Impact of Trade Liberalization on Research and Development (R&D) Expenditures in the Philippines

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Abstract

This paper examines the effects of tariff reductions endorsed under GATT-WTO and AFTA-CEPT on R&D expenditures of Philippine manufacturing firms. It also considers firm characteristics like exports, capital intensity, and size as explanatory factors. Using pooled firm-level data that are harmonized with the international nomenclatures for traded products, the results uphold that intensified competition from foreign players drive domestic firms to develop their production processes and products. Accordingly, the main findings of the paper reveal that reductions in MFN and ASEAN tariffs increase the growth rate of R&D within manufacturing firms. Likewise, a rising export share is associated with higher R&D growth rate and this is suggestive of how export profits further incentivizes firm innovation. The findings also link capital intensity and firm size to higher R&D growth rate. Overall, the results provide support for the role of tariff changes as conduits through which trade liberalization influences expenditure decisions of manufacturing firms.

Keywords: *trade liberalization, R&D, Philippine manufacturing, firm-level data*

Introduction

After more than three decades of adopting a protective policy stance, the Philippine government has undertaken considerable measures in integrating its marketplace into the world economy. Primarily branded by import controls and high tariff rates, the tariff structure underwent successive unilateral reform programs that were moored on an extensive liberalization across products. Beginning in the early 1980s, the trade regime started to loosen with the elimination of tariff and non-tariff barriers as legislated by the Tariff Reform Programs (TRPs). By 2004, no unilateral trade adjustment has been made. Thereafter, the ASEAN Free Trade Area-Common Effective Preferential Tariff (AFTA-CEPT) scheme became the basis for tariff reductions (Aldaba 2013).

As the country acceded to General Agreement on Tariffs and Trade-World Trade Organization (GATT-WTO) in 1995, the global predominance of bilateral and regional trading agreements has induced the Philippine government to engage further in Free Trade Agreements (FTAs) with several states and trade blocs.

Such trade liberalization efforts and intensified economic interdependence among countries broaden horizons for employment and productive efficiency. As implied by the Heckscher-Ohlin (H-O) model, the specialization strategy fostered by freer trade allows for gains to be realized as resources are effectively reallocated within firms and across industries. Yet, this globalization process has constructed an economic atmosphere for developing countries that breeds competition from which opportunities and challenges abound. Relatedly, the Product Life Cycle model provides another alternative account to the observable pattern of international trade and how it affects innovation decisions among firms in the market.

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Relatedly, Wood (1995) expounded the response of firms to freer trade through his "defensive innovation" hypothesis. It acknowledges the urgency for domestic producers to increase capital stock and R&D activities with heightened competition. While it can be presumed that profit-maximizing firms are already employing labor- and cost-saving inputs, the fact that these firms will never be completely knowledgeable of the technical prospects should not be overlooked. On the other hand, Fernandes and Paunov (2009) recognized the positive effect of import competition on product quality upgrading. As foreign competition intensifies, domestic firms are induced to develop novel products to bridge the gap between them and their foreign counterparts.

In the Philippines, trade policies have become the primary mechanism for commencing and strengthening industrialization. However, several studies still accentuate the industry sector's weak performance and negligible contribution to growth and employment. While this paper endeavors to get an overview of the country's investment status, it places utmost focus on how Philippine manufacturing firms, specifically their R&D expenditures, have been influenced by the tariff changes enforced under GATT-WTO and AFTA-CEPT.

International Trade, Competition, and Innovation

Generally, there is a broad consensus among economists that a freer trade strategy incites output growth and efficiency gains. However, as trade liberalization influenced countries at varying levels, the complexities from the growing international interdependence also became palpable. Fittingly, trade-induced phenomena became part of the discussions.

There are two conflicting ideas regarding competition and innovation. First, competition is perceived as an impediment to innovation and technological progress. As suggested by the Industrial Organization models, heightened competition cuts innovative activities as the monopoly rents disbursed to successful innovators are reduced. Conversely, the opposing view reasons that competition is likely to promote innovation as economic agents struggle to escape from their competitors (Aldaba 2012). In this vein, Aghion et al. (2002) developed a model wherein innovation incentives are determined by the disparity between the pre-innovation rent and post-innovation rent. According to them, intensified competition may raise profits from innovation and induce further investments on R&D to escape antagonism. However, this was only possible for industries within neck-and-neck competition where it is difficult to point out who the market leader is. For industries with less neck -and-neck competition, innovation among less productive firms falls as their rewards to catch up with the technological leader decline.

Upon reducing barriers to trade, competition has subjected economic producers to greater vulnerability. Congruently, scholars recognize the profound effects of trade policy changes on a firm's decision and incentive to invest. According to Wood (1995), the response of firms to international trade can be explained by his "defensive innovation" hypothesis. Under this principle, he pointed out that heightened competition from foreign firms is expected to motivate domestic companies to improve capital stock and to engage more on R&D. As profit-maximizing firms are already presumed to be employing labor- and cost-saving inputs that are already in the market, the concept may seem inconsistent with economic theory. However, he underpinned that firms can never have complete knowledge of the technical prospects.

To know more about these possibilities, it will have to incur search costs that may be in the form of R&D expenditures. Pissarides (1995) discussed that as competition among trading partners intensifies, firms have the incentives to innovate. In less advanced countries where superior technology is unknown or costly to employ, R&D activities undertaken are usually aimed at imitating or assimilating production techniques from superior countries. In light of this, Acemoglu (2003) held technology as an endogenous response to the profit incentives from trade.

On the other hand, Licandro and Ruiz (2010) established a two-country endogenous growth model in assessing the impact of trade openness on innovation and productivity growth. They articulated that trade liberalization has encouraged market competition and R&D efforts, which has led to aggregate productivity growth. Through intensified competition, markups are reduced and firms are prompted to innovate more in response to the profits from a larger market size. Likewise, Atkeson and Burstein (2010) supported the principle that falling trade costs have a considerable impact on the firm's decision to leave the market, export, and capitalize on R&D.

On a more recent study, Bas and Ledezma (2015) enunciated that freer trade prompts incentives for productivity-enhancing technologies by raising expected profits. However, heterogeneous firms have distinctive responses to profit opportunities. According to the authors, lower trade costs affect firms' profits differently. The net effect thereof sways the incentives to improve productivity, which they regarded as contingent to firm characteristics such as the export status. Hence, they only conferred the benefits of freer trade to exporters.

Philippine Trade and Innovation

Following significant trade reforms, several studies have also dwelled on the themes of trade, competition, and innovation in the Philippines. Dismally, the failure of the implemented liberalization policies to engender competitive gains and productivity growth has also been underpinned by scholars. In light of this drawback, several studies have dwelled on the innovation structure of the country. Focusing on the estimation of R&D gap in the Philippines, Cororaton (199a) underscored several indicators affirming the country's underinvestment on R&D. During the 1980s, R&D gap was at 0.6%. Accordingly, the ratio of R&D expenditure to GNP was reported to be 0.2% in 1992. This was substantially behind the maximum value of 3%. Additionally, he articulated that the number of scientists and engineers in the country is insufficient. As implied by the UNESCO data, the Philippines has only 152 scientists and engineers per million population. Again, this makes it far behind the average maximum number of 6,736 scientists and engineers per million population. Patalinghug (1999) reported that focus and clear direction for technological innovation has been out of the government's science and technology policies. Therefore, among his recommendations were to enhance the incentive system and R&D undertakings.

Still focusing on innovation, Cororaton (199b) examined the rates of return to R&D investments in his subsequent research. According to him, the rates of return in the primary and service sectors are substantially large at around 60%. For both sectors, the rates of return to other capital investments are relatively lower than R&D investments, with a difference of approximately 20%. Nonetheless, production was still deemed inefficient due to the minor spillover effects and negative total factor productivity growths. On the other hand, the rates of return to R&D activities were much lower in the industry sector at around 10 to 12%. For this sector, a higher rate of return is projected from capital machineries and equipment compared to R&D investments. On a brighter note, the industry sector still scored a positive total factor

The influence of R&D endeavors and the rates of return differ from sector to sector. Hence, this reveals how proper allocation of resources is essential to making R&D activities more effective in spurring economy-wide efficiency and growth. In this vein, it was highlighted by Patalinghug (2003) that the national innovation system of the country is moored on the viewpoint that technological capability is necessary for industrial expansion. Correspondingly, he accentuated that the development of technology is more acute at the firm level.

Using an unbalanced firm-level panel dataset, Aldaba (2008) provided evidence for the stylized fact that trade liberalization instigates productivity gains, and conversely protection leads to losses. According to her, trade liberalization leads to a process of resource restructuring and reshuffling such that lucrative activities expand while unprofitable ones contract. It allows for the entry of more productive firms, and drives the exit of less efficient ones. However, she stressed that the optimum gains from the trade reforms were not maximized. Amidst the transition to a more market-oriented trade policy, the government adopted a selective protection policy that reduced the credibility of the reforms. Consequently, there was a time-consistency problem because firms were not adjusting quickly with the expectation of further government protection in the future.

Still, there are subsequent studies that show the efforts of firms to overshadow the challenges brought about by foreign competition. While wage skill premium in developed countries started to fall, empirical evidence supports backward results for developing countries. Accordingly, it was deemed that production activities shifted to more skill-intensive technologies with the introduction of foreign competition in the latter countries. Adopting a panel micro data set and three trade policy proxies (MFN, ASEAN, EPR), Aldaba (2013) took into consideration the impact of trade reforms on wage skill premium in the country. According to the results of her study, trade liberalization generally reduced wage skill premium in the country. However, the interaction of skill intensity with tariffs and exports confirms that tariff reductions in 1996, 1997, 1998, and 2000 worsened the wage skill premium. Hence, firms have been shifting their production processes to more skill-intensive ones with the hopes of yielding better-quality products.

Framework

The Heckscher-Ohlin (H-O) model[2] remains to be one of the traditional avenues for examining the liberalization of trade regimes, and how benefits from it are furnished. Under its simple model with two countries, two factors, and two goods, it is assumed that a country will choose to export the good that intensively uses its relatively abundant factor. Goods that primarily employ the country's scarce factors as their inputs will then be imported. As countries decide to dismantle their trade barriers, say a reduction in tariffs, each of the countries will be able to sell its exports at a higher price in the world market while being able to purchase its imported inputs at lower prices.

While there is greater unanimity among economists that international trade fosters nationwide benefits for each country, empirical studies have stretched the focus to several efficiency and equity concerns. Correspondingly, a related strand of this literature deals with how smaller units in the economy have been responding to trade reforms, specifically the domestic producers.

[2] The reader is referred to Markusen et al. (1995) for a full discussion of the H-O model.

Amidst the upsurge in trade volumes with the annihilation of trade barriers, it is noticeable that more players are incentivized by the rising profit opportunities to enter the world market. While a freer trade regime delivers economy-wide benefits, it has engendered competitive pressures to business units. In this vein, the Product Life Cycle theory developed by Raymond Vernon offers another justification on the observable pattern of international trade, which may also elucidate the influence of tariff reductions on firm investment decisions. Its principle concedes that despite the growing sales volume from international trade, domestic firms have been under intensified pressure from foreign competition. Import-competing firms are driven to devise enhanced organizational schemes, production techniques, and products that will mitigate the threats from the inflow of cheaper and better-quality commodities from abroad. Likewise, the reduction of trade costs in the world market has enabled exporting-firms to assess and bridge the gap between them and their foreign counterparts to retain or expand their market share in the international arena. Consequently, firms have been engaging their finances on strategic ventures like R&D.

Methodology

Empirical Model

To assess the impact of trade policy changes on R&D expenditures of manufacturing firms, the study adopted a modified version of Aldaba's (2013) model. The pooled OLS regressions done made use of the following equation:

$$lnR\&D_{ij} = \beta_0 + \beta_1 Exports_{ij} + \beta_2 KL_{ij} + \beta_3 Firm\ Size_{ij} + \beta_4 Trade_j + \beta_5 Industry + \beta_6 Time + \mu_i$$

where the dependent variable, *lnR&D*, is the log of the total R&D expenditures for firm *i* belonging to industry *j*. Trade is the trade policy variable, which is proxied by MFN and ASEAN tariff rates. *Exports* (export share), KL (capital intensity) and *Size* (firm size) are the supplementary independent variables. For *Size,* (see Table 1), Industry (see Table 2) and *Time*, dummy variables were applied. Lastly, μ_i is the error term.

To carry out the analysis, the 1994 Philippine Standard Industrial Classification (PSIC) codes at the two-digit level were used as the basis in harmonizing firm-level data from the annual surveys. Subsequently, MFN and ASEAN tariffs averaged at the two-digit level classification codes were calculated and linked to their corresponding 1994 PSIC codes at the two-digit as well.

Table 1. Description of firm size dummy variables

Variable	Description (Total Employment)
Size 0	1 - 4
Size 1	5 - 9
Size 2	10 - 19
Size 3	20 - 49
Size 4	50 - 99
Size 5	100 - 199
Size 6	200 - 499
Size 7	500 - 999
Size 8	1000 - 1999
Size 9	2000 and over

Source: 2012 CPBI Explanatory Text

Table 2. Description of industry dummy variables

Variable	Industry Description
Industry 15	Manufacture of Food products and Beverages
Industry 16	Manufacture of Tobacco Products
Industry 17	Manufacture of Textiles
Industry 18	Manufacture of Wearing Apparel
Industry 19	Tanning and Dressing of Leather; Manufacture of Luggage, Handbags, and Footwear
Industry 20	Manufacture of Wood, Wood Products and Cork, except Furniture Manufacture of Articles of Bamboo, Cane, Rattan, and the Like; Manufacture of Plaiting Materials
Industry 21	Manufacture of Paper and Paper Products
Industry 22	Publishing, Printing and Reproduction of Recorded Media
Industry 23	Manufacture of Coke, Refined Petroleum and other Fuel Products
Industry 24	Manufacture of Chemicals and Chemical Products
Industry 25	Manufacture of Rubber and Plastic Products
Industry 26	Manufacture of Other Non-Metallic Mineral Products

Explanatory Variables Used

One of the reasons that can be put forward to expect a negative relationship between tariff cuts and R&D outlay is the pro-competitive effect of a freer trade. Aghion et al. (2002) and Bustos (forthcoming) point out that such removal of trade barriers boosts competition as more foreign players enter the market. Domestic firms are, then, enthused to accelerate their innovative efforts to escape competition. The two trade variables used are as follows:

- *Most Favored Nation (MFN) tariff rates*. Endorsed under GATT-WTO, these rates are custom duties levied on goods originating from all sources except those from Foreign Trade Agreement (FTA) partners.

Variable	Industry Description
Industry 27	Manufacture of Basic Metals
Industry 28	Manufacture of Fabricated Metal Products, except Machinery and Equipment
Industry 29	Manufacture of Machinery and Equipment, n.e.c.
Industry 30	Manufacture of Office, Accounting and Computing Machinery
Industry 31	Manufacture of Electrical Machinery and Apparatus, n.e.c.
Industry 32	Manufacture of Radio, Television and Communication Equipment and Apparatus
Industry 33	Manufacture of Medical, Precision, and Optical Instruments, Watches
Industry 34	Manufacture of Motor Vehicles, Trailers and Semi-Trailers
Industry 35	Manufacture of Other Transport Equipment
Industry 36	Manufacture and Repair of Furniture
Industry 37	Recycling
Industry 39	Manufacturing, n.e.c.

Source: 1994 Philippine Standard Industrial Classification

• *Association of South East Asian Nations (ASEAN) tariff rates*. The ASEAN Trade in Goods Agreement (ATIGA) rates, which is formerly known as the ASEAN Free Trade Area-Common Effective Preferential Tariff (AFTA-CEPT) Scheme, are import tariffs on goods coming from the ASEAN countries.

Recent work on international trade has also made firm heterogeneity a primary concentration since it came to emerge as an outlet for clarifying the nonconformity of most developing countries to the repercussions of the traditional trade theories. Relatedly, the succeeding variables were considered to ascertain how some firm characteristics are correlated with a manufacturing firm's R&D growth rate:

• *Export Share*. Taken as the share of exports to total revenue, this uncovers the firm's status in the export market. In 1986, Hughes (as cited in Parameswaran 2010) articulated that an upsurge in production due to higher export volumes is positively related to a firm's ability to exploit economies of scale. Moreover, better export prospects are projected to sway firms into making the necessary investments for innovation and growth to fleetingly materialize.

• *Capital Intensity*. Considered as the ratio of the book value of assets and the total number of workers, capital intensity is anticipated to be positively associated with R&D growth rate. As Cameron (2000) enunciated, capital intensity is reflective of the efficacy of firm investments. A higher capital to labor ratio renders R&D to be more effective.

• *Firm Size*. To account for this, the categories for the dummies were based on the codes that are commissioned to each employment stratum and used in the ASPBI and CPBI. A positive coefficient for firm size is expected, as larger firms are likely to have better footing when it comes to financing innovative investments like R&D (Cohen and Klepper 1996 and Parameswaran 2010).

Sources of Data

The firm-level data for the manufacturing sector used in this study are from the Census of Philippine Business Industry (CPBI), which is formerly the Census of Establishments, and the Annual Survey of Philippine Business and Industry (ASPBI). Both are designated statistical activities of the National Statistics Office (NSO). Records for 2006, 2009, and 2012 were utilized. Due to confidentiality concerns of the establishments in the said surveys, access of the microdata was only possible within the premises of the Philippine Statistics Authority (PSA). As for the tariff data, the ATIGA rates were acquired from the ASEAN Secretariat database and MITI web-site. On the other hand, MFN tariffs were obtained from the World Bank UNCTAD-TRAINS database.

Results and Discussion

Trajectory of Investment in the Philippines

Over the years, the progress of the Philippine economy has been stellar. By 2012, its growth rate of 6.8% was already higher relative to the average growth of its ASEAN peers (PSA 2013). To sustain the momentum, the government has strengthened its efforts to shore up investments that are essential to economic expansion and job creation. Expressed as the ratio of aggregate investment and gross domestic product (GDP), Figure 1 exhibits the overall trend of gross capital formation or investment in the Philippines from 2006 to 2012.

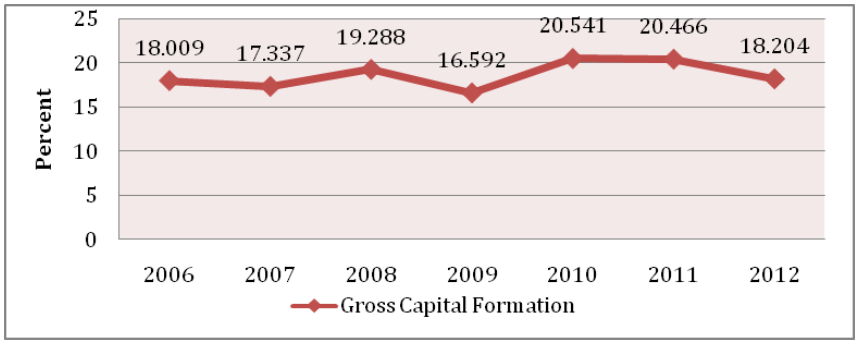

Figure 1. Philippine gross capital formation (% of GDP), 2005-2012
Source: World Bank 2017

Throughout the period, the share of investment in total production has been volatile and constantly within the range of 18% to 20%. With the onslaught of the global economic crisis in 2008 and 2009, the country's gross capital formation took a plunge to 16.59% in 2009. This was followed by a temperate progression to 18% by 2012. Yet, the investment climate remains critical to sustaining the country's rapid economic growth. As Bernardo (2015) emphasized, the country's gross capital formation (as a % of GDP) is still the lowest within the ASEAN community.

As global challenges abound from the integration of the national market into the world economy, there has been the urgency to enrich the country's productivity and competitiveness. Accordingly, the government has raised awareness on the state of science and technology that may be strategic to the aforesaid matter. With the collective participation of public and private institutions, investments on innovative activities have been considerably reinforced.

In light of this, research and development (R&D) has been one of its manifestations. Expenditures on R&D include the aggregate spending on scientific and creative work that are systematically done to increase the stock of knowledge, which is essential to creating or enhancing products, processes, and applications. It comprises of basic research, applied research, and experimental development. Accordingly, Table 3 presents the country's R&D spending (in absolute terms) in 2005, 2007, 2009, 2011 and 2013.

Table 3. Philippine gross expenditures on R&D, 2005-2013

Year	R&D Expenditures (In Million Pesos)
2005	6,326.74
2007	7,556.36
2009	8,779.16
2011	11,383.97
2013	15,914.71

Source: DOST 2015

From PhP 6.337 billion spent on R&D in 2005, gradual increases were noted through the years until it reached PhP 15.915 billion in 2013. Remarkably, expenditures on R&D sped up from its level in 2009. Among the sectors, the Department of Science and Technology (DOST) (2015) articulated that the private industry sector has contributed the highest share which is about 36% of the aggregate R&D expenditures. This was followed by 34% share from the higher education sector, 30% share from the government sector, and 0.82% share from the private non-profit sector.

Relatedly, Figure 2 shows the trend of R&D expenditures (% of GDP) in the Philippines from 2005 to 2013. Akin to the previous statistics, R&D spending in proportion to the country's GDP exhibits a growing trend. It marginally dropped in 2007, but has gradually increased to almost 14% in 2013. While the absolute value of R&D expenditures has substantially grown, its ratio to GDP remains minimal.

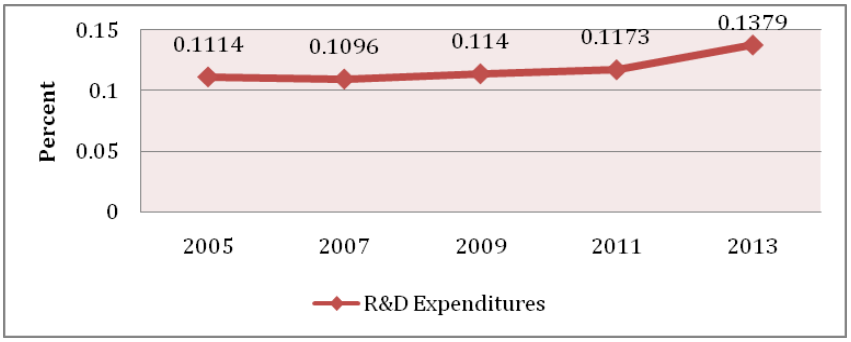

Figure 2. Philippine R&D expenditures (% of GDP), 2005-2013

Source: World Bank 2017

Apart from directing innovation and economic growth, R&D has been evoked as a measure for mitigating threats from global competition. Accordingly, the next subsection discusses the response of firm-level R&D to the tariff changes under the country's current trade liberalization commitments. The manufacturing sector was specifically considered since empirical reports affirm that it has not generated an exceptional growth despite the buttressing it has been given. As Aldaba (2013) recounted, the aggregate productivity of the sector has declined over the past years. It has failed to generate ample employment opportunities for both the new entrants and the migrating laborers from the agricultural sector.

Trade Liberalization and R&D Expenditures

In analyzing the impact of trade liberalization on firm behavior towards R&D, the empirical model was estimated separately using MFN tariff rates and ASEAN tariff rates. The second and third columns in Table 4 present the results using MFN tariffs as the trade variable. On the other hand, the fourth and fifth columns summarize the results with ASEAN tariffs as the trade proxy variable.

Table 4. Pooled OLS regression results using MFN and ASEAN tariff rates

Variable	MFN	Robust Standard Error (MFN)	ASEAN	Robust Standard Error (ASEAN)
Exports	380.7601***	135.0233	379.3959***	134.5314
KL	1.29E-08**	6.57E-09	1.29E-08**	6.59E-09
Size				
1	0.0500	0.0445	0.0498	0.0445
2	0.0801**	0.0362	0.0775**	0.0362
3	0.3642113***	0.0415	0.3640***	0.0416
4	0.6659***	0.0556	0.6641***	0.0556
5	0.9329***	0.0673	0.9307***	0.0673
6	1.1473***	0.0808	1.1455***	0.0808
7	1.5479***	0.1358	1.5441***	0.1357
8	1.4662***	0.1984	1.4638***	0.1980
9	2.0628***	0.2575	2.0594***	0.2579
MFN	-0.0297***	0.0083		
ASEAN			-0.0564**	0.0247
Industry				
16	0.1652	0.4021	0.3383	0.4008
17	-0.5391***	0.0735	-0.4746***	0.7370
18	-0.4505***	0.0609	-0.4743***	0.0585
19	-0.1521	0.0931	-0.0984	0.0956

Variable	MFN	Robust Standard Error (MFN)	ASEAN	Robust Standard Error (ASEAN)
20	-0.2271**	0.0107	-0.1235	0.0938
21	-0.4813***	0.1072	-0.3131***	0.0996
22	-0.3814***	0.0708	-0.2743***	0.0695
23	-0.4873	0.5524	-0.2320	0.5501
24	(omitted)		0.1751	0.1117
25	-0.2985***	0.0790	-0.1523**	0.0734
26	-0.2464***	0.0869	-0.1146	0.0818
27	-0.5398***	0.1054	-0.3614***	0.0951
28	-0.4375***	0.0704	-0.2782***	0.0611
29	-0.2633**	0.1117	-0.0670***	0.0974
30	-0.8460***	0.2014	-0.6509**	0.1948
31	-0.4383***	0.1340	-0.2780***	0.1285
32	-0.5616***	0.1374	-0.3993***	0.1322
33	-0.4583**	0.1876	-0.3002	0.1859
34	0.1360	0.1426	0.1544	0.1429
35	-0.3334**	0.1554	-0.1865	0.1517
36	0.1557*	0.0888	0.2338**	0.0909
37	-0.5386***	0.2056	-0.3978*	0.2034
39	0.0411	0.1226	0.1924*	0.1166
Year				
2009	0.0197	0.0337	-0.0375	0.0429
2012	4.0236***	0.1758	3.8788***	0.1893
Constant	0.5415***	0.1048	0.3512***	0.0911
Number of Observations	13810		13810	
Prob> chi^2	0.0000		0.0000	
R^2	0.1449		0.1452	

* significant at 10%, **significant at 5%, ***significant at 1%.

On both regressions done, the results reveal that the coefficients of the trade variables MFN and ASEAN are highly significant and negatively correlated with the growth rate of R&D expenditures. At par with the conclusions of Fernandes and Paunov (2009) and Bustos (forthcoming), this suggests that a fall in tariffs is associated with an increase in the growth rate of the manufacturing firms' R&D expenditures.

By the same token, firm characteristics such as export share, capital intensity, and firm size also matter in assessing the growth rate of R&D expenditures within firms. In the second and fourth columns of Table 4, the export share coefficient is highly significant at 1% level and positively correlated with R&D expenditure growth rate. Analogous with the report of Aw, Robert, and Xu (2009), this implies that exporting within manufacturing firms has, indeed, increased their innovative activities. Similarly, the significant and positive link between capital intensity and R&D expenditure growth rate coincides with Cameron's (2000) view that a high capital to labor ratio is indicative of greater R&D effectiveness. It is also notable in each of the regression results that the size dummy variables (Size 2 to Size 9) are significantly positive, thus making it consistent with the sentiments of Schumpeter (1950) and Cohen and Klepper (1996). The assumption is that larger firms (cet. par.) are more capable of manipulating the economies of scale and scope from R&D activities. Still, the positive and insignificant coefficient on Size 1 indicates that R&D may not substantially matter for firms with fewer personnel.

Furthermore, most of the industry dummy variables from both regressions have coefficients that are negative and significant. This reveals that the food products and beverage subsector (coded as Industry 15) outpaces the other manufacturing subsectors in terms of R&D ventures. Promisingly, Macabasco (2011) reported that this subsector has dominated the Top 1,000 Corporations as it contributed to almost 58% of the total manufacturing output and 12% of the country's GDP in 2009. This has been attributed to the growing demand for convenience, share of working women, and health and lifestyle consciousness. Furthermore, Singian (2014) regarded that the food and beverage processors are among the largest corporations in the country. Knowing that this is the case, it would be sensible to expect that firms engaged in this activity will register higher growth of R&D expenditures. Nonetheless, results also show that Industry 36 has a positive and significant coefficient at 10% probability level. This implies that the growth of R&D spending is higher for firms engaged in the manufacture and repair of furniture than those in the food and beverage subsector. In a website jointly created by the Department of Trade and Industry (DTI) and Board of Investments (BOI), it has been reported that since 2010, the export value of furniture has soared to US$ 179,709,000 in 2012. Dubbed as the "Milan of Asia," the country's furniture industry is still targeting to be more competitive for it to become a prime design innovator in the local and global market by 2030. Hence, the justification for the subsector's immense R&D expenditures aimed towards product development and capacity building. Finally, the positive and highly significant year dummy for 2012 implies that the growth rate of R&D expenditure within firms is higher in 2012 than in 2006 and 2009.

Summary and Conclusion

The import substitution policy pursued throughout the 1950s failed to provide an efficient mechanism of apportioning the country's economic resources. Hence, beginning in the early 1980s, the Philippine government was propelled to open up and integrate its domestic market into the world economy. Since then, the country has been exposed to the intricacies of the evolving global economic landscape. To continue acquiring the gains from international trade, sustaining the competitive spirit and growth of domestic firms became critical.

One of the conventional rulings from the trade and growth literature recognizes that international trade influences the attitude of economic agents towards innovative activities. Bustos (forthcoming), Licandro and Ruiz (2010), and Bas and Ledezma (2015) point out that tariff cuts from trade reforms incite productivity growth by encouraging market competition that eventually stimulates innovation among firms.

Correspondingly, the results presented in this study show that the Philippine manufacturing has been subjected to substantial competition as trade liberalization became central in sectoral and economic reforms. The association of MFN and ASEAN tariff reductions sanctioned by GATT-WTO and AFTA/ATIGA-CEPT to an increasing R&D growth rate implies that trade liberalization has a pro-competitive effect that provokes domestic firms to hasten their innovative efforts in order to enhance their productive capacities, and retain or expand their existing market shares. This estimated relationship acquiesces with the principle of the Product Life Cycle model. Additionally, in accord with the existing literature focusing on firm heterogeneity, firm characteristics like export share, capital intensity, and size were also reported to be statistically and economically significant.

The said results affirm the importance of trade policy changes as a conduit through which trade liberalization affects a firm's outlook on R&D endeavors. Relatedly, the termination of import substitution policies in the Philippines has contributed to the promotion of technological development. However, it has also made the manufacturing sector vulnerable to more external threats. Given this, it is essential for manufacturing firms to pursue innovative activities in order to survive international competition. With R&D as one of the primary channels for firm innovation, the results of the preceding analysis suggest the need to step up the education system and technical capability of the country. Specifically, the dissemination of exceptional management skills within manufacturing firms will be valuable to directing interests on emerging technologies. Congruently, a workforce that can direct and ride the tide of technological revolution is also extremely vital amidst the rising globalization and economic integration. By fortifying the efficiency and productivity of manufacturing firms, the manufacturing sector as whole can bolster its involvement and position in the world market.

While this study has attempted to investigate the impact of trade liberalization on R&D expenditures, it is important to note that an array of other elements like market regulations and institutional factors may have affected the growth of innovative activities at the firm level. However, a more complex and detailed examination is beyond the scope of this study due to limitation concerns of the available micro data.

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