of the firm-level innovation in services arises from collaboration or direct and indirect links with MNCs. Of course, links with MNCs need not suggest ownership; in fact, when other factors are considered foreign ownership was negatively (though not significantly) associated with innovation.

Three policy implications follow from these findings. First, co-operation programmes that lead to an increased exchange of information and knowledge between service firms and other firms, universities, research institutions and multilateral agencies should be fostered and nurtured with adequate incentives. Flexible collaborative arrangements among firms and research institutions and related knowledge sourcing strategies can be important catalysts for innovation. Well-designed public policies could also identify and target particular service subsectors to foster such exchanges. Second, links between MNCs and local service suppliers must be facilitated and strengthened through adequate incentives for the domestic sourcing of services since such links function as a conduit for the transfer of technology and technical expertise that drive innovation. Third, the results underscore the need to encourage independent endogenous innovation within service firms. Continued dependence on exogenous sources for technology cannot be a long-term strategy to power innovation. A more detailed study on factors that hamper innovation in services is called for.

The results also indicate a lower probability of innovation in the communications subsector. This is in striking contrast to findings in more mature industrial economies like Germany where firms in the telecommunications subsector showed the highest propensity for continuous internal R&D and firms in transport and wholesale trade were the least likely to innovate (Hipp and Grupp, 2005). Our finding reflects, in part, the structure of this subsector. There are seven main licensed domestic network operators in Malaysia,[12] of which the better known are Telekom Malaysia, Celcom, Maxis and DiGi. The head start enjoyed by Telekom Malaysia (an erstwhile government monopoly) and Time dotcom in the fixed line segment, coupled with the capital-intensive nature of this segment, has discouraged newcomers. In the case of mobile service, it was initiated in 1985 by Telekom Malaysia, though entry was subsequently allowed to a few more private providers in order to develop the subsector and improve the related infrastructure. However, the new entrants have focused their energies primarily in the urban mobile segment (Bursa Malaysia, nd). In sum, the small number of players coupled with the strict regulations on new entrants and on foreign participation have limited competitive pressures in the communications subsector and, doubtless, served as a disincentive to innovate. Consumer groups have complained that the call rates in Malaysia are among the highest in the region (NST, 2012: 19). Clearly, the lifting of legislatives barriers that restrict competition will create a healthier climate of competition and hopefully breed higher levels of innovation as well. More generally, the moves, since 2009, to liberalise the services sector are in the right direction. Hopefully, the opening up of more service subsectors to foreign

participation, new entrants and more competition will become important drivers of productivity growth and innovation.

The signs associated with several variables that were not significant deserve comment. The inverse relationship between innovation and the payment of royalties only indicates that in the absence of in-house innovation, new knowledge will be purchased from outside. It does not suggest the lack of access to the fruits of innovation. Only about 6 per cent of firms accessed technology through royalty payments.

The negative relationship between government R&D incentives and innovation, on the other hand, suggests that these incentives were either inappropriately designed or inaccessible (or both) to service sector firms. Malaysia offers a wide range of incentives for R&D but during the periods prior to the survey virtually none was tailored specifically for the services sector or for SMEs that are dominant here.[13] Furthermore, the factors responsible for the low use of incentives for human resource training and implementation of ICT infrastructure noted among SMEs in the electronics sector in Penang may have wider applicability. Factors that dissuaded firms from availing themselves of these incentives included lack of awareness due to poorly disseminated information, tedious procedures, bureaucratic red tape and undue delays in approval that diminished their usefulness (How, 2001). These weaknesses need to be addressed.

The negative correlation between age of the firm and innovation suggests that newer entrants tend to be more innovative than older ones. There may be several reasons for this. First, many older firms may be concentrated in the more traditional services that are less able to benefit substantially from investments in innovation. Second, since many older service sector firms are family–run SMEs, they appear, for various reasons, to be unwilling to incorporate modern ICT to upgrade their operations relative to newer ones (see Narayanan, 2004). Identifying and addressing these concerns deserve priority. Investments in ICT and their usage were found to be important drivers of innovation, both in manufacturing and services (Polder *et al.,* 2010). Third, newcomers in any sector face competition from existing, established firms and are therefore under greater pressure to invest in modern technology and innovate in order to gain a foothold in the sector.

The very small proportion of firms that have staff exclusively for R&D may be a reflection of the more informal nature of innovation in services. In any case, there was no significant difference in innovative activity among firms with dedicate R&D staff and those who had none.

Much of the innovation in services occurs via interactions with customers, suppliers and competitors. Improvements in productivity frequently materialise through the adoption of best practices, both within and between key service

industries. Based on this observation of service firms relying heavily on external sourcing of new knowledge, Uppenberg and Straus (2010) recommend policies to foster and nurture cluster formations that facilitate knowledge transfers and spill-overs to support innovation in services.

Finally, although not directly evident from the data or findings, it stands to reason that skilled human resources are necessary to drive innovation, regardless of whether it is formal or informal. Furthermore, even without formal innovation, the diffusion of ICT within services and the changing demands being made on the services sector by end-users will require a new breed of workers who are creative and techno savvy. In the longer term, modifying our education and training institutions in anticipation of this changing skill-mix in services is imperative. Towards this end, the National Education Blueprint (2013-25) that was announced in September 2012 intends to launch a new secondary school curriculum and revise the primary school standard curriculum by 2017 to integrate knowledge and skills to foster creative thinking, innovation, problem-solving and leadership (Ministry of Education, 2012). How effective this would be remains to be seen. In the shorter term, a more liberal approach to attracting appropriate foreign talent might be considered.

Notes

[1] This notion remained influential and was labelled as "Baumol's Disease." In a 2003 paper, Triplett and Bosworth announced that the 'disease' had been 'cured'!.

[2] We are grateful to the Bank for giving us access and permission to use the data.

[3] Did you enter new markets due to process or service improvements in quality or cost? (ii) Did you file any patents/utility models or copyright protected materials? (iii) Did you develop a major new service line? (iv) Did you upgrade an existing service line? (v) Did you introduce a new technology that has substantially changed the way the main service is produced?

[4] Even so, other shorter cut-off figures were used to define a well-established firm but it did not change the outcome in any significant fashion.

[5] One definition of SMEs in Malaysia is firms employing not more than 150 workers (SMIDEC, 2002: 5). For services the employment threshold is sometimes set even lower (not exceeding 50 employees). See UNDP (2007:2).

[6] These include other firms, universities or research institutions, and multilateral agencies.

[7] In cases where observations were very few Fisher's Exact Test was used.

[8] The Jarque-Bera test for normality indicated that the residuals were not normally distributed suggesting that the logit, rather than the probit, model might be more appropriate, although in practice they yield similar results.

[9] The characteristics of such a firm imply that all the dummies variables in the estimated equation will take on a value of zero. Thus we get ln P/(1-P) = -3.838 or P/(1-P) = $e^{-3.838} = 0.0215$.

[10] Solving the above for $P = e^{-3.838}/ (1 + e^{-3.838}) = 0.0210$.

[11] ln P/(1-P) = -3.838 + 2.988. From here we get $P/(1-P) = e^{-3.838 + 2.988} = e^{-0.85}$. Solving for P yields 0.2992.

[12] Telekom Malaysia Berhad, Maxis Broadband, DiGi, Celcom Transmission (M) Sdn. Bhd., TT dotcom, Fiberail Sdn. Bhd. and Prismanet (M) Sdn. Bhd.

[13] See PwC (2011) for a comprehensive review of these incentives.

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