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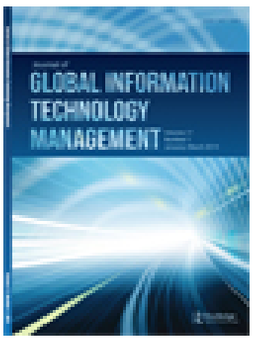

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The Determinant Factors of Business to Business (B2B) E-Commerce Adoption in Small- and Medium-Sized Manufacturing Enterprises

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ABSTRACT

This research examines the relationships between technological, organizational, and environmental (TOE) factors on different levels of B2B e-commerce adoption. A survey of 315 Ghanaian manufacturing SMEs was validated and tested using partial least squares structural equation modeling. The research findings indicate that perceived desirability, organization's readiness, and competitive pressure positively and significantly influence the different B2B e-commerce adoption levels. Likewise, top management support and government support partially had a significant impact on the various levels of B2B e-commerce adoption, whereas the business partner's pressure has no significant influence on B2B e-commerce adoption levels. This research's results confirm that the TOE factors influence B2B e-commerce adoption levels in the Ghanaian manufacturing SMEs. The results reveal that the various contextual factors have a different effect on the different levels of B2B e-commerce adoption. Also, the implications of this study are subsequently discussed.

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B2B e-commerce adoption levels; SMEs; TOE framework; partial least squares; Ghana

Introduction

The era of adoption of information technology, especially in Business to Business (B2B) e-commerce, has changed the way companies and individuals share information globally. The increasing interdependence among nations through international trade has promoted technology adoption in both developed and developing economies. This research adopts the definition of B2B e-commerce as the use of internet and web-technologies for conducting an inter-organizational business transaction (Teo & Ranganathan, 2004). The term B2B e-commerce has been used interchangeably with other phrases such as e-business, e-commerce, and web technologies that involves trading between organizations. B2B e-commerce provides the means to link technology and people, through information sharing to facilitate supplier–customer interactions. It offers many benefits and growth opportunities for companies, such as access to international markets, improves productivity, reduces cost, acquires new suppliers and customers, increases profits and gains in competitive advantage (Bala & Feng, 2019; Cudjoe, 2014; Hamad, Elbeltagi, & El-Gohary, 2018). It can help SMEs to achieve significant gains by improving operational efficiency, increasing sales and revenue, and enhancing customer/supplier relationships and strengthen their competitive position with large organizations in the global markets (Elbeltagi, Hamad, Moizer, & Abou-Shouk, 2016; Mohtaramzadeh, Ramayah, & Jun-Hwa, 2018; Rahayu & Day, 2017).

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B2B e-commerce is increasingly becoming one of the fastest-growing domains of technology adoption, and most scholars foresee it to continue to grow at a quicker rate than Business-to-Business Customers (B2C) (Sila, 2013; UNCTAD, 2015). B2B e-commerce is reported to account for the leading share of global e-commerce, and its revenue growth is anticipated to rise to 6.7 USD trillion in 2020 (Frost, & Sullivan, 2015). For instance, a report by UNCTAD (2015) indicates that B2B e-commerce market is expanding exponentially in high-income countries such as the US, the UK, China, Singapore, and Japan, while that of African nations is marginally above 2.0%. UNCTAD (2018) reported that the African continent is showing progress in key indicators related to e-commerce and that the e-commerce market in Africa was worth about 5.7 USD billion in 2017. Internet usage in Sub-Saharan Africa (SSA) has increased considerably in recent years. Internet users in SSA countries have recorded a remarkable increase of almost 15922.0% in Ethiopia, 3677.0% in Kenya, 14704.0% in Nigeria, and 712.0% in Botswana between 2002 and 2015, although from a low base. Internet usage has predominantly improved in South Africa, Kenya, and Nigeria (Evans, 2019).

The adoption of B2B e-commerce has become the main requirement for business improvement, especially in small and medium-sized enterprises (SMEs) through the use of the internet (Ifinedo, 2011; Sadowski, Maitland, & van Dongen, 2002). It is reported that the USA takes the lead in B2B e-commerce and almost American SMEs have integrated the internet into their business operations (Sila, 2013). For instance, B2B e-commerce adoption account for the largest share of business revenue in developed economies such as US (American manufacturers' B2B e-commerce activities accounting for about 42.0% of the total shipments or over 1.8 USD billion) and some of emerging economies like India, China, and Singapore (Sila, 2013; US Census Bureau, 2015). The use of B2B e-commerce is becoming widespread among manufacturing firms in developed countries. SMEs have been recognized globally during the last couple of decades as an essential sector of all nations' economies. SMEs constitute more than 90.0% of the businesses and are anticipated to account for 80.0% of the global economic growth (OECD, 2015). Also, in both developed and developing countries, SMEs are considered as the 'backbone' of many economies (Perera & Chand, 2015). These companies account for nearly 60.0% of the private employment (Abou-Shouk, Lim, & Megicks, 2016; Elbeltagi et al., 2016; OECD, 2015). According to reports, in developed countries, more than 95.0% of enterprises are SMEs. For example, in the USA, SMEs are an essential part of the economy, representing about 99.0% of all businesses. They provide about 65.0% of net new private-sector employment and engages more than half of the private sector workers (US Census Bureau, 2015). Similarly, in the developing countries, the SME sector contributes significantly to employment and gross domestic product (GDP) (Ngui, 2014), and has also played an essential role as the engine of growth and prolific job creators (Abor & Quartey, 2010; Wit & Kok, 2014). For example, in China, SMEs constitutes about 97.7% of all registered businesses, accounting for nearly 58.0% of the GDP and 68.0% of export, and contributing about 82.0% of total urban employment in China and responsible for almost 75.0% of new jobs every year (China Statistical Yearbook, 2017). The SMEs sector is a major player in the economy of both developed and developing countries. Therefore, B2B e-commerce adoption will strengthen their competitive position. In many developed countries, the adoption of B2B e-commerce is regarded as the best operational and strategic decision for SMEs (Elbeltagi et al., 2016). Whereas in developing nations, especially in Africa, B2B e-commerce adoption is not expanding so fast (UNCTAD, 2015) to enhance their global competitiveness.

Ghana is classified as lower–middle-income country (WEF, 2018). According to the Ghana Statistical Service, Ghana's economy is estimated to have expanded by 8.5% in 2017 from 3.6% a year, driven by the mining and oil sectors (WBG, 2018). The majority of registered business establishments are SMEs, they are constituting about 92.0% of all businesses in the country. SMEs account for about 80.0% of the private sector and contribute about 70.0% of GDP and account for about 85.0% of manufacturing total employment (Abor & Quartey, 2010; Awiagah, Kang, & Lim, 2016). The SME sector makes an immense contribution to job creation, technological innovation, and output. Therefore, SMEs in developing nations need more consideration regarding B2B e-commerce adoption to enable them compete globally and sustain their significant contributions to employment

and GDP. The Government of Ghana, in 2003, introduced the Ghana Information and Communications Technology for Accelerated Development (ICT4AD) policy, followed by the liberalization of the information and communication technology (ICT) sector, purposely to facilitate ICT infrastructural developments and human resource capacity building in technology adoption (Awiagah et al., 2016; Hu, Ocloo, Akaba, & Worwui-Brown, 2019). Together with the mobile cellular market, the internet market in Ghana presents substantial potential for growth and development, and more importantly, in bridging the digital divide between organizations in Ghana and their business partners in the advanced economies. Ghana's e-commerce readiness is taking shape following the introduction of the wireless third and fourth-generation (3 G/4 G) mobile, and fixed-wireless and mobile broadband technologies. According to World Internet statistics, Ghana is the twelfth largest country of Internet users (34.3%) in Africa. There is an increase in Internet usage in Ghana, and this seems to be increasing each year. Ghana has over 10 million internet users out of the estimated population of 29.6 million as of December 2017, with an internet penetration rate of 16.6%. As of December 2017, 35.0% of Ghanaians use the Internet compared to only 4.2% in 2009 (Internetworldstats, 2018; ITU, 2018). Ghana is amongst the best countries in SSA in e-readiness rankings (WEF, 2018), although there is a sharp divide between urban and rural areas so far as the distribution of ICT infrastructure is concerned. In 2015–2016, Ghana's Global Competitiveness rating was 119th out of 140 countries, and the Networked readiness ranking was 101th. However, it went up by five places to 114 out of 138 economies in the 2016–2017 ranking (WEF, 2018). In 2016, the Global Information Technology Report (GITR) and (WEF, 2018) downgraded Ghana to rank 102 in NRI, out of 139 economies that participated. Other SSA countries such as Namibia, Botswana have surpassed Ghana in the top 10 countries in SSA ranking, with Cote d'Ivoire making an entry among the top 10. The ICT landscape is continuously evolving to create more competitiveness for businesses, and there is the need for SMEs to plan and implement new strategies. ICTs have become a catalyst for business processes, being a support tool for managing businesses, leveraging developing strategies for achieving competitive advantage and innovation in business operations, and bringing sustainability to SMEs over time. B2B e-commerce has proliferated and penetrated SMEs in the past decade, transforming the organizational process by creating new ways of storing, distributing, and exchanging information between firms and customers. It has also transformed SMEs' business structure and strategy. The development of SMEs is on the agenda of the government of Ghana, and the rapid growth in ICT, especially the internet, has brought about drastic changes in how businesses operate in the economy. In this regard, the manufacturing sector in Ghana could adopt B2B e-commerce to improve business operations and expansion to the international markets.

The majority of the investigations, about the adoption of B2B e-commerce, focused predominantly on developed countries and very little on developing countries (Mohtaramzadeh et al., 2018; Sila, 2013). These researches concentrated mainly on the adoption from an individual approach with more investigation on business-to-customer contexts. Although scholars have investigated the adoption of B2B e-commerce and proposed many theories to explain it in diverse settings, some various issues have not yet been analyzed carefully and deserve attention. First of all, past investigations studied the impact of various determinants on B2B e-commerce adoption by focusing on dichotomous variables presented as adoption verse non-adoption, whereas there are limited studies on how these various factors affect the different adoption levels of B2B e-commerce. The huge potential of B2B e-commerce requires further research to examine the different aspects related to B2B e-commerce and to complement earlier investigations. The lack of empirical research on developing countries has brought about the speculation of results from other advanced nations which neglect to give a logical comprehension of e-commerce phenomena in developing nations. Also, it has been stated that current management practices and theories developed in the context of the western countries must be reevaluated in the context of developing nations to fit their technological and socio-cultural settings (Mohtaramzadeh et al., 2018). This is because those concerns that could be seen as irrelevant for developed nations can otherwise play a substantial role in B2B e-commerce adoption in developing countries. Therefore, the need to understand whether existing

theories apply to populaces in the region of developing nations is an important issue. The reviewed literature shows that the determinants used in B2B e-commerce adoption may vary depending on the level of adoption considered. The main research problem addressed herein is: How do the various factors affect SMEs' adoption of different levels of B2B e-commerce? It must be stressed that although various researches studied B2B e-commerce adoption among small and medium businesses, investigations on how different factors affect the different levels of B2B e-commerce adoption are less evident in B2B e-commerce literature (Hamad et al., 2018; Sila, 2015). Some main research strands are surrounding B2B e-commerce adoption. Some investigations found e-commerce to be widely adopted by large enterprises and little research has been devoted to the study of B2B e-commerce adoption and use by SMEs. Meanwhile, SMEs are a significant component of many economies globally (Ayyagari, Demirguc-Kunt, & Maksimovic, 2011; OCED, 2012). Although several of the investigations on B2B e-commerce adoption are carried out in the advanced economies such as the USA, the UK, Canada, and quite recently in Asian countries such as China, India, and Malaysia (Alsaad, Mohamad, Taamneh, & Ismail, 2018; Tan & Ludwig, 2016), there has been limited research that examines how the various factors impact the adoption levels of B2B e-commerce in SMEs in technology adoption research, particularly, from an SSA country perspective. Therefore, additional studies on the antecedents of B2B e-commerce adoption are of great significance and interest in countries such as Ghana.

This study contributes to the existing literature in many ways. It adds current literature on information technology/information systems (IT/IS) in relation to B2B e-commerce adoption. This research complements earlier investigations on innovation and diffusion studies by providing a new perspective related to organizational adoption decision of B2B e-commerce. This is because most early researches concentrated mainly on the adoption from an individual approach, such as individual innovation's perceptions and with more investigation on B2 C contexts. However, the adoption of B2B e-commerce among SMEs at the organizational level is a new phenomenon in Ghana and there is a paucity of empirical work on B2B e-commerce from an organizational perspective in a developing nation. Thus, analyzing the proposed framework in an environment (Ghana) in which social characteristics may differ from those of the western cultures in which past investigations have featured. Also, the study extends the TOE model that has been much commended for its sound theoretical base by many scholars in the western nations, to investigate issues in a developing country context. The study supports the applicability of the TOE framework, which is consistent with prior studies of IT innovation in developing countries (e.g., Lertwongsatien & Wongpinunwatana, 2003), reinforcing that certain key variables identified from the organization innovation theory in Western countries are applicable in the Ghanaian context, and in the context of B2B e-commerce innovation.

The findings of this research will assist top managers or policymakers to understand the significant factors surrounding B2B e-commerce adoption levels and issues that owners/managers will have to encounter during the adoption process. Finally, a novel contribution of this study is relating the research to the manufacturing sector. As far as we know, B2B e-commerce research in manufacturing SMEs in Ghana rare. Therefore, this research is a unique attempt in this respect. The findings will also help managers and policymakers to know the various situations under which B2B e-commerce adoption is viable, and to advance higher technology regarding future adoption. Thus, studies are needed to inform and grow awareness of the SMEs from an organizational perspective.

The rest of this research is outlined as follows: Section two presents the related literature and hypothesis development. This is followed by sections on research methods and, data analysis and results, respectively. This, in turn, leads us to the discussion of findings and the conclusion and research implications.

Related Literature and Hypotheses Development

In technology adoption literature, researchers have investigated B2B e-commerce adoption using various models and theories relevant to IT/IS adoption for SMEs. The innovation diffusion theory,

institution theory, and technology-organization-environment (TOE) theory are known as the widely used models in IT/IS literature. The concepts that were developed based on these theories had a different focus and presented a group of factors that affect the adoption of B2B e-commerce. Roger's theory of innovation diffusion is one of the prevalent theoretical models used for predicting B2B e-commerce adoption (Al-Qirim, 2007; Alsaad, Mohamad, & Ismail, 2014). Also, past investigations on technology adoption have widely used the technology-organization-environment (TOE) framework suggested by Tornatzky and Fleischer in 1990 (Aboelmaged, 2014; Arslan, Bagchi, & Kirs, 2019; Awa, Ojiabo, & Orokor, 2017; Kuan & Chau, 2001; Tran, Zhang, Sun, & Huang, 2014). This study uses the TOE framework because it is consistent in assessing the technological, internal, and external characteristics associated with the adoption of technology adoption. The framework proposes that technology adoption among SMEs is influenced by factors relating to technological, organizational, and environmental contexts. Fundamentally, TOE theorizes that the three key aspects of a firm's context – technological, organizational, and environmental – are interdependent in their constant interaction and changing influences. The technological context being the existing technologies in use and new technologies that has an essential impact on the adoption decision. Likewise, the organizational context describes the organizational characteristics such as the scope, the size, and managerial beliefs that affect the adoption. Finally, the environmental context includes the industry/supply chain, business operations, competitors, and government support and regulations.

It must be pointed out that although some models studied B2B e-commerce using the TOE framework, the TOE model does not explicitly classify the major factors within the frame and the variable in each context (Mohtaramzadeh et al., 2018; Wang, Wang, & Yang, 2010). Therefore, most researchers applied the TOE framework to suit the purpose of their investigations and concerns. Also, many of the B2B e-commerce models were designed in the developed countries and as such the variables selected were significant to the context of their respective countries. In contrast, in developing countries, including Ghana, the main issues that have been investigated by the scholars are not entirely alike. An overview of important empirical researches on B2B e-commerce in the TOE context is presented in Table 1.

The conception of the growth models recognizes that information technology adoption, including B2B e-commerce, in organizations, is not fixed but involves some levels of progression. The use of e-commerce growth models is very vital in providing a holistic description of the various factors that may influence different B2B e-commerce adoption levels. From the 1990s, scholars have developed several growth models to describe different stages of e-commerce adoption as shown in Table 2. This current study adopts Elbeltagi et al.'s (2016) growth model on B2B e-commerce which includes four levels of adoption.

However, this study considers basic B2B e-commerce application like the use of e-mail for business purposes. A research model consisting of six TOE-related factors and four levels of B2B e-commerce adoption (dependent variables) as shown in Figure 1 was developed. Each of the factors and the main hypotheses are discussed.

Technological Factor

Perceived desirability describes the degree to which an innovation is considered an appropriate and right choice (Alsaad, Mohamad, & Ismail, 2015). Thus, the tendency to adopt B2B e-commerce will be higher if the SMEs see it as a needed choice than those who do not. Consistently, relative advantage, compatibility, and complexity have been recognized as the most significant factors influencing innovation adoption (Alsaad, Mohamad, & Ismail, 2017). Relative advantage is the degree to which the adoption of innovation is seen as offering more organizational benefits than maintaining the status quo (Rahayu & Day, 2015). Compatibility means to the level to which innovation is perceived to fit with past experience and existing technology infrastructure, values, culture, and desired business operations of the organization (Alsaad et al., 2017). Lastly, complexity is the rate to which the adoption of innovation is seen to be relatively difficult to use (Rogers, 2003). Though earlier studies have

Table 1. An overview of important empirical researches on B2B e-commerce adoption.

Key findings on factors affecting B2B E-commerce adoption		Reference and country of study
Significant	Insignificant	
Perceived relative advantage, compatibility, CEO's innovativeness, information intensity, buyer/supplier pressure, and technology vendors support and competition	Cost, CEO IS knowledge, and business size	Ghobakhloo et al. (2011), Iran
Relative advantage, complexity, top management support, firm size, and government support	Compatibility, competitive pressure, and business partners' pressure	Hamad et al. (2018), Egypt
Cost, network reliability, data security, scalability, top management, firm size, firm type, management, trading partner pressure, and competitive pressure	Complexity and trust	Sila (2013), USA
Perceived desirability, management support, and competitive pressure.	Organizational readiness	Alsaad et al. (2017), Jordan
Organizational IT readiness, top management support, strategic orientation, customer pressure, regulatory environment, and national readiness		Al-Somali, Gholami, and Clegg (2011), Saudi Arabia
Perceived direct benefit, top management support, external pressure, and trust	Organizational readiness and perceived indirect benefits	Duan et al. (2012), Australia
Technology readiness, technology integration, education level, competitive pressure, and trading partner	Firm size and obstacles	Oliveira and Dhillon (2015), Europe
Cost of adoption, top management support, competitive pressure, and government support	Perceived relative advantage, legal infrastructure, IT infrastructural, and trading partners' pressure	Mohtaramzadeh et al. (2017), Iran
Perceived relative advantage, technology readiness, and owner innovativeness – owner IT ability and owner IT experience		Rahayu and Day (2015), Indonesia
Perceived benefits, technology readiness, competitive pressure, and trading partner collaboration	Technology integration and firm size	Oliveira and Martins (2010), Europe

addressed these three attributes separately, current empirical studies have found that they are highly interrelated and strengthen each other (Alsaad et al., 2017). In agreement with Alsaad et al. (2015), this current investigation suggests that perceived desirability affects SMEs' B2B e-commerce adoption levels. Hence, the following hypothesis postulates that:

H1. Perceived desirability is positively associated with B2B e-commerce adoption levels.

Organizational Factors

An organization's readiness is a degree to which available resources seem to be equal to the available resources desirable to adopt real innovation and sustain that specific innovation for long (Chwelos, Benbasat, & Dexter, 2001; Molla & Licker, 2005). Organization's readiness has to do with the technological, human, and financial resources that companies acquire, install, and integrate with their business processes (Grandon & Pearson, 2004; Ifinedo, 2011; Scupola, 2003). Financial resources have been proven by many researchers to have positive and significant relations to the adoption of e-commerce and ICT by SMEs (Mishra & Agarwal, 2010; Scupola, 2009; Ghobakhloo, Hong, & Standing, 2015). Financial resources associated with expenses before and during the time of new technology adoption (Alsaad et al., 2017). Organizations with higher levels of IT human resources will adopt more information management practices and integrate their IT innovations, and provide employees with a higher level of IT knowledge (Huy, Huynh, Rowe, & Truex, 2012; Mishra & Agarwal, 2010; Raghavan, Wani, & Abraham, 2018). Based on the above, an organization's readiness is a crucial driver of a firm's inclination to adopt technological applications. Hence, the following hypothesis postulates that:

H2. Organization's readiness is positively associated with B2B e-commerce adoption levels.

Table 2. E-commerce adoption growth models.

Authors/year	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
Abou-Shouk, Megicks, and Lim (2013)		Static web presence	Interactive online presence	Electronic transaction	Electronic integration	
Al-Somali et al. (2011)		Non-interactive electronic commerce	Interactive electronic commerce	Stabilized electronic commerce		
Chen and McQueen (2008)		Internet search and e-mail	Online marketing	Online ordering	Online transactions	
Rahayu and Day (2017)	No Internet/ no e-mail	e-mail but no websites	Static websites	Interactive website but no transactions	Websites with transactions	
Beck, Wigand, and Konig (2005)		Online advertising	Online sales	Online procurement	EDI with suppliers and customers	
Elbeltagi et al. (2016)		Electronic information search and creation	Simple electronic transactions	Complex electronic transaction	Electronic collaboration	
Rao, Metts, and Mora Monge (2003)		Presence on the web	Portals	Transaction integration	Enterprise integration	
Molla and Licker (2004)	No Internet connection	Internet with e-mails	Static web	Interactive web presence	Transactive web	Integrated web
Chan and Swatman (2004)		Initial e-commerce	Centralized e-commerce	Looking inward for benefits	Internet application	
Bingley and Burgess (2012)		Communicators (e-mail)	Information provision (websites)	Transaction (online statistics)		

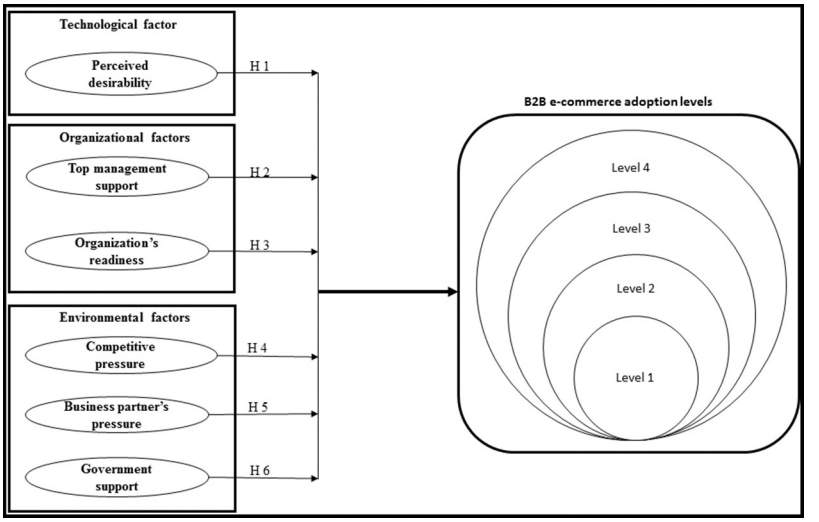

Figure 1. Research model.

While the organization's readiness is linked to technical and financial resources, top management support describes the level of corporate leadership's recognition of the importance of B2B e-commerce (Claycomba, Iyerb, & Germainc, 2005) and their commitment to adoption (Alsaad et al., 2017; Zheng, Chen, Huang, & Zhang, 2013). The success of technology adoption involves how top management evaluates the strategic opportunities and the long-term vision of integrating innovation into their

business activities and progression (Duan, Deng, & Corbitt, 2012; Liang, Saraf, Hu, & Xue, 2007). It is suggested that top management's commitment directly affects technology adoption by SMEs (Hamad et al., 2018; Teo, Lin, & Lai, 2009; Kurnia, Cho, Mahbubur, & Alzougool, 2015). The use of Internet technology between firms plays a very critical role when both management understand its significance and invests resources in it. Therefore, the following hypothesis postulates that:

H3. Top management support is positively associated with B2B e-commerce adoption levels.

Environmental Factors

Many variables in the business environment can affect the firm's technology adoption. This research focuses on competitive pressure, business partners' pressure, and government support. Competitive pressure describes the rate at which firms adopt an innovation due to market competition (Huo, Zhao, & Zhou, 2014). Firms have to frequently assess the advancement of modern technology and adopt it to attain a competitive edge. Competitive pressure has been recognized to be one of the significant determinants of SME technology adoption (Ahmad, Abu Bakar, Faziharudean, & Mohamad Zaki, 2015; Gono, Harindranath, & Berna Özcan, 2016). Competitive pressure will affect the adoption of B2B e-commerce when SMEs realize that such technology will enhance their competitiveness and help attain a competitive advantage (Hamad, Elbeltagi, Jones, & El-Gohary, 2015; Huynh et al., 2012; Lip-Sam & Hock-Eam, 2011). Hence, the following hypothesis postulates that:

H4. Competitive pressure is positively associated with B2B e-commerce adoption levels.

Business partner's pressure describes the extent of influence and pressure that a firm experiences from its suppliers and customers to adopt B2B e-commerce technologies (Mohtaramzadeh et al., 2018; Sila, 2013). Findings from empirical investigations indicate that the success of adopting B2B e-commerce depends on the partner's preparedness to jointly adopt the technologies in their business operations (Hamad et al., 2018; Lip-Sam & Hock-Eam, 2011). Business partner's pressure is an important factor that influences the adoption of e-commerce by SMEs (Al-Qirim, 2007; Huy & Filiatrault, 2006). Past empirical research confirms that coercive and normative pressures from suppliers, partners, and customers influence the adoption of B2B e-commerce (Ghobakhloo, Arias-Aranda, & Benitez-Amado, 2011; Sila, 2013). Hence, the following hypothesis postulates that:

H5. Business partner's pressure is positively associated with B2B e-commerce adoption levels.

Finally, empirical evidence reveals the significance of government support in technology adoption in SMEs (Awiagah et al., 2016; Scupola, 2003). Government support through the provision of technological infrastructure, policies, and funding could have a significant impact on technology adoption (Huynh et al., 2012; Saprikis & Vlachopoulou, 2012). Several investigations have confirmed that governmental factors have a substantial impact on the adoption of e-commerce by SMEs (Al-Alawi & Al-Ali, 2015; Rahayu & Day, 2015). For example, Martinsons (2008) as cited in Awiagah et al. (2016) found that e-business adoption in developing economies has immensely improved through government's commitment in providing the needed infrastructure for e-commerce development. Governmental policies involving favorable electronic legislation, tax incentives, and affordable Internet access will encourage the growth of B2B e-commerce. It is identified in technology adoption literature that government's support influences SMEs' decision to adopt e-commerce (Ahmad et al., 2015). Therefore, assessing the effect of government support on the level of B2B e-commerce adoption, the following hypothesis postulates that:

H6. Government support is positively associated with B2B e-commerce adoption levels.

Methodology

Sampling and Data Collection

A questionnaire survey was used for the data collection from SME owners/managers in the manufacturing sector. SMEs with less than 100 employees were considered based on the classification of businesses in Ghana by the National Board for Small-Scale Industries (NBSSI). The study randomly selected 1,124 Ghanaian manufacturing SMEs as the sample frame (from the Government of Ghana via the National Board for Small-Scale Industries, Registrar General Department, Association of Ghana Industries, and the Global Business Directorate databases). The data provided by these agencies were accessed through their websites. Further, using a systematic random procedure, a representative sample of 648 manufacturers with websites was chosen, using the aggregation of product type and geographic locations as stratification criteria. Geographic areas were across 4 regions out of the 10 regions in Ghana (at the time of data collection because there are 16 regions in Ghana currently), namely, Greater Accra, Western, Ashanti, and Eastern. The sampling frame is a cross-section of six industries, namely, construction and electricals, polymers and rubbers, textiles and clothing, pharmaceuticals and chemicals, food processing and beverages, and wood, tissues, and paper products to increase generalizability. A pilot study was conducted to test for the reliability and validity of the measurement items. The Cronbach's alpha reliability test values for the various constructs range between 0.824 and 0.913, this means that the indicators are valid for measuring the latent constructs in the questionnaire. In sum, the researchers identified no problems in the pilot study's results; henceforth, the questionnaire was used for the main survey to collect the data from manufacturing SMEs in Ghana. With the help of 15 research assistants, self-administered printed questionnaires were delivered by hand to selected sample firms. Follow-up telephone calls and e-mails were made to respondents as a reminder of the survey. A sample size of 315 respondents was used for the data analysis.

More than 53% of the responses were Chief Executive Officers/owners, and the rest were from heads of information technology departments. Following the NBSSI classification, 60% of the respondents could be classified as "medium businesses." Besides, those in business for over 10 years represented 71% of the responses. The demographic characteristics of the manufacturing SMEs who participated in this research are shown in Table 3.

Table 3. Demographic characteristics of respondents (n = 315).

Characteristics	Details	Percent
Type of industry	Construction and electricals	29.5
	Polymers and rubbers	19.1
	Textiles and clothing	14.9
	Pharmaceutical and chemicals	13.3
	Food processing and beverages	12.4
	Wood, tissues, and papers products	10.8
Firm size	5–29	40.3
	30–99	59.7
Education	Secondary level	1.0
	Tertiary level	44.8
	Postgraduate level	15.2
	Professional level	39.0
Gender	Male	74.3
	Female	25.7
Age	Less than 30 years	8.6
	30–39 years	49.5
	40–49 years	37.1
	50 years and above	4.8

Measurements

The questionnaire consisted of a series of Likert-type (scale of 1 – 5, strongly disagree/strongly agree) statements informed from the literature review; however, this research modified several items to fit the context of the present study. Perceived desirability was abstracted as an inclusive factor and measured by eight items and adopted from Alsaad et al. (2015). The organization's readiness as the next variable comprised IT human resources and financial resources which were measured using five items adapted from Grandon and Pearson (2004) and (Chwelos et al., 2001). Top management support consisted of four items and adapted from Liang et al. (2007). Competitive pressure (five items) and business partner's pressure (four items) measures were obtained from Al-Qirim (2007) respectively. Finally, six items were used to measure government support and adopted from Gibbs, Kraemer, and Dedrick (2003) and Kuan and Chau (2001). These items measure the six TOE-related factors as shown in Appendix A.

B2B e-commerce adoption was measured using 15 electronic business processes (eBPs) that categorized four different levels of B2B e-commerce adoption. The eBPs were adopted from Elbeltagi et al. (2016) and modified based on the researchers' view and pilot study. The proposed B2B e-commerce adoption levels include electronic information (Level 1), electronic interaction (Level 2), electronic transaction (Level 3), and electronic collaboration (Level 4) as depicted in Appendix A. Level 1 is the lower level of B2B e-commerce and level 4 is the higher level of B2B e-commerce.

Data Analysis and Results

This research uses partial least squares structural equation modeling (PLS-SEM) to test the hypotheses and through the SmartPLS software package (Ringle, Wende, & Becker, 2015). PLS-SEM is considered most appropriate for this research since it allows a simultaneous statistical test (Hoe, 2008) and can handle reflective and formative constructs (Hair, Hult, Ringle, & Sarstedt, 2016). PLS is a variance-based method to estimate path models with latent variables (Chin, 2010; Henseler, Hubon, & Ray, 2016) and has recently gained acceptance across many disciplines including information systems (Benitez, Llorens, & Fernandez, 2015). The PLS-SEM approach is particularly useful when the study's focus is on the analysis of a certain target construct's key sources of explanation. It is regarded as a good methodological alternative to theory testing when covariance-based structural equation modeling assumptions are violated concerning the normality of data distribution (Hair et al., 2016). Finally, a bootstrapping method is employed, being a non-parametric resampling technique that can construct confidence intervals of estimates for hypothesis testing even when the sample size used may be small. Therefore, the authors used the 'bootstrapping' resampling method to determine the resample path coefficients and the p-values. The main purpose of bootstrapping is to calculate the standard error (t and p values) of coefficient estimates in order to examine the coefficient's statistical significance (Vinzi, Chin, Henseler, & Wang, 2010). A bootstrapping algorithm of 5000 resamples was applied. PLS-SEM is appropriate in this case because it makes no hard requirements for the data to exhibit multivariate normality (Hair, Hult, Ringle, & Sarstedt, 2017a). Also, it is considered appropriate for examining complex cause-effect-relationship models (Henseler et al., 2016) and useful for prediction. All this form the basis of using the PLS technique for this study.

Measurement Model Assessment

In assessing the measurement model, the reflective and formative latent variables were measured. First, the reflective latent variables in the study are the TOE-related factors as shown in Figure 1. The measurement model of the reflective latent variables was assessed through tests of indicator

reliability, internal consistency, convergent validity, and discriminant validity using recommended guidelines (Chin, 2010; Hair, Ringle, & Sarstedt, 2011). The examination of the indicator reliability results identified some poor factor loadings for perceived desirability, four items (Pes1, Pes4, Pes7, Pes6), one item for organization's readiness (Org5), one item for competitive pressure (Cop3), and two items for government support (Gov3, Gov4). These items were removed from the analysis. The test was re-run, and all remaining reflective indicators demonstrated acceptable factor loadings of equal to or more than the minimum threshold of 0.70 (Appendix B). Similarly, the Cronbach's alpha and composite reliability (CR) were above the minimum benchmark value of 0.70, signifying acceptable construct reliability (Nunnally, 1978). Also, Dijkstra-Henseler's rho, a proposed alternative to Cronbach's alpha has loadings greater than 0.70, thus emphasizing the data's reliability. The construct's validity was tested by looking at both convergent and discriminant validity and by comparing the average variance extracted (AVE). The results in Table 4 show that all constructs are well above the cutoff point of 0.50. In testing the convergent validity, the AVE and factor loadings of all constructs ought to be equal to or more than 0.50. Also, for the discriminant validity, using the Fornell and Larcker (1981) criterion, the square root of each construct's AVE was greater than the correlations between it and any other construct in the model as seen in Table 4.

Second, the measurement model of the formative latent variables was measured by weight statistics (Hair et al., 2016). Each level of B2B e-commerce adoption is considered as a formative latent construct. A bootstrapping algorithm of 5000 resamples was applied to test the statistical significance and relevance of each formative indicator. As presented in Table 5, the weights of each formative indicator were substantial and had a significance level of 0.01 (Sarstedt, Ringle, & Hair, 2017). Likewise, variance inflation factors (VIF) were all below the cutoff point of 3.3 (Petter, Straub, & Rai, 2007), indicating that no collinearity issue exists (Table 5).

The measurement model assessment shows satisfactory quality and can be used for the evaluation of the structural model.

Table 4. Measurement model assessment of the reflective latent variables.

Group (levels)	Construct	Cronbach's alpha	rho_A	CR	AVE	SQTR AVE
	Pes	0.806	0.817	0.873	0.633	0.796
	Org	0.790	0.810	0.863	0.612	0.782
Level 1	Top	0.791	0.800	0.864	0.613	0.783
	Cop	0.800	0.809	0.870	0.626	0.791
	Bus	0.769	0.777	0.851	0.589	0.767
	Gov	0.825	0.861	0.870	0.654	0.809
	Pes	0.806	0.821	0.873	0.632	0.795
	Org	0.790	0.801	0.864	0.613	0.783
Level 2	Top	0.791	0.804	0.863	0.614	0.784
	Cop	0.800	0.816	0.869	0.625	0.791
	Bus	0.796	0.791	0.843	0.583	0.763
	Gov	0.825	0.844	0.884	0.655	0.810
	Pes	0.806	0.824	0.872	0.632	0.795
	Org	0.790	0.799	0.864	0.614	0.784
Level 3	Top	0.791	0.834	0.862	0.611	0.782
	Cop	0.800	0.810	0.870	0.626	0.791
	Bus	0.769	0.775	0.852	0.590	0.768
	Gov	0.825	0.868	0.882	0.653	0.808
	Pes	0.806	0.809	0.873	0.633	0.796
	Org	0.790	0.802	0.863	0.613	0.783
Level 4	Top	0.791	0.795	0.864	0.615	0.784
	Cop	0.800	0.817	0.869	0.625	0.791
	Bus	0.769	0.787	0.850	0.587	0.766
	Gov	0.825	0.853	0.883	0.655	0.809

Pes: perceived desirability; Org: organization's readiness; Top: top management support; Cop: competitive pressure: Bus: business partner's pressure: Gov: government support; SQTR AVE: squared root of AVE.

Table 5. Measurement model assessment of the formative latent variables.

B2B e-commerce adoption levels	Indicators	Weights	S.E.	VIF
Level 1: Electronic information	Level 1A	0.328**	0.016	2.535
	Level 1B	0.262**	0.016	2.285
	Level 1C	0.276**	0.021	1.808
	Level 1D	0.310**	0.019	2.087
Level 2: Electronic interaction	Level 2A	0.249**	0.025	1.424
	Level 2B	0.296**	0.023	1.552
	Level 2C	0.358**	0.014	2.672
	Level 2D	0.324**	0.015	2.406
Level 3: Electronic transaction	Level 3A	0.315**	0.023	1.701
	Level 3B	0.467**	0.024	2.000
	Level 3C	0.371**	0.018	2.263
Level 4: Electronic collaboration	Level 4A	0.301**	0.016	2.138
	Level 4B	0.285**	0.016	2.115
	Level 4C	0.364**	0.019	2.254
	Level 4D	0.269**	0.020	2.118

** $p < 0.001$.

Structural Model Assessment and Hypotheses Testing

The structural model was evaluated by the path coefficients, coefficient of determination (R^2), and cross-validated redundancy (Q^2) and effect size (f^2) of the proposed research framework. The research framework and hypothesized relationships were estimated using 1000 iterations, and the statistical significance of each structural path is evaluated via the bootstrap method, using 5000 resamples (Table 6). In addition to analyzing the R^2, the model is assessed by observing the Q^2 predictive relevance. The Stone-Gesser's Q^2 value larger than zero for a specific endogenous construct shows the model's predictive accuracy for that particular construct (Hair,

Table 6. PLS output after bootstrapping.

Constructs	Path coefficient	Standard error	T statistic	*P* value
Structural model of Level 1				
Perceived desirability	0.102	0.048	2.105	0.032*
Organization's readiness	0.268	0.055	4.807	0.000**
Top management support	0.113	0.062	1.812	0.068
Competitive pressure	0.304	0.067	4.505	0.000**
Business partner's pressure	−0.118	0.065	1.770	0.069
Government support	0.121	0.061	1.935	0.046*
Structural model of Level 2				
Perceived desirability	0.222	0.041	5.475	0.000**
Organization's readiness	0.314	0.047	6.577	0.000**
Top management support	0.139	0.063	2.173	0.030*
Competitive pressure	0.246	0.058	4.340	0.000**
Business partner's pressure	−0.152	0.065	2.273	0.023*
Government support	0.142	0.059	2.334	0.013*
Structural model of Level 3				
Perceived desirability	0.122	0.048	2.530	0.011*
Organization's readiness	0.390	0.045	8.670	0.000**
Top management support	0.129	0.065	1.971	0.046*
Competitive pressure	0.184	0.063	2.821	0.004**
Business partner's pressure	−0.102	0.068	1.509	0.136
Government support	0.133	0.053	2.517	0.012*
Structural model of Level 4				
Perceived desirability	0.193	0.046	4.195	0.000**
Organization's readiness	0.316	0.048	6.570	0.000**
Top management support	0.022	0.057	0.380	0.697
Competitive pressure	0.255	0.059	4.248	0.000**
Business partner's pressure	0.055	0.062	0.890	0.373
Government support	0.073	0.054	1.342	0.179

**$p < 0.001$, *$p < 0.05$; the bold represent the dependent variables.

Hollingsworth, Randolph, & Chong, 2017b; Sarstedt et al., 2017). Also, effect size values of 0.02, 0.15, and 0.35, respectively, represents small, medium, and large of the effects of the path coefficient (Cohen, 1988). Four models were tested to examine how the various factors influence each level of B2B e-commerce adoption.

Structural Model for B2B Level 1

For Level 1, perceived desirability ($\beta = 0.102$, $t = 2.105$, $p < .05$), organization's readiness ($\beta = 0.268$, $t = 4.807$, $p < .001$), competitive pressure ($\beta = 0.304$, $t = 4.505$, $p < .001$) and government support ($\beta = 0.121$, $t = 1.935$, $p < .05$) have positive impact on Level 1 adoption as depicted in Figure 2. Conversely, top management support ($\beta = 0.113$, $t = 1.812$, $p > .05$), and business partner's pressure ($\beta = -0.118$, $t = 1.770$, $p > .05$) has an insignificant influence on Level 1 adoption. For R-squared coefficients (R^2), the structural model of the four significant factors explains 36.6% of the variance in Level 1 adoption. Additionally, the effect size (f^2) results of organization's readiness (0.070) and competitive pressure (0.064) demonstrates a small effect on Level 1 adoption, respectively. However, perceived desirability (0.013) and government support (0.012), respectively, show a weak impact on the adoption of Level 1, although the p values are statistically significant. The Q^2 value of 0.246 (>0) establishes that the structural model of Level 1 has a satisfactory predictive relevance.

Structural Model for B2B Level 2

As shown in Figure 3, perceived desirability ($\beta = 0.222$, $t = 5.475$, $p < .001$) and organization's readiness ($\beta = 0.314$, $t = 6.577$, $p < .001$), top management support ($\beta = 0.139$, $t = 2.173$, $p < .05$), competitive pressure ($\beta = 0.246$, $t = 4.340$, $p < .001$), and government support ($\beta = 0.142$, $t = 2.334$, $p < .05$) have a positive and significant impact on Level 2 adoption. However, business partner's pressure ($\beta = -0.152$, $t = 2.273$, $p < .05$) has a negative and significant influence on Level 2 of adoption. The structural model explains 46.5% of the variance in Level 2 adoption. The f^2 results of perceived desirability (0.070), organization's readiness (0.116), and competitive pressure (0.051), respectively, reveal a small effect on Level 2 adoption. Besides, top management support (0.016), business partner's pressure (0.013), and government support (0.018) demonstrate a weak effect on Level 2 adoption. Regarding the Q^2, the value of 0.286 shows that the structural model of Level 2 equally has satisfactory predictive relevance.

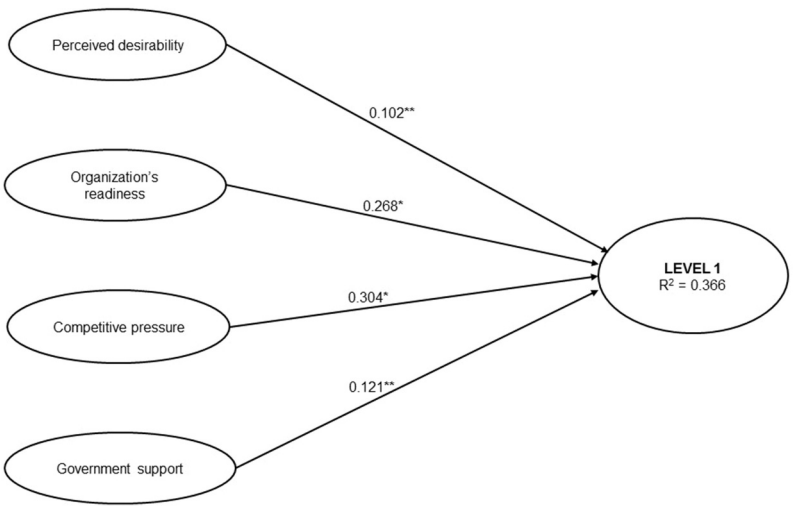

Figure 2. Structural model of Level 1.

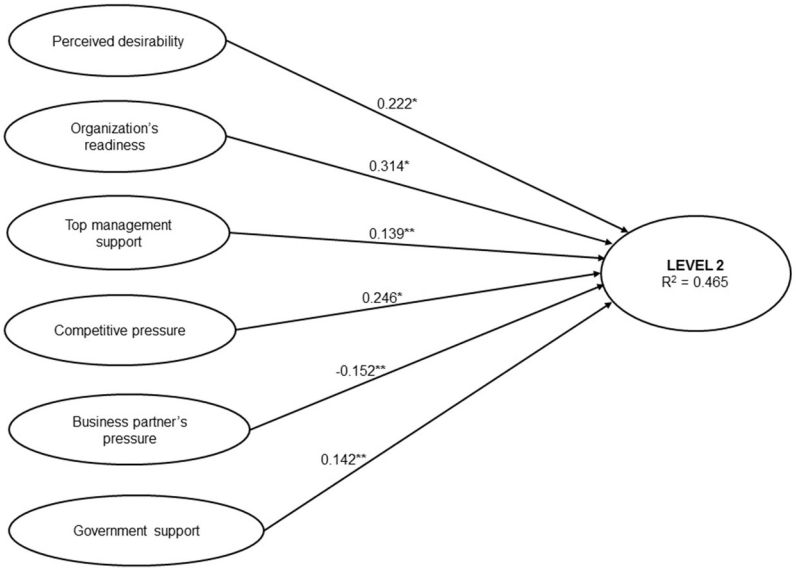

Figure 3. Structural model of Level 2.

Structural Model for B2B Level 3

For Level 3, perceived desirability (β = 0.122, t = 2.530, p < .05), organization's readiness (β = 0.390, t = 8.670, p < .001), top management support (β = 0.129, t = 1.971, p < .05), competitive pressure (β = 0.184, t = 2.821, p < .01), and government support (β = 0.133, t = 2.517, p < .05) have a positive impact on Level 3 adoption as depicted in Figure 4. Likewise, the structural model explains 42.5% of the variance in the adoption of Level 3. Conversely, business partner's pressure (β = −0.102, t = 1.509, p > .05) has an insignificant influence on the adoption of Level 3. For f^2, organization's readiness (0.174) demonstrates a medium effect, whiles perceived desirability (0.020) and competitive pressure (0.027), respectively, have a small effect on Level 3 adoption. Besides, the result of top management support (0.013) and government support (0.015) reveals a weak effect size on the adoption of Level 3,

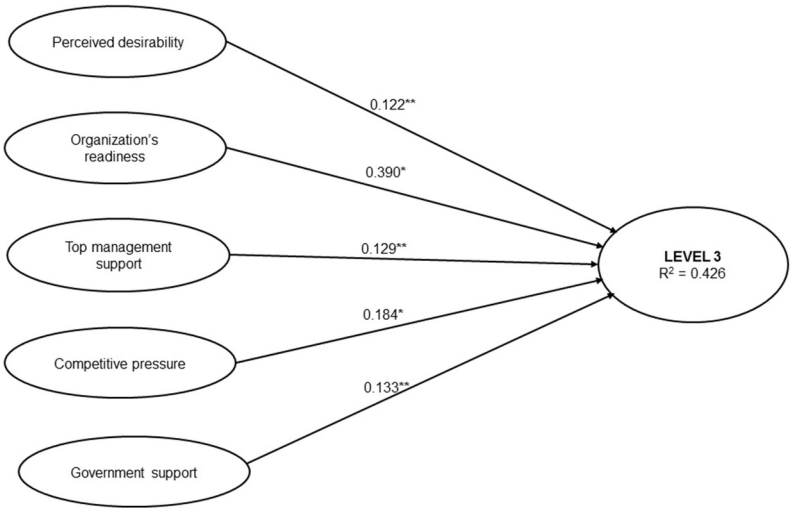

Figure 4. Structural model of Level 3.

although, the p values were significant. The Q^2 value of 0.291 establishes the fact that structural model of Level 3 also has an acceptable predictive relevance.

Structural Model for B2B Level 4

As shown in Figure 5, perceived desirability (β = 0.193, t = 4.195, p < .001), organization's readiness (β = 0.316, t = 6.570, p < .001), and competitive pressure (β = 0.255, t = 4.248, p < .001) results have a positive impact on Level 4 adoption. However, top management support (β = 0.022, t = 0.380, p > .05), business partner's pressure (β = 0.055, t = 0.890, p > .05), and government support (β = 0.073, t = 1.342, p > .05) shows an insignificant influence on Level 4 adoption. Statistically, the structural model of the significant factors explains 48.1% of the variance in the adoption of Level 4. For f^2, perceived desirability (0.054), organization's readiness (0.125), and competitive pressure (0.057) demonstrate a small effect on Level 4 adoption. The Q^2 value of 0.298 indicates that the structural model of Level 4 has satisfactory predictive relevance.

Additionally, regarding the goodness-of-fit of the four structural models, the analysis of the composite-based standardized root-mean-square residual (SRMR) yielded values of 0.074, 0.073, 0.075, and 0.077 for adoption Levels 1, 2, 3, and 4, respectively, which are below the threshold of 0.08 (Hair et al., 2016), hence confirming the overall fit of the PLS path models as a reasonable representation of the structures underlying the empirical data.

Discussion

This research's results confirm that the TOE factors influence B2B e-commerce adoption levels in the Ghanaian manufacturing SMEs. The results reveal that the various contextual factors have a different effect on the different levels of B2B e-commerce adoption. Regarding the technological factor, our results shown in Table 6 indicate that perceived desirability has a positive and significant impact on the four different levels of adoption. Therefore, these results support hypothesis H1. This finding follows the logic that SMEs recognize the economic benefits associated with technology adoption as has been reported extensively in the innovation diffusion literature (Davis, 1989; Venkatesh & Bala, 2012). These findings agree with Alsaad et al. (2017) and Rogers (2003) who indicated that e-commerce is adopted by firms when they perceive that the innovative features and benefits fit their needs. Surprisingly, although perceived desirability has a significant effect on all the adoption levels, their effect size is relatively small and even had a weaker effect on Level 1 adoption. It does not mean that B2B e-commerce technologies have a low degree of benefits. A possible reason is the lack of in-depth understanding by Ghanaian manufacturing SMEs of the apparent economic benefits of adopting B2B

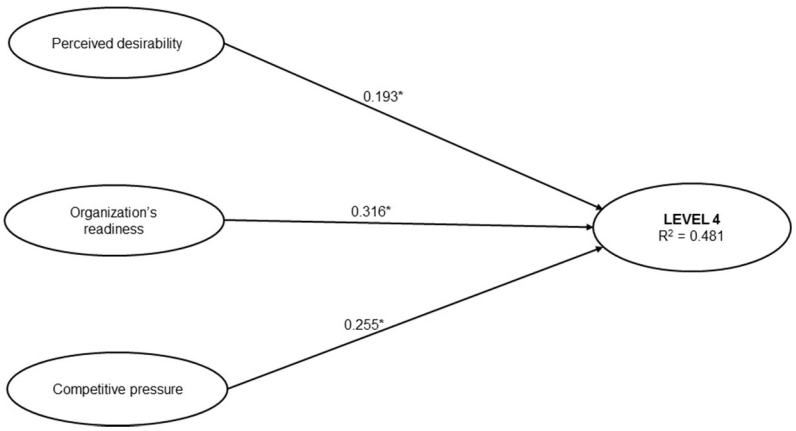

Figure 5. Structural model of Level 4.

e-commerce. Awiagah et al. (2016) indicated that Ghanaian SMEs find it difficult to see the practical benefits associated with e-commerce adoption. Another likely reason is the issue of inter-organizational culture in integrating better B2B e-commerce applications in their existing business and if these technologies well matched with the IT infrastructure in use.

Regarding the organizational factors, the study's results showed in Table 6 found that an organization's readiness has a positive and significant impact on the four different adoption levels, thus supporting hypothesis H2. This explains that regardless of the business type, there are the technical know-how and financial resources within the manufacturing SMEs in Ghana. These results are consistent with the findings of Huynh et al. (2012) and Grandon and Pearson (2004) who found that SMEs possess the technological and financial resources to adopt B2B e-commerce. Internet penetration has increased drastically in recent times which has its attendant impact on the related ICT innovation accessible to Ghanaian manufacturing SMEs.

Regarding top management support on the adoption levels, the results in Table 6 have shown that top management support positively and significantly impacts the adoption of levels 2 and 3. Therefore, hypothesis H3 is partially accepted. Likewise, the results showed an insignificant influence on level 1 and level 4 adoption and, thereby, rejects hypothesis H3 partially. These results sharply contrast with the findings of earlier studies that found top management support to be an essential factor and positively influences B2B e-commerce adoption (Ghobakhloo et al., 2011; Mohtaramzadeh et al., 2018). Based on this research, the insignificant effect of top management on the adoption levels of B2B e-commerce in the manufacturing SMEs in Ghana does not imply management are not very much aware of the potential benefits of technology adoption. It could be reasoned that the absence of strategic intent on the part of the top managers who might consider technology adoption as inappropriate to the type of businesses they operate. Therefore, the owners/managers develop a negative perception toward levels 1 and 4. This perspective is consistent with Hamad et al. (2018) who revealed that B2B e-commerce was unsuitable for Egyptian manufacturing SMEs' kinds of business. Another possible reason is the strategic orientation of the top managers. Culturally, Ghanaian business owners/managers perceive some level of risk and might think that they might lose out on their investment when they adopt advanced technology. Therefore, they lack a clear vision of B2B e-commerce development. Also, the perception of the regulatory environment as being unfavorable for B2B e-commerce adoption.

In the context of the environmental factors, as shown in Table 6, competitive pressure positively and significantly influences the four different levels of B2B e-commerce adoption in the Ghanaian manufacturing SMEs. Therefore, these results support hypothesis H4. This could mean that the manufacturing SMEs reacted to competition because they consider the adoption of B2B e-commerce as a strategic necessity to remain competitive in today's marketplace. Websites and e-mail addresses have become the most used technology applications for initiating business relationships, informing customers and suppliers, and advancing transactional processes. The findings of this study support earlier investigations (e.g., Ghobakhloo et al., 2011; Hamad et al., 2018; Huynh et al., 2012) who found competitive pressure to be a significant determinant in the adoption of B2B e-commerce in SMEs. The significant impact of competitive pressure on technology adoption shows the manufacturing SMEs in Ghana reacted to pressure from rivals to adopt B2B e-commerce to avoid losing their customers to other competitors. Also, it could enhance their competitive position and strengthen relationships along the supply chain.

With business partner's pressure, our results as shown in Table 6 revealed that the business partner's pressure has an insignificant impact on adoption levels 1, 3, and 4. Nonetheless, it has a negative effect on the adoption of level 2. Therefore, hypothesis H5 is rejected. The plausible explanation is that many of the trading partners are local suppliers who do not coerce their manufacturing SMEs to adopt B2B e-commerce technologies in undertaking business with them. Also, the manufacturing SMEs have customers and suppliers who still rely on traditional bricks and mortar method of business transaction. These findings are consistent with Hamad et al. (2018) who found that the business partner's pressure did not influence Egyptian SMEs' adoption levels of B2B e-commerce.

These results differ from the findings of other scholars (e.g., Ghobakhloo et al., 2011; Huynh et al., 2012) who revealed that pressure from business partners, suppliers influenced e-commerce adoption within SMEs.

Moreover, the results of this study in Table 6 found that government support has a positive and significant impact on the adoption of levels 1, 2, and 3, thus supporting hypothesis H6 partially. However, government support does not influence level 4 of adoption. Therefore, hypothesis H6 is partially rejected. These results could imply that owners/top managers are aware of government's commitment to supporting SMEs to adopt technology. Nonetheless, some possible reasons might hinder the adoption of advanced technology as revealed by the findings. The manufacturing SMEs may encounter difficulties in the area of supports that include IT expertise, lack of financial incentives, and training programs from government. If owners/top managers of the SMEs can perceive IT support from government institutions and technology vendors, they will be highly enthused to adopt higher e-commerce technologies. Another reason could be cyber fraud, Internet security, and data protection issues coupled with inadequate infrastructure, legislation, and unfavorable e-commerce laws in guarding technology adoption. This result supports the findings of Hamad et al. (2018) who found that the lack of infrastructure and legislation were critical barriers to the adoption of B2B e-commerce in Egyptian SMEs.

Conclusion and Implications

This research investigates the influence of the TOE related factors on the adoption levels of B2B e-commerce adoption. The research findings indicate that perceived desirability, organization's readiness, and competitive pressure positively and significantly influenced all the adoption levels. Likewise, top management support and government support partially had a significant impact on the various levels of B2B e-commerce adoption, whereas business partner's pressure has no significant effect on the four adoption levels. The results of this research confirm that various factors influenced the different levels of B2B e-commerce adoption. It means different factors impact manufacturing SMEs' adoption levels, which highpoints the significance of the factors to the specific level of adoption. The issue of inter-organizational culture in integrating B2B e-commerce applications in manufacturing SMEs' activities poses some level of challenge in embracing technology adoption. Taking into consideration the socio-cultural underpinnings, owners and top managers of manufacturing SMEs perceived some level of adverse effect on their investment when they adopt internet technologies.

The findings of this research have significant theoretical and practical implications. One important contribution is that this study extends the TOE framework that has been much commended for its sound theoretical base by many scholars in the developed countries, to investigate issues in the context of SSA countries. This study was built on the TOE model, which facilitated examining the applicability of the model that was designed specifically for the developed countries, to analyze different internal (technological and organizational) and external (environmental) factors that influence the adoption of different levels of B2B e-commerce in the manufacturing SME setting of a developing country.

Also, the study has enriched the existing B2B e-commerce research by examining contextual factors that influence the different adoption levels of B2B e-commerce. As noted earlier, the gap in studies of how the various factors impact the adoption levels of B2B e-commerce adoption in SMEs is still scanty in technology adoption research, particularly, in Africa countries. Therefore, this study contributes to filling the gap in the literature. Moreover, critical discussion of the literature indicates investigations into B2B e-commerce matters in manufacturing SMEs is in its embryonic stage in developed nations and even scarcer in the developing countries. This research's findings add to the increasing body of knowledge in the field of B2B e-commerce adoption, particularly within Ghanaian SMEs which have limited studies in the existing literature. Additionally, this research reveals the perceptions of B2B e-commerce in Ghana, in particular, thus providing the perspective of a developing nation, and might be used in future studies to make a comparison with advanced developing countries.

In addition, this research offers some insights for top managers and owners of SMEs on the success of adopting B2B e-commerce and preferably, adopt an advanced level of B2B e-commerce applications. The study found that top managers are not willing to adopt higher technologies. Top managers and owners must show commitment to the course of embracing technological innovation and express their fear and belief by participating in various support programs such as IT sensitization, training program, and activities through working groups to change their perception and attitude. The full potential of technology and for that matter, B2B e-commerce can only be realized if owners and top managers will think beyond the risk element at the initial stage of IT investment. Top management should provide more organizational and technical support that could be more useful for their business and help draw a roadmap and strategies that will lead to advanced technology adoption.

Moreover, technology adoption involves the presence of appropriate government policies and support. The government should be more supportive through drafting favorable policies and legislation and provision of IT infrastructure. The government should also offer tax incentives on technology devices such as computers, servers, and website designs which may advance B2B e-commerce adoption. Regarding legislation, the government should design a robust regulatory framework to support B2B e-commerce adoption and protect businesses and customers from hacking and fraud. Government agencies and technology vendors must intensify IT awareness, particularly of why trading partners and suppliers of manufacturing SMEs should adopt technology and disseminate the potential benefits of B2B e-commerce adoption. Technology vendors should be more supportive by offering IT services and promoting appropriate technologies to suit the need of the SMEs. It will be very prudent to establish national policies and strategies toward the adoption of technological applications. Indeed, the government should play a major leading role in promoting technology adoption and help overcome the barriers associated with the adoption of B2B e-commerce adoption.

This study suffered some limitations that future studies should address. This study employed a quantitative method that is based on a self-administrated cross-sectional survey to examine the determinant associated with different adoption levels of B2B e-commerce. The cross-sectional survey only reflects the respondents' beliefs, perceptions, and experiences toward B2B e-commerce adoption at a particular point in time. However, these can change over time which necessitates conducting a longitudinal survey in the future research to provide more robust evidence that explains the factors associated with B2B e-commerce adoption levels and gives further validation of the research framework proposed in this study. Further, the 15 electronic business processes (eBPs) used to categorize the four different adoption levels reflect the current B2B e-commerce applications among Ghanaian manufacturing SMEs. The research findings clearly show that Ghanaian manufacturing SMEs are not adopting advanced B2B e-commerce technologies. Therefore, future research should attempt to increase the eBPs to assess the maturity stages of B2B e-commerce adoption in Ghana. Finally, the sample size and study area pose some constraints on the ability to generalize the findings outside the manufacturing sector for Ghana. Hence, future research is undoubtedly needed to validate the applicability of this outcome by applying it to other SME sectors such as financial and services and also across different developed countries and developing countries and cultures like China, to enhance the generalizability of findings.

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Appendix A. Measurement items and statistics

To what extent does your firm perform the following business processing using the website?	Scale	Mean	S.D.
1. Providing general information about the company (Level 1A).	1–5	3.46	0.87
2. Promoting the company's products and services (Level 1B).	1–5	3.57	0.91
3. Communicating and responding with suppliers and/or customers by e-mail (Level 1 C).	1–5	3.51	0.97
4. Seeking out new customers and/or suppliers (Level 1D).	1–5	3.50	0.98
5. Responding to customer and/or suppliers' enquiries and feedback (Level 2A).	1–5	3.83	0.70
6. Placing and managing orders with suppliers (Level 2B).	1–5	3.40	0.93
7. Receiving and managing orders with customers (Level 2 C).	1–5	3.48	0.99
8. Offering customers' after-sales service (Level 2D).	1–5	3.50	0.94
9. Receiving electronic payments from customers (Level 3A).	1–5	3.51	0.97
10. Making electronic payments to suppliers (Level 3B).	1–5	3.56	0.95
11. Negotiating contracts (price and volume) with suppliers and/or customers (Level 3C).	1–5	3.55	0.92
12. Using management information systems to enhance quality assurance (Level 4A).	1–5	3.60	0.89
13. Using extranet to communicate with key suppliers (Level 4B).	1–5	3.55	0.90
14. Transferring documents and technical drawing to suppliers (Level 4C).	1–5	3.34	0.95
15. Tracking products (purchased and sold) during transportation (Level 4D).	1–5	3.62	0.99
To what extent do you think the following influences your adoption of B2B e-commerce?	**Scale**	**Mean**	**S.D.**
Perceived desirability (Pes)			
1. The adoption of B2B e-commerce will enable our firm achieve specific task more easily (Pes1).	1–5	2.98	1.08
2. The adoption of B2B e-commerce will allow us to enhance our business productivity (Pes2).	1–5	3.91	0.69
3. The adoption of B2B e-commerce will improve our work performance (Pes3).	1–5	3.87	0.70
4. The adoption of B2B e-commerce is consistent with our business strategy (Pes4).	1–5	2.89	1.09
5. Our existing hardware and software are compatible with B2B e-commerce adoption (Pes5).	1–5	3.89	0.69
6. The adoption of B2B e-commerce is compatible with our firm's culture and values (Pes6).	1–5	2.70	1.03
7. The adoption of B2B e-commerce is too difficult to be incorporated in our business activities (Pes7).	1–5	2.76	1.01
8. The adoption of B2B e-commerce requires a lot of mental efforts (Pes8).	1–5	3.69	0.71
Organization's readiness (Org)			
1. Our firm has the necessary expertise and skills to support B2B e-commerce adoption (Org1).	1–5	3.81	0.62
2. Our employees are very proficient in computer hardware and software applications (Org2).	1–5	3.85	0.70
3. Our firm have financial resources to adopt B2B e-commerce (Org3).	1–5	3.89	0.74
4. Our firm have enough financial allocations to adopt B2B e-commerce (Org4).	1–5	3.82	0.63
5. Our firm has a flexible technical infrastructure that can easily incorporate B2B e-commerce technology (Org5).	1–5	4.04	0.62
Top management support (Top)			
1. Our top managers actively articulate a vision for the firm's adoption of B2B e-commerce (Top1).	1–5	4.07	0.69
2. Our top managers formulate a strategy for the firm's use of B2B e-commerce (Top2).	1–5	4.18	0.65
3. Our top managers define goals and standards to monitor the B2B e-commerce use (Top3).	1–5	3.92	0.75
4. Our top managers believe incorporating B2B e-commerce practices is a very important way to gain competitive advantage (Top4).	1–5	3.93	0.80
Competitive pressure (Cop)			
1. Our firm thinks we will lose our trading partners if we do not adopt B2B e-commerce (Cop1).	1–5	4.09	0.72
2. Our firm considers that B2B e-commerce has an impact on competition in our industry (Cop2).	1–5	4.13	0.74
3. Our firm is under pressure from competitors to adopt B2B e-commerce (Cop3)	1–5	3.36	1.20
4. Our firm thinks we lose our customers/suppliers if we do not adopt B2B e-commerce (Cop4).	1–5	4.06	0.73
5. Some of our competitors have already started using B2B e- commerce (Cop5).	1–5	4.18	0.76
Business partner's pressure (Bus)			
1. Our firm depends on trading partners that are already using B2B e-commerce (Bus1).	1–5	3.82	0.78
2. Our suppliers and trading partners are pressuring us to adopt B2B e-commerce (Bus2).	1–5	3.69	0.76
3. Our suppliers demand us to use B2B e-commerce for doing business with them (Bus3).	1–5	3.87	0.71
4. Our customers are ready to do business over the website (Bus4).	1–5	3.83	0.70
Government support (Gov)			
1. The government has provided public infrastructure readiness that support electronic payment (Gov1).	1–5	3.54	0.87
2. The government has developed ICT infrastructure to support B2B e-commerce initiatives (Gov2).	1–5	3.67	0.74
3. The government is offering tax incentives to SMEs to boost B2B e-commerce development (Gov3).	1–5	3.74	0.90
4. The government has provided various educational programs to train entrepreneurs and staff in use of B2B e-commerce (Gov4).	1–5	3.70	0.80
5. The government has provided support to ensure affordable Internet services for use of B2B e-commerce (Gov5).	1–5	3.83	0.80
6. The government has initiated technology vendor support (IT consultancy services) for use of B2B e-commerce (Gov6).	1–5	3.80	0.85

Appendix B. Measurement model statistics

Table B1. Factor loadings (bolded) and cross-loadings of reflective constructs of Level 1.

	Pes	Org	Top	Cop	Bus	Gov
Pes2	**0.775**	0.310	0.179	0.180	0.253	0.233
Pes3	**0.823**	0.343	0.200	0.292	0.280	0.337
Pes5	**0.839**	0.409	0.121	0.211	0.161	0.173
Pes8	**0.742**	0.415	0.327	0.391	0.419	0.357
Org1	0.305	**0.696**	0.012	0.118	0.203	0.213
Org2	0.329	**0.804**	0.301	0.358	0.353	0.320
Org3	0.382	**0.788**	0.286	0.401	0.465	0.401
Org4	0.416	**0.834**	0.238	0.325	0.417	0.430
Top1	0.228	0.173	**0.772**	0.492	0.543	0.424
Top2	0.309	0.344	**0.816**	0.471	0.563	0.459
Top3	0.108	0.233	**0.725**	0.599	0.492	0.302
Top4	0.142	0.143	**0.816**	0.514	0.534	0.403
Cop1	0.335	0.417	0.489	**0.796**	0.535	0.453
Cop2	0.252	0.273	0.478	**0.802**	0.474	0.509
Cop4	0.226	0.211	0.504	**0.721**	0.578	0.449
Cop5	0.230	0.359	0.622	**0.841**	0.514	0.411
Bus1	0.373	0.415	0.422	0.477	**0.711**	0.423
Bus2	0.281	0.372	0.470	0.481	**0.818**	0.468
Bus3	0.212	0.366	0.607	0.547	**0.766**	0.395
Bus4	0.126	0.297	0.639	0.528	**0.772**	0.535
Gov1	0.255	0.363	0.519	0.519	0.587	**0.827**
Gov2	0.313	0.423	0.451	0.484	0.621	**0.880**
Gov5	0.242	0.317	0.352	0.419	0.521	**0.740**
Gov6	0.274	0.342	0.295	0.437	0.502	**0.782**

Table B2. Factor loadings (bolded) and cross-loadings of reflective constructs of Level 2.

	Pes	Org	Top	Cop	Bus	Gov
Pes2	**0.769**	0.308	0.183	0.180	0.256	0.231
Pes3	**0.813**	0.343	0.202	0.290	0.293	0.337
Pes5	**0.846**	0.408	0.127	0.212	0.180	0.172
Pes8	**0.749**	0.412	0.329	0.389	0.423	0.359
Org1	0.305	**0.709**	0.019	0.121	0.214	0.214
Org2	0.331	**0.813**	0.303	0.359	0.354	0.320
Org3	0.386	**0.777**	0.291	0.401	0.470	0.397
Org4	0.417	**0.828**	0.242	0.325	0.419	0.431
Top1	0.227	0.170	**0.768**	0.490	0.540	0.425
Top2	0.310	0.342	**0.832**	0.472	0.553	0.458
Top3	0.109	0.232	**0.720**	0.602	0.476	0.304
Top4	0.142	0.140	**0.806**	0.513	0.525	0.401
Cop1	0.337	0.410	0.486	**0.793**	0.523	0.450
Cop2	0.253	0.273	0.476	**0.807**	0.486	0.512
Cop4	0.225	0.208	0.500	**0.708**	0.568	0.450
Cop5	0.230	0.356	0.620	**0.848**	0.509	0.412
Bus1	0.375	0.412	0.421	0.476	**0.754**	0.425
Bus2	0.278	0.367	0.470	0.478	**0.804**	0.466
Bus3	0.213	0.360	0.606	0.541	**0.731**	0.396
Bus4	0.126	0.296	0.642	0.527	**0.762**	0.534
Gov1	0.255	0.362	0.520	0.519	0.603	**0.829**
Gov2	0.310	0.417	0.453	0.482	0.638	**0.870**
Gov5	0.239	0.313	0.351	0.419	0.538	**0.750**
Gov6	0.273	0.338	0.298	0.435	0.522	**0.784**

Table B3. Factor loadings (bolded) and cross-loadings of reflective constructs of Level 3.

	Pes	Org	Top	Cop	Bus	Gov
Pes2	**0.789**	0.308	0.179	0.182	0.256	0.237
Pes3	**0.827**	0.345	0.201	0.291	0.287	0.338
Pes5	**0.816**	0.409	0.123	0.215	0.167	0.171
Pes8	**0.749**	0.413	0.328	0.392	0.419	0.358
Org1	0.301	**0.717**	0.017	0.119	0.208	0.212
Org2	0.328	**0.797**	0.304	0.362	0.350	0.315
Org3	0.382	**0.783**	0.291	0.408	0.468	0.403
Org4	0.414	**0.830**	0.238	0.329	0.418	0.431
Top1	0.230	0.167	**0.770**	0.488	0.537	0.419
Top2	0.313	0.341	**0.821**	0.471	0.558	0.451
Top3	0.116	0.226	**0.739**	0.601	0.486	0.294
Top4	0.149	0.134	**0.800**	0.513	0.530	0.396
Cop1	0.339	0.407	0.489	**0.809**	0.531	0.456
Cop2	0.252	0.271	0.479	**0.797**	0.475	0.502
Cop4	0.232	0.205	0.504	**0.702**	0.573	0.446
Cop5	0.232	0.354	0.628	**0.847**	0.511	0.409
Bus1	0.374	0.413	0.420	0.472	**0.717**	0.429
Bus2	0.290	0.370	0.470	0.480	**0.826**	0.471
Bus3	0.225	0.358	0.608	0.545	**0.753**	0.391
Bus4	0.131	0.292	0.641	0.527	**0.765**	0.529
Gov1	0.258	0.360	0.520	0.512	0.587	**0.805**
Gov2	0.318	0.418	0.448	0.485	0.625	**0.872**
Gov5	0.249	0.314	0.352	0.416	0.524	**0.754**
Gov6	0.282	0.340	0.295	0.436	0.508	**0.802**

Table B4. Factor loadings (bolded) and cross-loadings of reflective constructs of Level 4.

	Pes	Org	Top	Cop	Bus	Gov
Pes2	**0.789**	0.308	0.179	0.182	0.256	0.237
Pes3	**0.827**	0.345	0.201	0.291	0.287	0.338
Pes5	**0.816**	0.409	0.123	0.215	0.167	0.171
Pes8	**0.749**	0.413	0.328	0.392	0.419	0.358
Org1	0.301	**0.717**	0.017	0.119	0.208	0.212
Org2	0.328	**0.797**	0.304	0.362	0.350	0.315
Org3	0.382	**0.783**	0.291	0.408	0.468	0.403
Org4	0.414	**0.830**	0.238	0.329	0.418	0.431
Top1	0.230	0.167	**0.770**	0.488	0.537	0.419
Top2	0.313	0.341	**0.821**	0.471	0.558	0.451
Top3	0.116	0.226	**0.739**	0.601	0.486	0.294
Top4	0.149	0.134	**0.800**	0.513	0.530	0.396
Cop1	0.339	0.407	0.489	**0.809**	0.531	0.456
Cop2	0.252	0.271	0.479	**0.797**	0.475	0.502
Cop4	0.232	0.205	0.504	**0.702**	0.573	0.446
Cop5	0.232	0.354	0.628	**0.847**	0.511	0.409
Bus1	0.374	0.413	0.420	0.472	**0.717**	0.429
Bus2	0.290	0.370	0.470	0.480	**0.826**	0.471
Bus3	0.225	0.358	0.608	0.545	**0.753**	0.391
Bus4	0.131	0.292	0.641	0.527	**0.765**	0.529
Gov1	0.258	0.360	0.520	0.512	0.587	**0.805**
Gov2	0.318	0.418	0.448	0.485	0.625	**0.872**
Gov5	0.249	0.314	0.352	0.416	0.524	**0.754**
Gov6	0.282	0.340	0.295	0.436	0.508	**0.802**