E-GOVERNMENT SOPHISTICATION:

A CROSS-SECTIONAL STUDY OF TECHNOLOGICAL, ECONOMIC AND INSTITUTIONAL FACTORS

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Attestation of authorship

"I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning."

Signature: _____ Date: _____

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Abstract

In view of the uneven development of e-government around the world, it is not unimagined that governments and scholars have started to question what influences its sophistication. The term sophistication captures the degree of service functionality as e-government evolves through a series of stages. A considerable body of the literature has examined indicators of technological, economic and institutional factors, which are likely to influence the sophistication of e-government. The majority of these studies have placed more emphasis on the analysis of a country's technological and economic conditions only. Recognising that other factors might influence the sophistication of e-government, more recent studies are incorporating indicators of the institutional dimension into this analysis -i.e., the rules, norms and laws that shapes a country's society.

However, e-government is not static, and the examination of these indicators across different sophistication levels has been ignored. Thus, the following study questions what the influence is from these indicators, and what differences exist between them across different degrees of e-government sophistication. To answer these questions, a two-step examination approach was undertaken utilising secondary sources from 142 countries around the globe. The first part of the study examined the influence of indicators of technological, economic and institutional factors –i.e., ICT infrastructure, GDP per capita, corruption control, press freedom and human capital – in the sophistication of e-government. A regression model was utilised for this first analysis. The second part evaluated with closer granularity these indicators across groups that represent the different levels of e-government sophistication. A Kruskal-Wallis test was undertaken to study these indicators across groups of high, medium and low degrees of sophistication.

The results from the regression analysis provide support to ICT infrastructure and human capital as significant indicators of the sophistication of e-government. For the second part of the analysis, with the exception of press freedom and human capital, differences across all groups were identified for the indicators ICT infrastructure, GDP per capita, and corruption control. Considering these findings, countries should take a closer examination to the indicators ICT infrastructure and human capital as potential indicators of higher levels of e-government sophistication. Also, countries need to examine their particular circumstances to understand the underlying causes that might influence the observed results across groups of e-government sophistication.

Chapter 1 Introduction

1.1 Chapter overview

The purpose of this opening chapter is to introduce the context of study for this dissertation, in particular, the preceding conditions leading to the present role of e-government. After the introduction of the motivation for conducting this study and the initial arguments about the factors, which are likely to influence the sophistication of e-government, the research questions are posited. This chapter concludes with the outline of the dissertation structure.

1.2 Research motivation

There is no social benefit from e-government when people are excluded from access to it (Helbig, Ramón Gil-García, & Ferro, 2009). In this regard, the literature highlights mixed results on the socioeconomic advantages obtained from e-government, partly since the forces that influence its development go far beyond a country's technological and economic conditions (Dada, 2006; Weerakkody, El-Haddadeh, & Al-Shafi, 2011). These mixed results range from developing nations struggling to achieve the promised benefits of e-government (e.g., corruption control), to nations with the financial resources attempting, but failing, in their endeavours to successfully implement it (Dada, 2006; Weerakkody et al., 2011). Confronted by these contrasting results, recent studies have examined the role of technological, economic and institutional factors in the search for answers to what influences the sophistication of e-government (Azad, Faraj, Goh, & Feghali, 2010; Ifinedo, 2012b).

However, these studies often overlook the examination of these factors across groups with different degrees of e-government sophistication. In addition, it is noteworthy that the number of studies considering specifically the institutional factor is limited. Indeed, some authors (Azad et al., 2010; Yildiz, 2007) suggest that the traditional view in the literature most favourably considers a country's technological and economic side of the analysis. This technological and economic determinism leaves not much to ponder around the contribution of indicators of institutional factors, and undermines a government's ability to adopt the benefits of using e-government (Azad et al., 2010).

Therefore, considering that there are gaps in the literature, it is justifiable to re-establish the discussion on the sophistication of e-government. The term sophistication, as

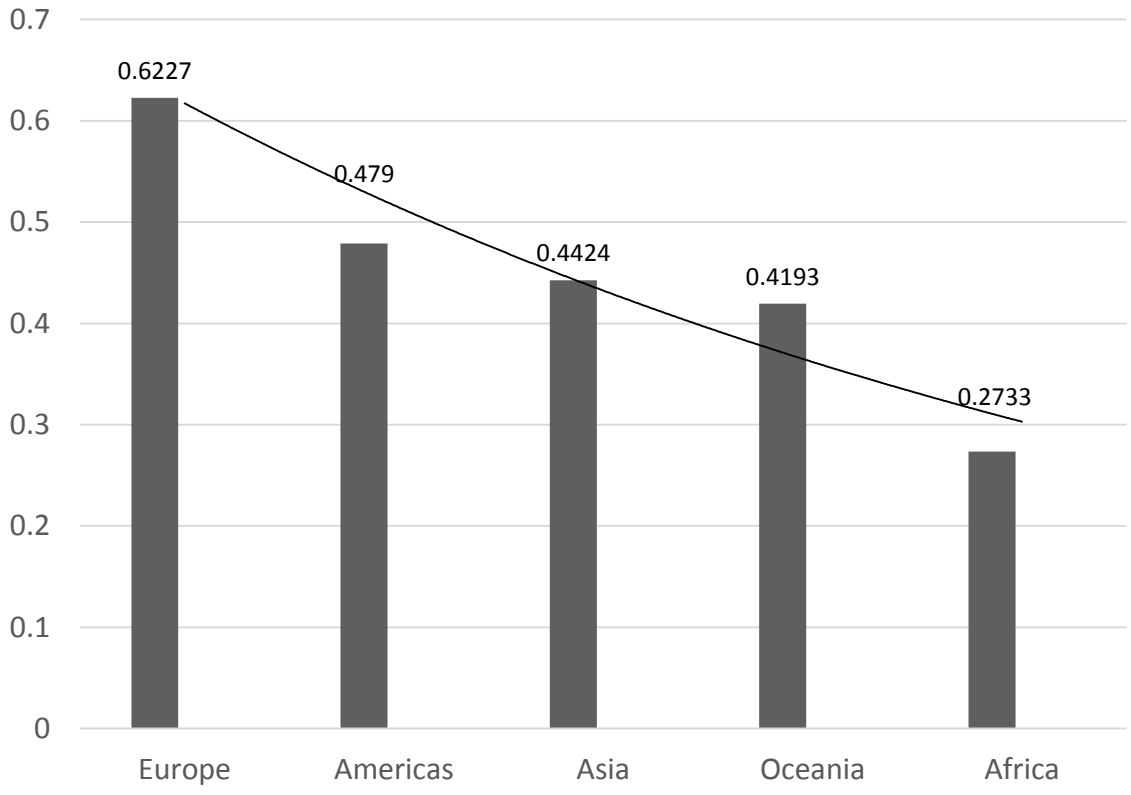
explained in more detail in the next section, capture the technological development of e-government (Andersen & Henriksen, 2006).

This study is aming to readdress this dialogue by undertaking the analysis of technological, economic and institutional factors. The results from this research will offer policymakers and practitioners, as well as scholarly researchers, with some new perspectives on what the influence is from technological, economic and institutional factors.

1.3 E-government- a new hope

The advances in computing interconnectivity are not restricted to the commercial sector only. Indeed, government institutions have also been brought up to the electronic space. This electronic space in the form of e-government is far from an isolated event, but its adoption is a worldwide rising occurrence. Statistics from the United Nations (UN, 2010) show an upward trend in the development of e-government around the globe, with the European region leading this process, followed by the Americas, Asia, Oceania and Africa (see development indexes in Figure 1).

Figure 1: E-government development by world region



Source: UN (2010)

This global rise shows that not only e-government is assuming an increasing role at government institutions, but it also makes clear the presence of an inconsistent development of e-government across the globe. For example, although the progress of e-government in the Americas, Asia and Oceania shows similarities across its regions, there is a noticeable difference from Africa to the development of e-government in Europe (see Figure 1). This statistic accentuates a noticeable divide between developed and under-developed regions of the globe. This uneven progression of e-government could help explain why the underlying causes for these differences have received considerable attention from government institutions as well as from scholars.

E-government evolves through different stages of sophistication. The term sophistication refers to the development in a series of steps, from low to high levels of complexity (Andersen & Henriksen, 2006). Some authors in the literature speak of the development process also as maturity, whilst other authors use the term sophistication to refer to this same development progress (Azad et al., 2010; Das, Singh, & Joseph, 2011; Gil-Garcia & Martinez-Moyano, 2007). The term sophistication captures the degree of service development of e-government functions. This study utilises the term sophistication, since the maturity process in this research is described in terms of the degree of service functionality as e-government evolves through a series of stages.

The word e-government has surfaced as an argot in public administration and academic circles, and has become a buzzword synonymous of public access to government self-service electronic platforms. Despite the diverse number of ways in which the term is utilised, the literature agrees that e-government is the provision of government services through an electronic medium, either using the Internet or any other electronic information technology (Gil-Garcia & Martinez-Moyano, 2007; West, 2004). This provision of services diverge according to its orientation, and is categorised into three broad areas: government-to-citizen (G2C), government-to-government (G2G) and government-to-business (G2B) (Yildiz, 2007). The sophistication process in this study, as examined in Chapter 2, is described according to the interaction of government-to-citizen. Therefore, this study takes a G2C orientation to the examination of the sophistication of e-government.

Not only e-government is categorised according to its service orientation, but studies in the literature are also classified according to their scope of research. Traditionally, research studies on e-government are classified into four broad areas: e-readiness, demand studies, supply studies, and research on the economic and non-economic impact of e-government (Das et al., 2011; Waksberg-Guerrini & Aibar, 2007). First, the focus of studies on e-readiness is the analysis of factors that might influence the development of e-government. Studies on e-readiness are often oriented from a global perspective (Azad et al., 2010; Das et al., 2011; Ifinedo, 2012a). Second, the objective of the studies analysing the demand side is to obtain a better understanding of citizens' acceptance to a variety of e-government services. These studies on the demand of e-government services tend to be narrower in the number of countries that are examined (Streib & Navarro, 2006). The third classification is supply studies; its purpose is to understand the number and type of services available. Supply studies are often coupled to the analysis of the demand side (Marius & Calin, 2011). Lastly, there are studies whose purpose is to examine the impact from e-government (Bhatnagar, 2003; Helbig et al., 2009). The purpose of this study is to examine the relationship between technological, economic and institutional factors and e-government sophistication. For that reason, the focus of this research in particular is on e-readiness, a scholarly study aiming to understand what influences the sophistication of e-government.

In the early attempts to undertake the analysis of e-government as an emerging new field of research, few studies examined the institutional environment where e-government operates (Reece, 2006; Yildiz, 2007). The early attempts to understand the new phenomenon placed more emphasis to the technological features, and dedicated less attention to the theoretical underpinnings to understand what influences the sophistication of e-government (Reece, 2006; Yildiz, 2007). This started to change with a shift in the role of e-government (Yildiz, 2007). More clearly, in a similar way the expansion of the Internet and the widespread use of personal computers transformed the business sector, e-government has also changed the role of government institutions by reorienting its services to assist citizens in a more customer oriented fashion (Yildiz, 2007). As a result of this shift, from its original function as a managerial solution back in the shadows of government offices, e-government has evolved in a gradual process to the forefront of government ICT innovation (Tat-Kei Ho, 2002; Yildiz, 2007). This change in the role of government institutions and the promised socioeconomic benefits of e-government have generated an increased interest from the academic community and a surge in the number

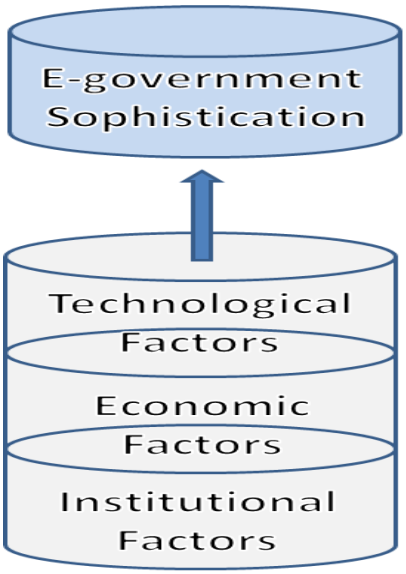
of studies and theories, making clear of its importance as a multidisciplinary scholarly field of study (Heeks & Bailur, 2007).

This change in the significance of e-government has also guided researchers to often depict e-government in the literature from an optimistic, well-intentioned viewpoint (Weerakkody et al., 2011). This enthusiasm suggests that e-government stands out from other ICT initiatives as a new hope in the promotion of transparency, corruption reduction, service improvement, trust and confidence in government institutions (Bertot, Jaeger, & Grimes, 2010; Bhatnagar, 2003; Dwivedi, Weerakkody, & Janssen, 2011; Gupta & Jana, 2003; Tolbert & Mossberger, 2006). However, not everything is optimistic, as there are inconsistent results in different countries' ability to accomplish the above-mentioned benefits. For example, e-government programmes have not consistently improved access to government services for many people in countries where a suitable socio-political context is absent, most noteworthy in developing countries (Dada, 2006; Yildiz, 2007). As there are potentially contrasting views on the benefits of e-government, it has become increasingly difficult not to reopen the discussion to analyse what factors influence the sophistication of e-government.

1.4 Research problem and questions

In more recent efforts, the studies examining what influences the sophistication of e-government have started to depart from the early studies' technology-economic-only focus, changing its centre of attention to the role exerted by societal norms and practices (e.g., press freedom and corruption perception) (Azad et al., 2010). This readdressing of the discussion to an institutional viewpoint is more likely the realisation from prior studies acknowledgment that technological and economic factors are not unique actors mediating the effective implementation of ICT initiatives (DiMaggio, Hargittai, Neuman, & Robinson, 2001; Gichoya, 2005). Because of that, this study argues that the development of e-government is a process where technological, economic and institutional factors altogether influence its sophistication (see Figure 2). These indicators serve as gauges of a country's technical, economic and institutional capability.

Figure 2: Enablers of e-government sophistication



In light of the above discussion, the first research question for this study is:

RQ1: What is the influence of indicators of technological, economic and institutional factors on e-government sophistication?

To address the study of what the influence is from technological, economic and institutional factors, this research develops a conceptual model to establish the links between indicators of these factors and the sophistication of e-government. However, e-government is not a homogenous, non-changing occurrence, but it is rather an evolving technology (Gil-Garcia & Martinez-Moyano, 2007). Since there are noted disparities on the sophistication of e-government, most notably between developed and developing nations (Dada, 2006), this study also seeks to examine these technological, economic and institutional factors across different levels of sophistication. Specifically, it has been suggested in the literature, but not examined in detail from a global perspective, that countries with the same technological, economic and institutional development might show different levels of e-government sophistication (Dada, 2006; Ifinedo, 2012a; Weerakkody et al., 2011). Therefore, the second research question of this study is:

RQ2: What is the relative weight of the indicators of technological, economic and institutional factors among different degrees of e-government sophistication?

To provide answers to these research questions, the analysis is conducted in two stages utilising secondary data about countries around the world compiled by international organisations. The purpose of the first stage is to examine the influence of indicators of technological, economic and institutional factors on the sophistication of e-government. In the second part, these indicators are examined across different groups of sophistication.

1.5 Chapter conclusion and dissertation overview

To address the research questions that were presented in this chapter, this study develops a hypothesised model that guides the analysis in the search for answers. Each chapter in this dissertation starts with an overview and concludes with a brief discussion of the main arguments. This study has been organised as follows: Chapter 2 introduces the theoretical underpinnings that support the development of the hypothesised relations to address the research problem. These relations build up from findings in the literature to establish the theoretical bridge between the indicators of technological, economic and institutional factors and the sophistication of e-government. Chapter 3 explains the methodology for testing the secondary data. Chapter 4 serves to present the analyses. Chapter 5 is dedicated to the discussion of findings. Lastly, Chapter 6 is the conclusion to this dissertation.

Chapter 2 Literature review and hypothesised model

2.1 Chapter overview

Having introduced the context of this study and the research problems in Chapter 1, this chapter presents the literature review and the development of the theoretical concepts. In order to seek answers to the research questions, this chapter introduces three commonly cited models of sophistication and defines the indicators that are examined in this study. This chapter concludes by establishing the hypotheses and the hypothesised model that will be empirically tested in the next chapter.

2.2 E-government, better country?

Scholars assent that the impact of e-government on improving access to government institutions has been significant (Reece, 2006). This emergent new access has generated an enthusiasm that, in part, has contributed with the literature to be largely dominated by an unrealistic optimistic view of what e-government can deliver (Heeks & Bailur, 2007). An examination of the literature indicates that this optimistic viewpoint is supported by research that points to e-government as a promoter of speech and media transparency, reducing corruption, improving service, trust and confidence in government institutions (Bertot et al., 2010; Bhatnagar, 2003; Dwivedi et al., 2011; Gupta & Jana, 2003; Tolbert & Mossberger, 2006). Still, much of this optimism in e-government as a panacea towards a more utopian democracy is mostly overstated (Reece, 2006).

Dada (2006), for example, observes that in practice, developing countries even with the adequate technological infrastructure have fallen short on improving access to government services. This failure to achieve the benefits from e-government is particularly more cumbersome for the poor and the less privileged constituents of society (Dada, 2006). In addition, these inconsistent results are not exclusive of poor developing nations. For example, Qatar has invested a large sum of financial resources in e-government and has also struggled with its implementation (Weerakkody et al., 2011). There are also cases where there is no clear relation between a country's democratic practices and e-government. Singapore is a good example of this. This country was ranked number 11 in the e-government UN worldwide rank (UN, 2010).

During the same year, Singapore's government fell low in the transparency rankings by achieving position 136 in the press freedom index (RWB, 2010).

However, these previous examples are not aiming to generalise or suggest that a shortcoming to the potential benefits of e-government exists. It is presented to show that there is not always a clear relation between a country's level of e-government sophistication, the socioeconomic benefits and the institutional context where e-government operates. From this discussion, there is a question that surfaces: is e-government a new hope in the transformation of public institutions accountability? Wong and Welch (2004) posit an interesting remark around this question, "It is simply a myth that e-government will automatically and dramatically change the accountability nature of public organisation" (p. 291).

The above-mentioned dichotomy in the research findings led this study to question what the relationship is between the indicators of technological, economic and institutional factors, and the sophistication of e-government. In addition, these paradoxes posit the question, what are the differences (if any) of these indicators across dissimilar groups of sophistication? Actually, there is not much discussion in the literature examining these indicators across different levels of e-government sophistication. As a consequence from these observed inconsistencies on the benefits from e-government, a growing number of studies reject the development of e-government as an issue of technological and economic factors only (Azad et al., 2010).

2.3 E-government sophistication

Technological and economic factors are not unique determinants for the effective implementation of e-government initiatives (DiMaggio et al., 2001). An important contribution to this understanding was made by Azad et al. (2010), who, considering indicators of institutional factors, argued that the sophistication of e-government is not restricted only by the influence of a country's technological and economic conditions. For this reason, this study also reflects not only on a country's technological and economic conditions, but also on institutional factors in the search of answers to the research questions. Before starting the analysis of the theoretical perspectives between these factors and the sophistication of e-government, the next section examines how different models in the literature are utilised to describe the manner in which e-government develops.

2.3.1 Models of e-government sophistication

According to Andersen and Henriksen (2006), sophistication refers to the improvement of e-government services in a series of different stages. As introduced earlier in this study, the term sophistication captures the functionality of e-government services through a series of stages. An example of this functionality development is the evolution of a government website from information only to the incorporation of real time transactions. In other words, each of these stages carries unique characteristics, where a higher level indicates a higher degree of sophistication. This process of sophistication is the result of governments' attempt to fulfil citizens' demands for better services, reduction of transactional costs, and to readdress the attention of government institutions to a more citizen-centric focus (Dwivedi et al., 2011; Layne & Lee, 2001).

Two traditions in the literature are central to this discussion of how researchers have modelled the process of sophistication, i.e., according to its technological development or from a customer-centric and design features perspective (Andersen & Henriksen, 2006; Layne & Lee, 2001). Layne and Lee (2001) put forward a model categorised in the first group as technology oriented, and it is one of the most commonly cited development models in the academic literature (Andersen & Henriksen, 2006). In this model, the process of sophistication is described using four stages: cataloguing, transaction, vertical integration and horizontal integration. In the earliest stage, cataloguing, e-government is characterised by the limited interaction between the government and citizens. The information available is limited to the presentation of catalogued material and downloadable forms. The next stage is the transaction level, which, as its name implies, is characterised by the incorporation of design features, allowing citizens to conduct basic online transactions (e.g., payments). It is not until the highest levels of sophistication, the vertical and horizontal stages, that real time processing is integrated. In the vertical integration, the e-government platform has the capability to execute similar transactions across different government levels (e.g., local vs. national), whilst in the horizontal stage, transactions across different departments are possible.

As seen in the previous description of Layne and Lee's (2001) model, its focus is technological. Whilst it briefly hints to the issue of limited access to e-government services, mainly at the lowest levels, the four-stage classification model is descriptive in nature and does not incorporate how institutional factors play a role in the sophistication of e-government. In this regard, Andersen and Henriksen (2006) question Layne and

Lee's (2001) model and suggest that even as the model effectively integrates the technological characteristics of e-government at each stage of sophistication, it does not explain issues related to a country's public administration.

Aiming to address the aforementioned gaps in the Layne and Lee (2001) model, Andersen and Henriksen (2006) bring together a more pragmatic approach of four progressive phases to depict how e-government evolves over time – i.e., Phase I- cultivation, Phase II-extension, Phase III-maturity and Phase IV-revolution. In the first phase of this model, cultivation, there are few and scattered customer-oriented services. Citizens are presented with some basic information in this first phase, but the integration of customer-centric activities is minimal to non-existent. Phase II, extension, is a developed account of the previous phase and is characterised for a more customer-centric web presence. An example of this customer-centric presence is the availability of downloadable forms and the website's reorientation to help citizens find service transactions, instead of government as a provider of information only.

However, the processes in this second phase are still mainly supported by traditional face-to-face transactions and the redirection of users to other websites. E-government services differentiate from the previous phases when the platform achieves Phase III- maturity. In this third phase, transactions can be performed online and the integration with other government institutions is possible. In the fourth stage, revolution, there is an exchange of information across departments and vendors. Audit trail capabilities are extensively used in this last phase to track government and citizens' transactions.

Another e-government development model that is frequently cited in the literature is the sophistication model presented in the United Nations Survey Report (UN, 2010). In the UN model, emerging, enhanced, transactional and connected constitute the four stages of e-government sophistication. The model distinguishes itself from Layne and Lee's (2001) and Andersen and Henriksen's (2006) models, in that it takes a functional focus. In other words, each level in the sophistication model is assessed according to its utility and level of functionality from a citizen's perspective (UN, 2010).

The web presence in the early emerging stage is limited to the presentation of information and links to other websites. In the second stage, enhanced information services, government websites blend features from the first stage with additional capabilities such as audio, video and improved communication channels. Still, at this second stage, there

are no real time transactions occurring. Transactions and real time interaction from government to citizen is achieved at the third stage, termed transactional services. In the transactional services stage, bi-directional communication and the use of advanced authentication and interaction is possible. The last stage, connected services, differentiates from the third stage in the integration of social networks (e.g., Web 2.0) to engage citizens to participate and get involved on government initiatives.

Both Andersen and Henriksen's (2006) and Layne and Lee's (2001) models are suitable for setting a framework to understand the development process of e-government. However, valuable as these models are, quantitative data from disparate sources cannot be integrated into these models. Since this study utilises indicators measuring various factors in quantitative terms from various secondary sources, Andersen and Henriksen's (2006) and Layne and Lee's (2001) models do not fit well to search for answers to the research questions. On the other side, the United Nations (UN, 2010) model is linked to quantitative indexes. The methodology in this study, as explained in further detail in Chapter 3, employs quantitative methods. Since this study employs numerical data from secondary sources, the United Nations model (UN, 2010) makes the examination of the research questions plausible utilising quantitative methods.

The previous discussion is not suggesting an advantage of a quantitative model over other conceptual frameworks, such as the ones presented by Andersen and Henriksen (2006) and Layne and Lee (2001). There are circumstances when these models are more appropriate. For example, these models are useful to assess and describe the development status of e-government initiatives at specific countries or regions. However, it is beyond the scope of this study to assess advantages or disadvantages between these sophistication models. The analyses in this study are quantitative. Also, the United Nations model (UN, 2010) describes each level in terms of its functionality-i.e., the range of services and interaction provided, which is how the term sophistication is utilised in this study. Thus, this study utilises as its point of reference for its analyses, the development model in the United Nations Survey Report (UN, 2010), which is more appropriate for a quantitative study. The sophistication models that were discussed in this section are summarised in Table 1.

Table 1: Comparison of selected sophistication models from the literature

Sophistication Stages/Phases	Focus	Author
1. Cataloguing 2. Transaction 3. Vertical Integration 4. Horizontal Integration	Technology-organisation focus	Layne and Lee (2001)
1. Cultivation 2. Extension 3. Maturity 4. Revolution	Customer-activities focus	Andersen and Henriksen (2006)
1. Emerging 2. Enhanced 3. Transactional 4. Connected	Functional focus	UN (2010)

2.4 Theoretical perspectives on e-government sophistication

Societies are influenced by institutional factors that mediate a country's development process (North, 1991). This theoretical perspective suggests that a country's technological advances, workforce specialisation and economic conditions are the product of a country's institutional context. Private or public institutions help shape this institutional context through the rules, codes and practices that, in the end, affect the economic and technological growth of a country (Azad et al., 2010; Ifinedo, 2012b; North, 1991). For example, laws, norms and rules that facilitate private and public transactions might promote better opportunities for economic, human capital and technological growth (North, 1991). How well these rules and laws ensure transparent processes, control of corruption, and incentive labour force specialisation will all have intended or unintended consequences in a country's economic and technological growth (Ifinedo, 2012b; North, 1991).

In other words, this perspective on institutional factors points toward the existence of practices that influence a country's development beyond conditions imposed by technological and economic conditions only. This viewpoint in the context of e-government suggests that in order to evolve into higher levels of sophistication, countries must first have the appropriate institutional climate in the form of rules, norms and laws

to support such developmental undertakings (Ifinedo, 2012b). This institutional perspective has been empirically examined within the context of the sophistication of e-government (Azad et al., 2010; Ifinedo, 2012b).

Certainly, other indicators could potentially serve as gauges in the sophistication of e-government. However, the indicators identified through this study capture the interactions of the aforementioned (i.e.,North, 1991) technological, economic and institutional perspectives. The following section will examine these indicators of technological, economic and institutional factors in further detail to develop the conceptual model that will guide the rest of this study.

2.5 Factors shaping e-government sophistication

As indicated by the previous discussion, there are socioeconomic and technological conditions that might influence the sophistication of e-government (Ifinedo, 2012b). These are measured through indicators of a country's socio-economic and technological environment. It is a common practice in the literature to employ the use of research models to establish hypothesised connections between indicators of these factors and the sophistication of e-government (Azad et al., 2010; Das et al., 2011; Ifinedo, 2012a). In order to examine the differences across world regions, these research models often examine the sophistication process from a global perspective.

For example, Azad et al. (2010) examines the relationship between technological, economic and institutional factors, contrasting a model based on the traditional argument (i.e., technological and economic factors only) with a proposed model considering the inclusion of institutional factors. The results from Azad's et al. (2010) study suggest that when institutional factors are also considered, not only the predictive power of the resultant model is increased, but also leads to statistical significance differences when compared to the use of technological and economic factors only. These observations from Azad et al. (2010) support the importance of a country's institutional structures in the sophistication of e-government.

In contrast to the approach employed by Azad et al. (2010), Das at al. (2011), and Ifinedo (2012a, 2012b) have examined the development of e-government through a conceptualisation of a single research model. However, in contrast to the findings from Azad et al. (2010), the results from Das at al. (2011) support the significance of economic factors in predicting the sophistication of e-government. On the other hand, the results from Ifinedo (2012a, 2012b) partially agree with Azad et al. (2010) findings. In particular,

Ifinedo (Ifinedo, 2012a, 2012b) found that a country's technological infrastructure is a significant influencing indicator of e-government sophistication. These findings from previous research on e-government show how broad results in the literature are. Thus, there is still an open field for additional investigation on what influences the sophistication of e-government.

2.5.1 Technology and e-government sophistication

In terms of the technological infrastructure utilised for access to e-government, Bhatnagar (2003) recognises two prominent venues. First, the use of web-based self-service government portals are the most commonly used point of access to e-government services utilised by citizens in developed nations, whilst communal access centres, telecentres, etc., are more prevalent in developing nations. In this study, the term information and communication technology (ICT) infrastructure refers to a composite indicator that encompasses the number of computers, Internet users, mobiles, telephone landlines and broadband connections per 100 inhabitants (UN, 2010). This composite indicator was selected for this study because it provides a holistic approach that captures the ample variety of technological infrastructure that is utilised by citizens for access to e-government services. The indicator also captures the basic infrastructure to access e-government services-i.e., telephone landlines, to mobile phones, which is required to access some of the most sophisticated features (e.g., Web 2.0) at the highest levels of e-government sophistication (UN, 2010).

This selection of ICT infrastructure as an indicator of technological factors is also supported by empirical evidence that points toward the existence of a relationship between ICT infrastructure and the sophistication of e-government (Azad et al., 2010; Das et al., 2011; Ifinedo, 2012a, 2012b; Ifinedo & Singh, 2011; Siau & Long, 2009; Singh, Das, & Joseph, 2007; Srivastava & Teo, 2010). In this regard, Singh et al. (2007) suggests that the sophistication of e-government is constrained to a certain extent by the ICT infrastructure of a country as it facilitates or hinders the government's ability to provide citizens with e-government services. From an institutional perspective, a country's technological infrastructure is viewed as an endogenous factor, which serves as a stimulus to the sophistication of e-government (Siau & Long, 2009). In other words, countries' internal developments in ICT infrastructure might influence the sophistication of e-government.

Surely, countries with a more rudimentary ICT infrastructure might be able to implement some basic e-government services. For example, an automated self-service telephone line service to conduct basic transactions over the phone. A particular government might decide that a low level of e-government service is what the country needs. Furthermore, this study is not suggesting that ICT infrastructure is a panacea to the sophistication of e-government, as there is an institutional dimension that, as stated previously, is a strong component of the underlying causes for a country's technological development (North, 1991). However, these countries might not be able to engage in initiatives directed to develop their e-government service into higher levels of sophistication without first implementing significant improvements to their ICT infrastructure (Das et al., 2011). Therefore, this study acknowledges the importance of a country's ICT infrastructure as a potential indicator for the sophistication of e-government.

On the other hand, the literature suggests that even with the availability of equal ICT infrastructure across different countries, the benefits and the sophistication of e-government have not been equal across nations (Dada, 2006; Weerakkody et al., 2011). For example, Luxembourg, Sweden and Switzerland, according to the United Nations (UN, 2010), show a level of ICT infrastructure that is comparable to countries with high levels of e-government sophistication like the Netherlands and Norway (i.e., Luxembourg = 0.713, Sweden = 0.752, Switzerland = 0.768, Netherlands = 0.766, Norway = 0.683). However, Luxembourg, Sweden and Switzerland are not in the group of highly sophisticated countries (see appendix 2). This suggests that there are cases of countries that might show different levels of e-government sophistication despite showing equal developments of ICT infrastructure. This example is not suggesting a contradiction. Surely countries' e-government might be influenced by the presence of better ICT infrastructure (Das et al., 2011). However, when examined with closer granularity, there might be different levels of success across nations even with equal development levels of ICT infrastructure.

A lack of adequate institutional structures in developing countries have been suggested as a possible causes for these differences (Dada, 2006; Yildiz, 2007). This highlights how the specific circumstances beyond the availability of technological infrastructure might have a restraining effect on the sophistication of e-government. In this regard, this is consistent with North's (1991) viewpoint –i.e. a lack of supporting institutional

structures could hinder a country's technological advancement. For example, a country might attempt to imitate the required e-government infrastructure from a different country, but success is not likely without the adequate institutional context (Dada, 2006). Thus, this study recognises that even with equal development of ICT infrastructure, there might be different levels of e-government sophistication across different countries. The following hypotheses emerged from the previous discussion on the indicator ICT infrastructure:

H1: ICT infrastructure shows a positive influence in the sophistication of e-government.

H2: ICT infrastructure shows equal development levels at different degrees of e-government sophistication.

2.5.2 Economy and e-government sophistication

The importance of a country's economic capability to support the implementation of e-government is a dimension that must not be underestimated (Weerakkody et al., 2011). Access to financial resources is not only a constraint for the development of private business ICT initiatives, but has also been identified as a barrier for the sophistication of e-government (Eyob, 2004; Gichoya, 2005; Weerakkody et al., 2011). Economic constraints could take the form of a lack of investment capital for the implementation phases or further funding for maintenance and administration of the ICT infrastructure. GDP per capita in this study is utilised as an indicator of a country's national wealth and its production capabilities (Das et al., 2011; Srivastava & Teo, 2010). GDP per capita represents a country's GDP divided by its total population. Since this study is conducting an examination of countries around the globe, it is plausible to consider GDP per capita over crude GDP in order to account for the differences in population sizes.

The sophistication process of e-government is a costly endeavour, therefore, it is not a coincidence that wealthier countries are more likely to invest on e-government (Das et al., 2011; Singh et al., 2007). This is not suggesting that better economic conditions are directly conducive to better e-government services. Certainly, countries are not obligated to utilise their national wealth on improving or even initiating the offering of e-government services. Governments could decide that traditional face-to-face transactions are what they need. However, governments that decide to do so, and engage e-government initiatives, are in a better position to develop their technological conditions in the presence of economic progress (Romer, 1994). From an institutional perspective, there are

indications that the sophistication of e-government is possible when the institutional context provides incentives for economic growth (Ifinedo, 2012b). Thus, a country's economic condition is a factor that should be considered together with the analysis of the institutional environment. The indicator GDP per capita in this study captures this economic growth. These previous arguments support the decision to undertake the indicator GDP per capita in the analysis of e-government sophistication.

The inclusion of the indicator GDP per capita in this study is also supported by empirical studies that suggest there is a relationship between this indicator and the sophistication of e-government (Das et al., 2011; Ifinedo, 2012b). In this regard, in a study covering several years, Das et al. (2011) noted that for 177 countries around the globe, GDP per capita influences the development of e-government. Whilst Ifinedo (2012b) reached similar conclusions, noting specifically the impact of a country's GDP per capita on developing countries in Latin America. These prior observations lend evidence to the viewpoint of economist and researcher Romer (1994), who supports wealth as an influencing factor of a country's technological infrastructure development (Ifinedo, 2012b; Siau & Long, 2009). In other words, a country's capability to provide financial investments for the sophistication of e-government is one aspect that needs to be considered. Therefore, this study considers a country's GDP per capita since it is a potential indicator of the sophistication of e-government.

In contrast, Weerakkody et al. (2011) points out how countries in the Middle East, specifically Qatar, having the same economic capabilities as more developed countries, struggles with the development of e-government. Weerakkody et al. (2011) is not presenting a contradiction, as they agree with prior observations that support the availability of funding as a necessary condition for the development of e-government. What they suggest is that a country's institutional context, in the end, is what decides how these economic resources are utilised, therefore the noted paradox. This viewpoint is in line with theories on economic growth indicating that the increment of countries' GDP per capita is the product of the internal institutional context (Romer, 1994). More clearly, the institutional contexts in the form of rules, laws and norms exercise an important role on how countries manage their national wealth and ultimately influence the sophistication of e-government (Ifinedo, 2012b; North, 1991; Romer, 1994; Weerakkody et al., 2011). Thus, countries across a region might show equal economic growth but still have different levels of success with e-government (Weerakkody et al.,

2011). Recognising that there are different institutional contexts across different world regions, countries with different levels of e-government sophistication might show equal growth levels of GDP per capita. The following are the hypotheses that emerged from this prior discussion on the indicator GDP per capita:

H3: GDP per capita shows a positive influence in the sophistication of e-government.

H4: GDP per capita shows equal growth levels across countries with different degrees of e-government sophistication.

2.5.3 Institutions and e-government

E-government itself does not promote government accountability (Wong & Welch, 2004). In particular, the present study is in agreement with prior scholars and takes the position that it is the institutional context within which e-government operates, which brings out its benevolent characteristics to benefit society (Wong & Welch, 2004). This national context is influenced by a country's institutional practices. As stated by North (1991), formal and informal laws, codes and practices help shape the interaction with a country's technological and economic activities. Because of this, having the proper institutional structures is the first step governments should consider prior to pursuing the development of e-government (Ifinedo, 2012b).

Indicators of these institutional factors include a country's control of corruption, press freedom and its human capital. These indicators have been identified through empirical studies as indicators of the sophistication of e-government (Azad et al., 2010). Also, these indicators are linked to the laws, norms and rules in the institutional context needed for a country's technological development (North, 1991). Societies help shape a country's education system, civil liberties and norms. Thus, in the context of this study, these indicators serve to measure institutionalised practices that might either hinder or advance the development of e-government to different levels of sophistication. More recently, empirical studies have also found support to suggest a potential relationship between e-government sophistication and the indicators of the institutional factors corruption control, press freedom, as well as human capital development (Azad et al., 2010; Bertot et al., 2010; Ifinedo, 2012a, 2012b; Ifinedo & Singh, 2011; Siau & Long, 2009; Srivastava & Teo, 2010). The following paragraphs develop the discussion on these indicators in more detail.

Corruption control: Corruption in this study refers to the "perceptions of the extent to which public power is exercised for private gain" (Kaufmann, Kraay, & Mastruzzi, 2010, p. 4), and captures how political and public structures are perceived (TPI, 2010). For example, bribery of public employees, unethical behaviour in the procurement process, embezzlement and the effectiveness of anti-corruption initiatives (TPI, 2010). Corruption has negative consequences over a country's development, as it is a roadblock to the reduction of poverty and a leading cause of economic underperformance (UNODC, 2004). From an institutional dimension, control of corruption is an indicator within the rules and norms of society with implications in a country's technological growth (North, 1991). Corruption control in this study is an indicator of this institutional context.

When norms, laws and practices to control corruption are not present, it might lead to mistrust and fear to conduct transactions with public institutions (Srivastava & Teo, 2010). In regards to the sophistication of e-government, a lack of corruption control in a country is seen as an impediment to the sophistication process (Azad et al., 2010). For example, a lack of process transparency to conduct business-to-government transactions emerges when corruption is ingrained in public institutions, thus, private and public investments are discouraged (Srivastava & Teo, 2010). Prior empirical studies have also observed a positive relationship between countries that are seen as less corrupt and the sophistication of e-government (Azad et al., 2010; Ifinedo, 2012b).

However, this study is not suggesting that corrupted nations could not undertake the use of e-government. A nation perceived as corrupt might engage in e-government initiatives looking to advance the political ideas of the governing parties (Wong & Welch, 2004). For example, corrupt countries might implement e-government services but require payments or put excessive conditions for transactions that, under normal circumstances, should be provided without major restrictions. An example of this would be requiring contractors to make payments or special donations to politicians in order to gain access to an electronic bidding process. However, higher levels of e-government sophistication might make it more difficult to play this game of favourites (Bhatnagar, 2003). In light of these arguments, this study embraces the viewpoint that nations with a lack of corruption control are less likely to support higher levels of e-government sophistication (Ifinedo, 2012b). In other words, corruption control is a potential

indicator of the sophistication of e-government, since it is more likely that less corrupted nations will be willing to engage in higher levels of e-government (Ifinedo, 2012b).

As it was mentioned before, countries that are perceived as having corrupt practices may still engage in the use of e-government services. An example of this is illustrated by the case of Mongolia. This country, according to the United Nations e-government survey report (2010), shows some promising sophistication of e-government (index = 0.55, highest = 1.00). However, in the corruption control ranking for the same year (2010), Mongolia ranks in a low position (116 out of 178) (TPI, 2010). Uzbekistan is another example. This country despite showing progress in terms of e-government sophistication (index = 0.377, highest = 1.00), ranks 172 (out of 178) in corruption control (TPI, 2010). These examples are not contradictory to the prior discussion, as surely there are examples showing countries that are perceived as corrupted with noticeably low levels of e-government sophistication. However, this study is aiming to convey a new perspective to the analysis of e-government sophistication, as there are cases of countries that might show no differences of corruption control across different degrees of sophistication. Certainly, as discussed before, it is more likely that less corrupted nations will be willing to engage in higher levels of e-government (Ifinedo, 2012b). However, when this issue is considered with closer granularity across countries, there might be equal levels of corruption control perception across different levels of e-government sophistication.

Considering these theoretical perspectives, this study posits the following hypotheses for the indicator corruption control:

H5: The perception of corruption control shows a positive influence in the sophistication of e-government.

H6: The level of corruption control perception is equal across different degrees of e-government sophistication.

Press freedom: Press freedom refers to the unrestricted transparent flow of information. As such, it is a common institutional practice that is expected from democratic societies (Azad et al., 2010). Press freedom is one of several different forms of civil liberties, indicative of the freedom enjoyed by journalists, citizens, and the media (RWB, 2010).

Prior empirical research found a positive relationship between this greater level of civil liberties as seen through the level of press freedom and e-government sophistication (Azad et al., 2010). This indicator is defined in terms of the number of incidents to restrict this freedom of press -i.e., a higher score equals a lower level of press freedom (RWB, 2010). Examples of these incidents include false arrests, threats and violence, as well as censorship and media control, including Internet media (RWB, 2010). In the context of the institutional perspective, press freedom is linked to the rules and norms that are necessary to enable a country's e-government sophistication (Azad et al., 2010; Ifinedo, 2012b; North, 1991). The indicator press freedom, as utilised in this study, captures these rules and norms from the institutional context.

This study is not suggesting that there are no countries perceived as having lower levels of press freedom engaging in the use of e-government services. For example, benchmark reports indicate these are the cases of Bahrain and Colombia (RWB, 2010). These countries are positioned in the list of top ranked sophisticated e-government services in the United Nations e-government survey report (2010). However, in the press freedom index, Bahrain and Colombia are ranked 144 and 145 respectively (RWB, 2010). This is noticeably low considering that the country in the lowest position, Eritrea was ranked 178 (RWB, 2010). For those cases, the important question is, what are those countries intentions with e-government? This is not proposing that it is the case of Bahrain and Colombia, but, for example, countries with lower levels of press freedom might be trying to control the message through the use of e-government by conveying the information that is more favorable to the political structure (Wong & Welch, 2004).

Governments could go farther and control the media by employing discriminatory practices (e.g., denying a licence to operate) against those that expose government mismanagement. The position this study argues is that when there is no protection for the free flow of information, not only is the media affected, but also it is likely that this control of the media will be taken to all different levels, including information in the electronic form (Azad et al., 2010). Also, as mentioned earlier, a lack of institutional structures of which press freedom is part, is an impediment to a country's technological development (Azad et al., 2010; North, 1991). Thus, this study considers that countries with a lower number of incidents with the media are more likely to undertake initiatives to sophisticate their e-government services.

The previous example of Bahrain, Colombia and Eritrea show also how countries could have related levels of press freedom but different levels of e-government sophistication. Specifically, Bahrain, Colombia and Eritrea show low levels of press freedom, however, Eritrea is in the low levels of e-government sophistication, whilst Bahrain and Colombia are in the highest level (see appendix 2). These examples are not aiming to contradict the prior discussion, as there are examples of countries with low levels of press freedom with low levels of e-government sophistication. The argument this study is aiming to convey is that when examined across nations, countries might have comparable levels of press freedom, but still show different degrees of e-government sophistication. Thus, this study takes the position that press freedom most likely influences the sophistication of e-government. However, when examined across different levels there might be no differences in press freedom.

The following are the hypotheses linked to the indicator press freedom:

H7: Press freedom influences the sophistication of e-government sophistication.

H8: The level of press freedom is equal across countries with different degrees of e-government sophistication.

Human capital: Empirical studies for countries around the world suggest that there is a positive relationship between human capital and the sophistication of e-government (Ifinedo, 2012a, 2012b; Ifinedo & Singh, 2011; Siau & Long, 2009; Srivastava & Teo, 2010). Human capital in this study refers to a country's level of educational attainment and literacy (Das et al., 2011; Singh et al., 2007). This educational attainment is the product of country's institutional effort to educate its citizens. The indicator accounts for the literacy of the adult population and the combined enrolment in primary, secondary and tertiary education. In the context of e-government, human capital is an important indicator of institutional factors since the level of educational attainment influences the likeliness for citizens to use ICT technologies (Thomas & Streib, 2003). An example of this is a citizen's ability to perform basic functions to use a personal computer. Surely, just some basic knowledge is required to perform a basic search in a computer.

However, as the level of complexity of e-government increases, these interactions might require higher levels of skill beyond point and click, as well as typing using computer peripherals.

For example, the United Nations model (UN, 2010) describes how, at the lower levels of sophistication, users can perform basic information searches, whilst the use of Web 2.0 tools is integrated at the highest levels of sophistication. This progression suggests that higher literacy skills are necessary to keep abreast with the sophistication of e-government. Moreover, specialised human capital is necessary to support the sophistication of ICT technologies as it evolves (Gregorio, Kassicieh, & De Gouvea Neto, 2005). Thus, having better and more educated citizens "should facilitate e-government development in the nation" (Srivastava & Teo, 2010, p. 270). These more educated citizens, as indicated above, are more likely to attain the skills necessary for the development of e-government initiatives. This is an understandable proposition, since managers, programmers and developers require different levels of specialised knowledge to undertake projects aiming to sophisticate e-government. The indicator human capital, as it is employed in this study, captures this progression of educational attainment – i.e., primary, secondary and tertiary education. Therefore, human capital is regarded as a potential indicator of the sophistication of e-government.

However, a question at this point is: Is it possible to have a similar human capital development across different countries at different sophistication levels? Two interesting cases of this situation are illustrated by Armenia and Tonga. These two countries in the the United Nations e-government survey report (2010) show human capital components at the same level as those countries with high e-government sophistication. This does not mean that there are no examples showing the contrary, but these examples are indicative that countries might show comparable levels of human capital development at different levels of sophistication. It is a possibility, not necessary the cause, but this apparent paradox might be attributed to the government of these countries having no interest on implementing higher levels of e-government services. As this example suggests, countries with low levels of sophistication might show related levels of human capital to those countries in high levels of sophistication. Thus, this study supports that human capital is a potential indicator of the sophistication of e-government.

However, when this is examined more closely across countries with different levels of sophistication, there might be no differences in human capital levels. Thus, this study posits the following hypotheses for the indicator human capital:

H9: Human capital shows a positive influence in the sophistication of e-government sophistication.

H10: The level of human capital is equal across different degrees of e-government sophistication.

Table 2 summarises the hypotheses developed from the literature reviewed in this chapter.

Table 2: Summary of hypotheses in this study

Number	Hypotheses
H1	*ICT infrastructure shows a positive influence in the sophistication e-government.*
H2	*ICT infrastructure shows equal development levels at different degrees of e-government sophistication.*
H3	*GDP per capita shows a positive influence in the sophistication of e-government.*
H4	*GDP per capita shows equal growth levels across countries with different degrees of e-government sophistication.*
H5	*The perception of corruption control shows a positive influence in the sophistication of e-government.*
H6	*The level of corruption control perception is equal across different degrees of e-government sophistication.*
H7	*Press freedom influences the sophistication of e-government sophistication.*
H8	*The level of press freedom is equal across countries with different degrees of e-government sophistication.*
H9	*Human capital shows a positive influence in the sophistication of e-government sophistication.*
H10	*The level of human capital is equal across different degrees of e-government sophistication.*

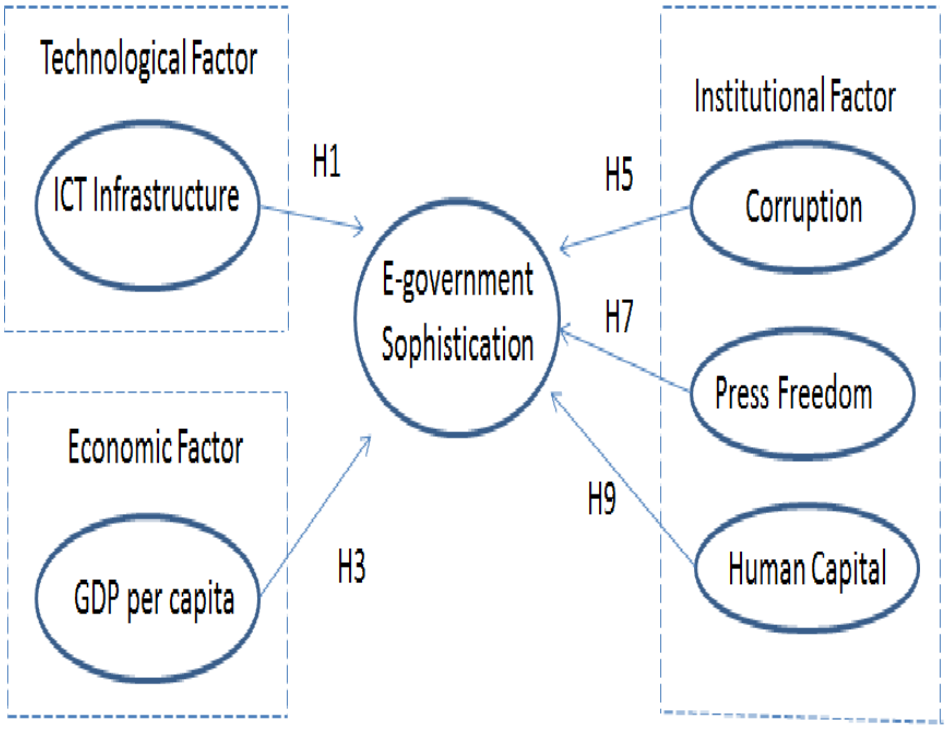
Table 3 summarises the use of indicators of technological, economic and institutional factors in previous studies.

Table 3: The links between indicators and the research findings from the literature

Factor	Indicator	Description	Use of this factors and indicators in previous studies
Technological Factor	ICT Infrastructure	Indicator of a country's technological infrastructure required for access to e-government services.	Azad et al. (2010); Das et al.(2011) Ifinedo (2012a) (2012b) Ifinedo and Singh (2011) Siau and Long (2009) Singh et al. (2007) Srivastava and Teo (2010)
Economic Factor	GDP per Capita	Indicator of a country's national wealth and production capabilities.	Das et al.(2011) Ifinedo (2012b)
Institutional Factors	Corruption	Indicator of the perceptions of how well corruption is controlled.	Azad et al. (2010) Ifinedo (2012b)
	Press Freedom	Indicator of the number of incidents to silence the media.	Azad et al. (2010)
	Human Capital	Indicator of literacy and educational attainment.	Ifinedo (2012a) (2012b) Ifinedo and Singh (2011) Siau and Long (2009) Srivastava and Teo (2010)

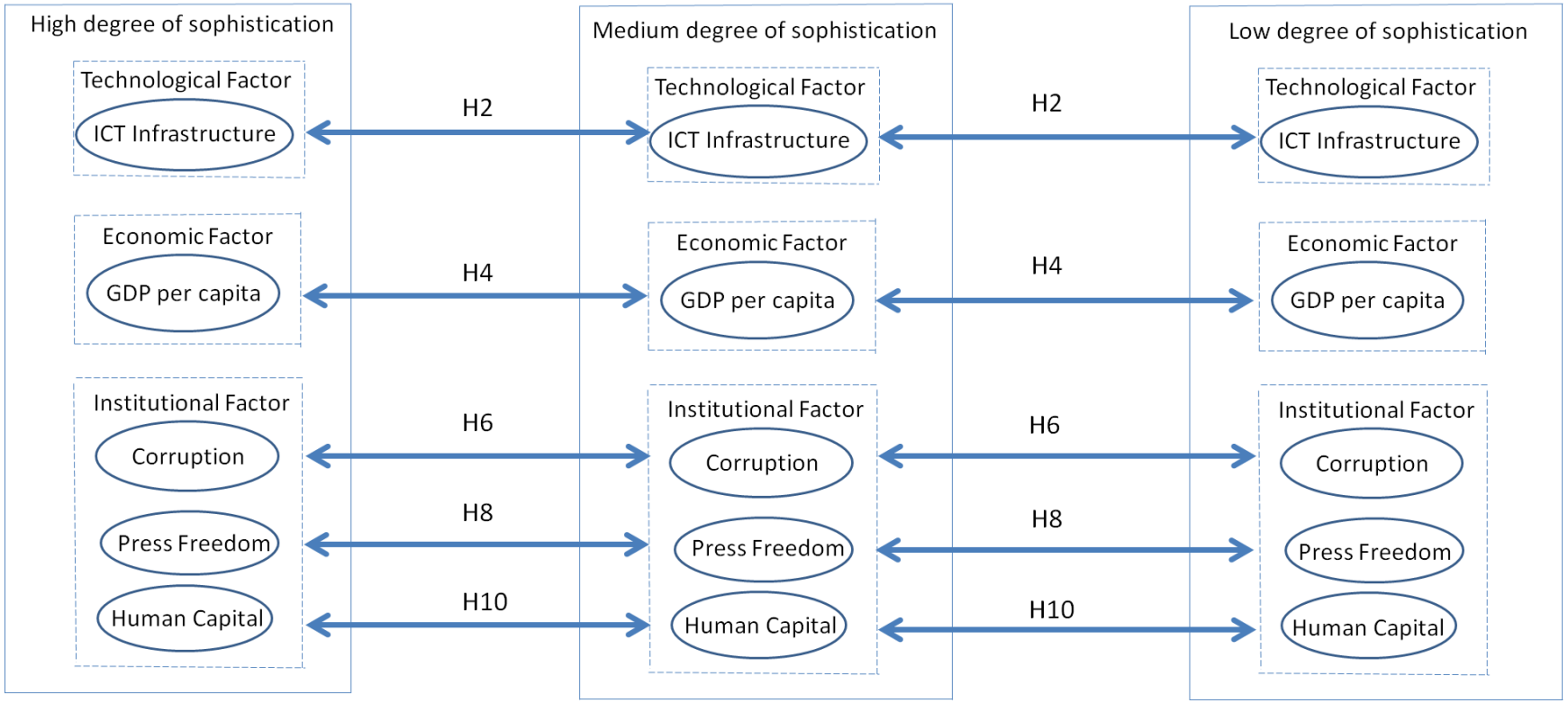
In the first part of this study, the influences of the above-referred indicators on e-government sophistication are examined (see Figure 3).

Figure 3: Indicators influencing e-government sophistication



The hypothesised model in Figure 3 summarises the theoretical links between the indicators of technological, economic and institutional factors, and the sophistication of e-government. This model will serve as the theoretical foundation that will guide the first part of the analysis. For the second stage, the model in Figure 4 will guide the analysis to examine these indicators across low-medium, medium-high and low-high degrees of sophistication. The criteria for the degrees of sophistication, high medium and low, is explained in the next chapter, along with the methodology and procedures to be undertaken to conduct the analyses for both parts of this study.

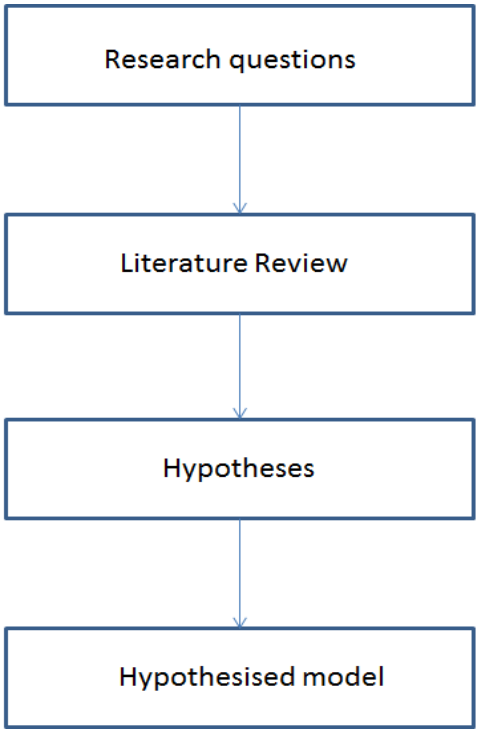
Figure 4: Indicators across different levels of e-government sophistication



2.6 Chapter conclusion

A review of the relevant theoretical underpinnings has resulted in the identification of indicators of technological, economic and institutional factors, which are likely to influence the sophistication of e-government. These theoretical underpinnings lead to the development of the hypothesised model that will guide the empirical testing in the next chapter. Figure 5 summarises the steps that were undertaken from the research questions, to the development of the hypothesised model.

Figure 5: Research questions connection to the study hypothesised model



Chapter 3 Methodology

3.1 Chapter overview

Having finalised the review of the theoretical underpinnings, it is important to examine the research methodology this study employs. Specifically, this chapter presents the justifications for utilising the selected procedures in the analysis of the indicators of technological, economic and institutional factors. This chapter concludes with an explanation of the steps to assemble the data sets used for the analyses.

3.2 Justification of methodological procedures

This study makes use of two examination procedures to provide answers to the research questions. The first part of the analysis examines the influence of the indicators of technological, economic and institutional factors on e-government sophistication. A linear regression is utilised for this purpose. In the second part, these indicators are examined across high, medium and low degrees of sophistication by employing a Kruskal-Wallis test. The appropriateness of the selected procedures and how these techniques help address the research questions are explained in more detail as follows.

3.2.1 Linear regression - appropriateness of the test and data set fit

There are several plausible reasons to consider a linear regression as an appropriate test for the first part of the study. First, this study hypothesised a relationship between independent variables and a dependent variable. In this case, the collective contribution, rather than the individual influences, must be considered to determine the relative weight of these indicators on the sophistication of e-government. Thus, the analysis calls for a procedure that connects simultaneously the five independent variables-i.e., ICT infrastructure, GDP per capita, corruption control, press freedom and human capital, to the dependent variable, e-government sophistication. In counterpart from an univariate analysis, the use of a multivariate linear regression is useful to examine this relationship with multiple independent indicators (Hair Jr, Anderson, Tatham, & William, 1995). Whilst other procedures (e.g. Structural Equation Modelling) can aid in examining the direction in the proposed relationships, the purpose of this study is to answer what the influences are from these factors, and it is not the aim to analyse the pathways of the variables in this study.

Second, a linear regression will help explain the influences from the hypothesised relations in terms of their statistical average, taking into consideration the inherent errors in their relations (Hair Jr et al., 1995). In other words, the linear regression produces estimated averages of the relation between the indicators of technological, economic and institutional factors and e-government sophistication, rather than exact values, since it is not possible to account for all the behaviours involved in these theoretical relationships (e.g., human decisions) (Hair Jr et al., 1995). For example, it has been argued through this study that technological, economic, and institutional factors might influence the sophistication of e-government. However, as discussed earlier, there are potentially underlying causes not accounted for in these theorised relations to explain that there might not be differences in these factors across different sophistication levels. Since it is not practical to express the relationship between variables in exact values, a linear regression makes it possible to weigh and examine these theoretical relationships in terms of average approximations. The regression model is therefore an objective explanation of the independent variables' influence on the sophistication of e-government (Hair Jr et al., 1995).

Third, it is important to be able to interpret the results in terms of the individual contribution of the indicators of the technological, economic and institutional factors. Although all variables are entered simultaneously in the multivariate linear regression, the individual contributions can be examined from the resultant model (Hair Jr et al., 1995). Lastly, the use of a linear regression provides a level of flexibility for studies like this one, which employs sources of secondary data. This flexibility is provided by the ability to employ transformations (Hair Jr et al., 1995). Specifically, the aggregation of data has a peculiar characteristic, which is that it might not be possible to approximate linearity between independent variables and the dependent variable without first utilising transformation techniques, or through the augmentation of the data set (Azad et al., 2010). As explained later in this chapter, transformations were employed for the data set in this study to improve linearity and stabilise several of the variables. The use of transformations is a flexible way to establish a linear relationship between the independent variables and the dependent variable (Hair Jr et al., 1995).

These characteristics of the linear regression are plausible to answer the research question*:* What is the influence of indicators of technological, economic and institutional factors on e-government sophistication? Therefore, it seems reasonable to utilise a linear regression analysis for the first part of this study.

3.2.2 Kruskal-Wallis - appropriateness of the test and data set fit

In the second part of this study, the indicators of technological, economic and institutional factors are examined across different levels of sophistication. As explained later in this chapter, the different degrees are organised in three groups of high, medium and low degrees of sophistication. Since it was hypothesised that the indicators of these factors are not different across different groups of e-government sophistication, a test is required to undertake an examination across different groups. Kruskal-Wallis is a statistical procedure that can be utilised to conduct this analysis to examine the differences across different levels of sophistication (O'Donoghue, 2013).

ANOVA is another test that is frequently employed for this type of analysis (O'Donoghue, 2013). However, an assumption for using ANOVA that is underscored by several authors, is that the residuals of the individual variables must follow a normal distribution (O'Donoghue, 2013). Since countries around the world show different levels of sophistication, the number of observations per sophistication group is not equal. The sample of 142 countries is divided in unequal groups of high, medium and low degrees of sophistication. Because of the smaller number of observations per group, the normality assumption could potentially be violated. Therefore, a test like ANOVA should not be utilised. There is research supporting the robustness of ANOVA procedures against violations of normality (Schmider, Ziegler, Danay, Beyer, & Bühner, 2010). However, Kruskal-Wallis is a more adequate procedure for cases such as this study that has groups with unequal sizes and where data might not be normally distributed (Roberts & Toleman, 2007).

The Kruskal-Wallis analysis will indicate if there are significant differences across sophistication levels. Still, this test will not point to which groups' combinations are contributing with these differences. Because of this, a Mann-Whitney test is utilised as a post hoc procedure to examine groups' contributions when statistically significant differences across groups are indicated (Stevens, 2009). For the reasons stated above, it is considered plausible to utilise a Kruskal-Wallis test for the second part of the analysis,

followed by a post hoc Mann-Whitney to be undertaken if the results from the test show statistical differences among the groups. These characteristics of the Kruskal-Wallis test are plausible to answer the research question*:* What is the relative weight of the indicators of technological, economic and institutional factors among different degrees of e-government sophistication? Therefore, it seems sensible to utilise a Kruskal-Wallis test for the second examination in this study.

3.3 Sources of data and measures

This study employs four well-known sources of secondary data from databases and reports corresponding to the year 2010. The year 2010 was selected since, at the time of writing this dissertation, it is the most recent period with available secondary sources of publicly open data for all variables across the same year. One source is the United Nations e-government survey report (UN, 2010) from where the datasets for e-government sophistication, ICT infrastructure and human capital are derived. The e-government reports published by the United Nations are widely used for academic research and are considered a reputable source of secondary data for countries around the globe (Azad et al., 2010; Das et al., 2011; Ifinedo, 2012a, 2012b; Kovacic, 2005; Siau & Long, 2009). The data from this publication is retrieved from the United Nations e-government development knowledge base (UN database, 2010).

Another source of secondary data is the World Economic Outlook database, prepared by the International Monetary Fund (IMF, 2010). This dataset is utilised to obtain the GDP per capita information. The International Monetary Fund (IMF, 2010) publishes detailed information on the economic outlook of countries around the globe and has been used for research studies on e-government development (Das et al., 2011). In addition to the collection and dissemination of economic data, the organisation serves as an expert consultant on financial matters.

An additional source of secondary data used in this study is the data published by Reporters Without Borders (2010). This data set is utilised to derive the scores for the press freedom index. RWB (2010) publishes the scores on the level of press freedom for countries around the world. The organisation serves as an international monitor. Through their activism, the organisation denounces incidents against the media and has been publishing their surveys since the year 2002. This data has been utilised, for example, in the analysis of Internet censorship in China (MacKinnon, 2009).

Lastly, the data for corruption control perception is obtained from Transparency International (TPI, 2010), a global outreach organisation. This organisation promotes government transparency by exposing corrupted practices and publishing the corruption control scores for countries around the globe. The data from Transparency International has been used in the study of what the influence is from countries' institutional environments in the sophistication of e-government (Azad et al., 2010).

Table 4 summarises the data sources for the variables utilised in this study.

Table 4: Summary of data sources

Variables	Data source
E-government sophistication	United Nations e-government survey report (2010)
ICT infrastructure	United Nations e-government survey report (2010)
Human capital	United Nations e-government survey report (2010)
GDP per capita	International Monetary Fund (2010)
Press freedom	Reporters Without Borders (2010)
Corruption control	Transparency International (2010)

3.4 Operationalisation of variables

Having explained the sources of secondary data, the purpose of this section is to operationalise the six variables utilised in this study. In the first part, the analysis fit in one dependent variable – i.e., e-government sophistication – and five independent variables – i.e., ICT infrastructure, GDP per capita, corruption control, press freedom and human capital. For the second part, three groups are assembled according to high, medium and low degrees of e-government sophistication. The variables ICT infrastructure, GDP per capita, corruption control, press freedom and human capital are then examined across each of these levels of sophistication.

E-government sophistication: For both parts of the analyses, the e-government sophistication data is derived from the online service index in the United Nations e-government survey report (UN, 2010). The mode in which this variable is used in this study is twofold. It is first utilised as a dependent continuous variable for the regression

analysis, then, for the second part, the variable is used as the grouping factor in the Kruskal-Wallis procedure. The following sections explain these differences.

The regression in the first part of the analysis utilises the online service index from the UN Report (UN, 2010) as a dependent variable and is an indicator of the sophistication of e-government. This index represents a total score, with a minimum value of 0 (lowest sophistication) to a maximum possible value of 1 (highest sophistication). This variable is linked to the sophistication of e-government according to the four stages model in the United Nations e-government survey report (UN, 2010) – i.e., emerging, enhanced, transactional and connected presence. The reason this measurement is a total score is because e-government services at different government departments and levels (e.g., national or regional government) within the same country are not all at the same level of sophistication. In other words, not all e-government services within the same country are at stage one (emerging), stage two (enhanced), stage three (transactional) or stage four (connected). In practice, it is observed that within the same country, some services are on stage one (emerging), others are on stage two (enhanced), three (transactional) or four (connected). According to the United Nations e-government survey report (UN, 2010), the total score is calculated by employing a survey with yes/no questions corresponding to each stage of sophistication. Specifically, each question in the survey assesses how the different government service features agree with the descriptions of each individual level in the four stages development model. The total online service value is the sum of each individual score corresponding to each stage of sophistication.

One additional step is undertaken by the United Nations e-government survey report (UN, 2010) to report this index. The online service is reported as a normalised index. First, the total score is subtracted from the lowest score in the data set. Second, the range from all countries divides this resultant total value. Prior researchers have utilised the sophistication indexes published by United Nations for similar examinations as in this research (Azad et al., 2010; Ifinedo, 2012a, 2012b; Siau & Long, 2009).

In the Kruskal-Wallis analysis, the variable e-government sophistication is utilised to establish the grouping criteria. As mentioned before, the measurement scale for this variable is defined by the data source (UN, 2010), with a minimum value of 0 (lowest sophistication) to a maximum possible value of 1 (highest sophistication). The

sophistication of countries in the middle is expressed in fractions between 0 and 1. A subdivision of the dataset in three groups is sensible for this study given that the number of observations per group must be larger than five in the Kruskal-Wallis test (O'Donoghue, 2013). The criteria for the organisation of the indicators ICT infrastructure, GDP per capita, press freedom, corruption control and human capital in the three groups of sophistication using this scale are explained as follows.

Each country in the dataset has a sophistication measurement associated to it, that as stated before, is a total value from the sum of each individual score corresponding to each stage of sophistication. In addition, each data measurement for the indicators ICT infrastructure, GDP per capita, press freedom, corruption control and human capital is linked to a country with a specific level of sophistication. To organise these indicators according to high, medium and low degrees, countries were assembled in groups by dividing the sophistication scale in thirds. The lower third, medium third and high third divisions represent low, medium and high degrees of sophistication, respectively. Since the value for each indicator is attached to a specific country, the division of countries in the data set in three groups consequently results in the regrouping of the indicators according to high, medium and low degrees of sophistication. Specifically, each indicator was assigned to a group formed by thirds of the sophistication scale using the criteria: 1.0-0.67 (high degree), 0.34-0.66 (medium degree), 0.33-0 (low degree).

ICT infrastructure: The ICT infrastructure data is based on the Telecommunications infrastructure index in the United Nations e-government survey report (2010). According to this data source, the index is a composite indicator conformed by the total number of computers/100 individuals, Internet customers/100 individuals, telephone landlines/100 individuals, mobile subscriptions/100 individuals and high speed subscriptions/100 individuals. The total is converted to an index subtracting the total score from the lowest score in the data set and dividing the resultant value by the range from all countries. A higher index signifies a higher level of ICT infrastructure. In the first part of the study ICT infrastructure is an independent variable for the regression analysis. In the second part, ICT infrastructure is examined across high, medium and low degrees of sophistication. Similar utilisation of this variable has been employed in the study of the factors that influence the development of e-government (Siau & Long, 2009).

GDP per capita: The GDP per capita is based on the data produced by the International Monetary Fund (2010) and is derived from converting the GDP (current prices) in national currency to U.S. currency, and then dividing the result by the country's total population. In the first part of the study, GDP per capita is an independent variable for the regression analysis. In the second part, GDP per capita is examined across high, medium and low degrees of sophistication. GDP per capita has been utilised similarly to this study in prior research on e-government (Das et al., 2011).

Corruption control The data for corruption control is derived from the scores published by the organisation Transparency International (TPI, 2010). According to the organisation, the score is a perception index of the corruption in the political and public sectors and captures data from different surveys conducted by recognised institutions. The surveys incorporate questions about bribery of public employees, unethical behaviour in the procurement process, embezzlement and the effectiveness of anti-corruption initiatives. The score ranges from zero to 10, and a higher score is an indicator of a country where the public sector is perceived as less corrupted. In the first part of the study corruption control is an independent variable for the regression analysis. In the second part, the indicator corruption control is examined across high, medium and low degrees of sophistication. Prior research has utilised the data from Transparency International in the analysis of e-government development (Azad et al., 2010).

Press freedom The press freedom data is derived from the scores published by Reporters Without Borders (2010). According to RWB (2010), the survey to evaluate a country includes questions regarding incidents that affect the role of journalists and the media (e.g. censorship, murders, and attacks). A lower score is associated to less number of incidents affecting press freedom. Prior research has utilised the data from Reporters Without Borders in the analysis of e-government development (Azad et al., 2010).

Human capital The data for human capital is drawn from the human capital index reported in the United Nations e-government survey report (2010) and is based on the information provided by the United Nations Educational, Scientific and Cultural Organization (UNESCO). According to the UN Report (2010), the index is a composite indicator that accounts for the literacy of the adult population and the combined enrolment in primary, secondary and tertiary education. Two-thirds of the weight in this index corresponds to adult literacy and one-third is assigned to the gross enrolment. The adult

literacy and gross enrolment indexes are normalised and indexed separately before they are finally added together. The normalisation of each individual index is accomplished by subtracting the total score from the lowest score in the dataset and dividing the result by the range from all countries. Thus, the human capital index is the addition of two-thirds times the adult literacy index, plus one-third times the gross enrolment index. A higher index signifies a higher level of Human Capital. Prior researchers have utilised the Human Capital index from the United Nations e-government reports similarly to how it is used for this study (Das et al., 2011; Ifinedo, 2012a).

Table 5 summarises how the variable e-government sophistication is utilised for both parts of the analysis.

Table 5: Operationalisation of e-government sophistication variable

First part – Linear regression			
Data Source	**Description**		**Countries**
United Nations e-government survey report (2010)	The online service index (OSI) is indicative of the e-government sophistication level according the four stages model in the United Nations e-government survey report (2010): emerging, enhanced, transactional and connected presence.		142
Second part – Kruskal-Wallis			
Data Source	**Groups**	**Groups Criteria**	**Countries per group (Total 142)**
United Nations e-government survey report (2010)	High	1.00 - 0.67	9
	Medium	0.66 - 0.34	45
	Low	0.33 - 0	88

Table 6 summarises how ICT infrastructure, GDP per capita, corruption control, press freedom and human capital are utilised for the analysis in this study.

Table 6: Summary of independent variables operationalisation

Variable	Description
ICT Infrastructure	Composite indicator conformed by the total number of computers/100 individuals, Internet customers/100 individuals, telephone landlines/100 individuals, mobile subscriptions/100 individuals and high speed internet/100 individuals (UN, 2010).
GDP per capita	GDP (current prices) converted from national currency to U.S. currency (As of 25 November 2013) and divided by the country total population (IMF, 2010).
Corruption Control	Index that captures the perception of corruption (TPI, 2010). For example, bribery of public employees, unethical behaviour in the procurement process, embezzlement and the effectiveness of anti-corruption initiatives.
Press freedom	Score that indicates a country's level of press freedom as captured through the number of incidents that affect the role of journalist and the media (RWB, 2010).
Human capital	Composite indicator that accounts for the literacy of the adult population and the combined enrolment in primary, secondary and tertiary education (UN, 2010). The data is collected by the United Nations Educational, Scientific and Cultural Organization.

3.5 Data sets

The datasets utilised for both parts of the analysis of this study are assembled from the aforementioned sources. As a result, not every country from the United Nations e-government survey report (2010) was included in the analysis, since the aggregation process lead to cases with extreme values, or data was not available for one or more variables for the year 2010. The data set finished with a total of 142 countries (see appendix 1). A robust regression model must be designed to include a minimum of 20 observations for each predictor (O'Donoghue, 2013). According to this tenet, the sample size of 142 data sets for each predictor in this study is reasonably robust for a regression

analysis with five predictors (i.e., ICT Infrastructure, GDP per capita, corruption control, press freedom and human capital).

For the Kruskal-Wallis test, five is the minimum number of observations for each group (O'Donoghue, 2013). The groups for the Kruskal-Wallis analysis resulted in 9, 45 and 88 countries for the high, medium and low degree groups respectively (see appendix 2). Thus, the number of countries per group in the data set met the aforementioned tenet for the Kruskal-Wallis test. In addition, an effect of aggregating data from different sources has not always been able to meet, or approximate a linear or normal distribution relationship. This study makes use of logarithmic and square root transformations to stabilise variables and reduce its variance (Stevens, 2009). A visual inspection of variables utilising plots led the analysis to several transformations. Specifically, for the regression analysis, the variables GDP per capita and corruption control were log transformed to improve linearity. For the Kruskal-Wallis analysis, all variables, except GDP per capita were square root transformed to approximate similar distributions across the groups. GDP per capita remained log transformed.

3.6 Chapter conclusion

This chapter has established and justified, the methodology to be utilised to find the answers to the research questions. In addition, this chapter outlined the secondary data sources selected and discussed how the variables are utilised. The data set assembled from the secondary sources for both parts of this study resulted in a sample of 142 countries.

Chapter 4 Data analysis and findings

4.1 Chapter overview

Having established the methodology in Chapter 3, this chapter proceeds now to present the results from the data analysis. The purpose of this chapter is to find answers to the two research questions that were presented in Chapter 1. To accomplish this objective, the hypotheses that were postulated in Chapter 2 are tested. Before presenting the results from the linear regression, the collinearity assumption, residuals autocorrelation, homoscedasticity, normality assumptions and the validation of the regression model are examined. Lastly, the Kruskal-Wallis test is undertaken to examine the indicators of technological, economic and institutional factors across high, medium and low degrees of sophistication. The Statistical Package for the Social Sciences (SPSS) software was utilised for the statistical tests in this chapter.

4.2 Data examination

The hypotheses from Chapter 2 are tested in this chapter, utilising the same data set for the regression and Kruskal-Wallis analyses. Before presenting the results from the regression model, a number of assumptions must be met for the model to yield prediction results that are statistically plausible. In particular, the collinearity assumption, residuals autocorrelation, homoscedasticity normality conditions and the validation of the regression model are examined (Hair Jr et al., 1995; O'Donoghue, 2013; Stevens, 2009). In the second part, a Kruskal–Wallis test is undertaken to examine how the predictors contrast across high, medium and low degrees of sophistication. The results are interpreted at a 0.05 level of statistical significance.

4.2.1 Regression analysis pre-test diagnostics

To examine the collinearity assumption, the proposed regression model was fitted with the dependent variable and all the independent variables. Table 7 presents the results from the collinearity statistics.

Table 7: Collinearity statistics

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.116	.104		-1.119	.265		
	Infrast	.478	.123	.511	3.901	.000	.180	5.546
	GDP	-.005	.039	-.016	-.120	.904	.173	5.792
	Corrup	.151	.099	.155	1.525	.130	.299	3.344
	PressF	.001	.001	.109	1.672	.097	.723	1.383
	HCap	.273	.101	.235	2.705	.008	.410	2.437

a. Dependent Variable: Sophistication

A review of the collinearity statistics in Table 7 shows that the Variance Inflation Factor (VIF) for the predictors are less than 10 (Min = 1.383, Max = 5.792). As a result, there is no severe collinearity indicated (Hair Jr et al., 1995; Stevens, 2009).

The autocorrelation was examined utilising a Durbin-Watson statistic to examine the assumption on the residuals (O'Donoghue, 2013). Table 8 presents the results from the Durbin-Watson test. A test statistics table (Draper & Smith, 1998) indicates that the resultant value of 1.818 met the condition, thus, no significant serial autocorrelation in the residuals is indicated.

Table 8: Durbin-Watson autocorrelation

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.761[a]	.579	.564	.1229833	1.818

a. Predictors: (Constant), HCap, PressF, Corrup, Infrast, GDP

b. Dependent Variable: Sophistication

Table 9 shows that there is no significant correlation (r = 0.156, p = 0.064) at 0.05 of statistical significance between unstandardized predicted values and the absolute values of the residuals. Thus, the homoscedasticity assumption is met for the regression model.

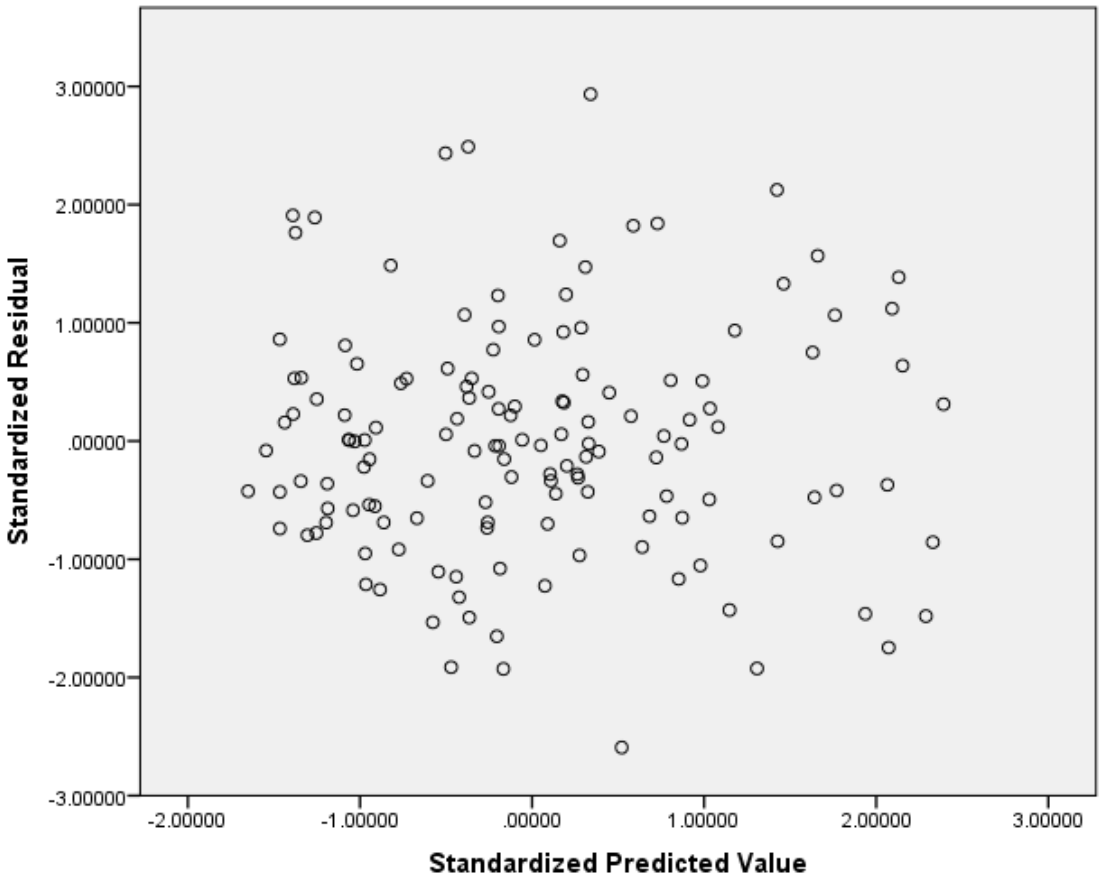
Table 9: Homoscedasticity

Correlations

		Unstandardized Predicted Value	ABS_RESID
Unstandardized Predicted Value	Pearson Correlation	1	.156
	Sig. (2-tailed)		.064
	N	142	142
ABS_RESID	Pearson Correlation	.156	1
	Sig. (2-tailed)	.064	
	N	142	142

In addition to the technique applied previously, a scatterplot is utilised to visually inspect for the presence of undesired patterns (e.g. curve, fanning effect). Figure 6 shows a scatterplot with no systematic patterns. This confirms the results from the correlation statistics, thus the homoscedasticity assumption of the regression model is satisfied.

Figure 6: Homoscedasticity post-test diagnostic



To evaluate the normality assumption for data sets that are larger or equal to 50 values, the result from the Kolmogorov-Smirnov test is examined (O'Donoghue, 2013). The result from the statistical test in Table 10 is not statistically significant (p = 0.200) at the 0.05 level. Thus the residuals from the regression model met the assumption of a normal distribution.

Table 10: Test of normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.060	142	.200*	.990	142	.400

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The procedure to validate the regression is twofold. First, two random subsamples of the data set were generated to confirm that there are not noteworthy differences across R squares, adjusted R squares and the standard error of estimates (Hair Jr et al., 1995). Second, a cross-validation was undertaken by splitting the dataset of 142 countries in two random samples to examine the correlation between predicted values and actual values from the dataset (Stevens, 2009).

As shown in Figure 7, the R square, adjusted R square, and standard error of estimates compares satisfactorily across the regression models. This was further verified by means of cross-validation. The results in Figure 8 for the derivation sample show a significant correlation between predicted and sophistication values ($r = 0.762$, $p < 0.05$). In addition, in agreement with the derivation sample, the correlation of the other part of the dataset shows a significant correlation between predicted and sophistication values ($r = 0.717$, $p < 0.05$). This confirms the utility of this model in the prediction of values beyond the data set assembled for this study.

Figure 7: Model validation – R squares

Model summary from all observations, split 1 and split 2.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.761[a]	.579	.564	.1229833

a. Predictors: (Constant), HCap, PressF, Corrup, Infrast, GDP

Model Summary

Model	R split1 = .00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.789[a]	.622	.591	.1282144

a. Predictors: (Constant), HCap, PressF, Corrup, Infrast, GDP

Model Summary

Model	R split2 = .00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.779[a]	.607	.583	.1290215

a. Predictors: (Constant), HCap, PressF, Corrup, Infrast, GDP

Figure 8: Correlation results from cross-validation

Correlations

		PRED	Sophisticatio n
PRED	Pearson Correlation	1	.762**
	Sig. (2-tailed)		.000
	N	81	81
Sophistication	Pearson Correlation	.762**	1
	Sig. (2-tailed)	.000	
	N	81	81

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		PRED	Sophisticatio n
PRED	Pearson Correlation	1	.717**
	Sig. (2-tailed)		.000
	N	61	61
Sophistication	Pearson Correlation	.717**	1
	Sig. (2-tailed)	.000	
	N	61	61

**. Correlation is significant at the 0.01 level (2-tailed).

The diagnostic examinations indicate that the data set utilised in the regression analysis has no significant assumptions violations. Therefore, this supports the appropriateness of the regression model.

4.2.2 Multivariate linear regression

The results from the regression model indicates (see Table 11) that only ICT infrastructure (β = 0.478, p <0.05) and human capital (β = 0.273, p <0.05) are statistically significant indicators influencing the sophistication of e-government. GDP per capita (β = -0.005, *N.S*), corruption control (β = 0.151, *N.S*), and press freedom (β = 0.001, *N.S*), do not have a statistically significant effect on e-government sophistication. The adjusted R square is 0.564, thus the predictors in this regression model explain 56.4% of the e-government sophistication variance. The resultant adjusted R square of 0.564 met the prediction power at the 0.05 level of statistical significance (Hair Jr et al., 1995).

Table 11: Results from the regression analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.761[a]	.579	.564	.1229833

a. Predictors: (Constant), HCap, PressF, Corrup, Infrast, GDP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.834	5	.567	37.481	.000[b]
	Residual	2.057	136	.015		
	Total	4.891	141			

a. Dependent Variable: Sophistication

b. Predictors: (Constant), HCap, PressF, Corrup, Infrast, GDP

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.116	.104		-1.119	.265	-.321	.089
	Infrast	.478	.123	.511	3.901	.000	.236	.721
	GDP	-.005	.039	-.016	-.120	.904	-.081	.072
	Corrup	.151	.099	.155	1.525	.130	-.045	.348
	PressF	.001	.001	.109	1.672	.097	.000	.002
	HCap	.273	.101	.235	2.705	.008	.073	.472

a. Dependent Variable: Sophistication

4.2.3 Kruskal-Wallis analysis

The statistics tests from the Kruskal-Wallis analysis show that ICT Infrastructure (chi-square = 59.280, p = 0.000), GDP per capita (chi-square = 53.122, p = 0.000), corruption control (chi-square = 46.556, p = 0.000), press freedom (chi-square = 13.627, p = 0.001) and human capital (chi-square = 50.222, p = 0.000) are statistically significant at the 0.05 level (see Table 12). Since the results from the Kruskal-Wallis analysis shows statistical significance, a post hoc Mann-Whitney test is undertaken to examine how the paired groups contribute to these differences.

Table 12: Kruskal-Wallis test results

Test Statistics[a,b]

	Infrast	GDP	Corrup	PressF	HCap
Chi-Square	59.280	53.122	46.556	13.627	50.222
df	2	2	2	2	2
Asymp. Sig.	.000	.000	.000	.001	.000

a. Kruskal Wallis Test

b. Grouping Variable: Sophistication

The results from the post hoc Mann-Whitney test between low and medium degrees of sophistication show that ICT Infrastructure (Z = -6.629, p = 0.000), GDP per capita (Z = -6.249, p = 0.000), corruption control (Z= -5.663, p = 0.000), press freedom (Z = -3.296, p = 0.001) and human capital (Z = -6.203, p = 0.000) are statistically significant at the 0.05 level (see Table 13).

Table 13: Post hoc groups 1 (low) and 2 (medium)

Test Statistics[a]

	Infrast	GDP	Corrup	PressF	HCap
Mann-Whitney U	586.000	666.000	790.000	1287.000	675.500
Wilcoxon W	4502.000	4582.000	4706.000	2322.000	4591.500
Z	-6.629	-6.249	-5.663	-3.296	-6.203
Asymp. Sig. (2-tailed)	.000	.000	.000	.001	.000

a. Grouping Variable: Sophistication

The results from the post hoc Mann-Whitney test between medium and high degrees of sophistication show that only ICT Infrastructure (Z = -3.075, p = 0.002), GDP per capita (Z = -2.925, p = 0.003) and corruption control (Z= -2.729, p = 0.006) are statistically significant at the 0.05 level (see Table 14). Press freedom (Z= -0.732, p = 0.464) and human capital (Z = -1.938, p = 0.053) are not statistically significant.

Table 14: Post hoc groups 2 (medium) and 3 (high)

Test Statistics[a]

	Infrast	GDP	Corrup	PressF	HCap
Mann-Whitney U	70.000	76.500	85.000	171.000	119.000
Wilcoxon W	1105.000	1111.500	1120.000	216.000	1154.000
Z	-3.075	-2.925	-2.729	-.732	-1.938
Asymp. Sig. (2-tailed)	.002	.003	.006	.464	.053

a. Grouping Variable: Sophistication

Finally, the results from the post hoc Mann-Whitney test between low and high degrees of sophistication show that ICT Infrastructure (Z = -4.725, p = 0.000), GDP per capita (Z = -4.514, p = 0.000), corruption control (Z= -4.525, p = 0.000), press freedom (Z = -2.182, p = 0.029) and human capital (Z = -4.340, p = 0.000) are statistically significant at the 0.05 level (see Table 15).

Table 15: Post hoc groups 1 (low) and 3 (high)

Test Statistics[a]

	Infrast	GDP	Corrup	PressF	HCap
Mann-Whitney U	16.000	33.000	32.500	220.500	47.000
Wilcoxon W	3932.000	3949.000	3948.500	265.500	3963.000
Z	-4.725	-4.514	-4.525	-2.182	-4.340
Asymp. Sig. (2-tailed)	.000	.000	.000	.029	.000

a. Grouping Variable: Sophistication

4.3 Chapter conclusion

A multivariate linear regression and Kruskal-Wallis analyses have been undertaken for testing the ten hypotheses posited in Chapter 2. Before proceeding to the discussion of the regression results, the collinearity assumption, residuals autocorrelation, homoscedasticity, normality conditions and the validation of the regression model were

examined. Based on this preliminary analysis, no issues with the test assumptions were noted. Therefore, the regression analysis was carried utilising all the proposed predicting variables drawn from the literature on e-government. The results from the regression analysis found that ICT infrastructure and human capital influence the sophistication of e-government. Whilst GDP per capita, corruption control and press freedom were not supported predictors.

For the second part of the analysis, a Kruskal-Wallis test was utilised to examine how the indicators of technological, economic and institutional factors in the assembled data sets contrast across high, medium and low degree of sophistication. The results from the Kruskal-Wallis test indicated that ICT infrastructure, GDP per capita, corruption control, press freedom and human capital contrast across high, medium and low degrees sophistication. A post hoc Mann-Whitney test was conducted to understand which groups contributed to these significant differences. Except for press freedom and human capital, the results from the post hoc analysis show that ICT Infrastructure, GDP per capita, and corruption control contrast across all groups. The Mann-Whitney statistics for press freedom and human capital indicated that there are no statistical differences between the high and medium degrees of sophistication groups. Statistically significant differences were observed for press freedom and human capital between low-medium and the high-low groups. These findings are examined in further detail
in Chapter 5.

Chapter 5 Discussion

5.1 Chapter overview

Motivated by gaps found in the literature on what influences the sophistication of e-government, Chapter 1 introduced the research questions that were examined in this study. In order to answer these research questions, the literature review in Chapter 2 provided support to the development of the hypotheses and the research models. The methodology was explained in Chapter 3, and the results from the hypotheses testing were presented in Chapter 4. The purpose of this chapter is to answer the research questions based on the results from the hypotheses testing. This chapter concludes by examining, in detail, the results from each of the indicators of technological, economic and institutional factors.

5.2 Hypothesises summary and answers to the research questions

The purpose of this research was to examine the influence from indicators of technological, economic and institutional factors on the sophistication of e-government, and what differences exist between them across degrees of sophistication. The sophistication process in this study was analysed considering the technological development of e-government. This research considered specifically a combination of indicators of technological, economic and institutional factors. These indicators are highlighted in the literature as gauges of the sophistication of e-government. For the first part of the analysis, it was hypothesised that the indicators ICT infrastructure, GDP per capita, corruption control, press freedom and human capital influence the sophistication of e-government. For the second part, this study hypothesised that these indicators are not different across levels of e-government sophistication. Tables 16 and 17 summarises the results from the hypotheses testing.

Table 16: Regression analysis summary of hypotheses testing

Hypothesis	Variable	Significance*
H1	ICT infrastructure	Supported
H3	GDP per capita	Not supported

* At 5% level of statistical significance

Table 16: Regression analysis summary of hypotheses testing (continued)

Hypothesis	Variable	Significance*
H5	Corruption control	Not supported
H7	Press freedom	Not supported
H9	Human capital	Supported

* At 5% level of statistical significance

Table 17: Kruskal-Wallis summary of hypotheses testing

Hypothesis	Variable	Significance*	Post hoc test significance*
H2	ICT infrastructure	Not supported	Not supported across all groups
H4	GDP per capita	Not supported	Not supported across all groups
H6	Corruption control	Not supported	Not supported across all groups
H8	Press freedom	Not supported	Supported for medium-high Not supported for Low-high, Low-medium
H10	Human capital	Not supported	Supported for medium-high Not supported for Low-High, Low-Medium

* At 5% level of statistical significance

The regression model provided support for Hypotheses 1 (ICT Infrastructure) and 9 (Human capital). Whilst, Hypotheses 3 (GDP per capita), 5 (Corruption control) and 7 (Press freedom) were not supported. This shows that within the context of the fitted regression model in this study, only ICT infrastructure and human capital significantly influence the sophistication of e-government.

For the Kruskal-Wallis analysis, Hypotheses 2 (ICT Infrastructure), 4 (GDP per capita), 6 (Corruption control), 8 (Press freedom) and 10 (Human capital) were not supported. A post hoc analysis utilising a Mann-Whitney test indicates that differences exist across all groups, except for press freedom and human capital, which show no statistically

significant differences between high and medium degrees of sophistication. In summary, except for no differences of press freedom and human capital between the high and medium groups, there are statistical differences on the indicators of technological, economic and institutional factors across the three groups.

The results from the unconfirmed hypotheses should not be held, as these factors are not essential for the sophistication of e-government. These results are presented within the context of the secondary data assembled, corresponding to the year 2010 and thus, the hypothesised models utilised for this study are not intended to establish causation. More specifically, these indicators represent a snapshot of the data set for the year 2010, and the changes over time for these variables is beyond the scope of this study. Thus, direct causality should not be assumed from neither confirmed nor unconfirmed hypotheses. The results for each prediction variable are further examined in the next sections.

5.2.1 ICT infrastructure

The regression results support ICT infrastructure as a significant influencing indicator for the sophistication of e-government. This is not implying that ICT infrastructure is an immediate solution to the issue of e-government sophistication. What it provides is some insight of an indicator that requires a closer examination in future studies. In other words, although not the only underlying cause, the result provides some statistical support to highlight the importance that the indicator ICT infrastructure plays in the sophistication of e-government. These results lend support to prior studies on e-government where similar results for this relationship have been observed (Azad et al., 2010; Das et al., 2011; Ifinedo, 2012a, 2012b; Ifinedo & Singh, 2011; Singh et al., 2007; Srivastava & Teo, 2010). In particular, the results upkeep the argument from prior research, which point toward investments in ICT infrastructure as a pathway to the sophistication of e-government (Das et al., 2011).

The results from the Kruskal-Wallis analysis show that the indicator ICT infrastructure is significantly different across high, medium and low degrees of sophistication. The unconfirmed hypothesis for the second part of the analysis should not be interpreted, as there could not be cases of countries with similar levels of ICT infrastructure, but with different degrees of e-government sophistication. What this shows is that in statistical terms, in the 142 countries considered for this study the differences across the three groups are stronger than the possible similarities. Thus, there could still be cases of

countries with the same ICT infrastructure but showing different levels of success with e-government. However, within the context of this study the differences across groups were in statistical terms more likely to occur. Still, the combination of results for the indicator ICT infrastructure support that the differences across groups are likely to influence the sophistication of e-government. Therefore, a closer examination considering a specific country or region is recommended as an opportunity for further research. This closer examination would help understand, for example, the underlying causes for those countries observed by Dada (2006) where ICT infrastructure is not different from others, but still they are showing different levels of success with the use of e-government.

5.2.2 Results and discussion: Human capital

Human capital, as well as ICT infrastructure, is highlighted by the regression analysis as a significant indicator for the sophistication of e-government. Whilst not suggesting that the influence of human capital acts alone in this process, the relation between human capital and e-government has been observed in countries in eastern Europe, where countries with a better educated population tend to have higher levels of e-government sophistication (Ifinedo, 2012b). The results from this analysis lend support to the findings from prior researchers (Ifinedo, 2012a, 2012b; Ifinedo & Singh, 2011; Siau & Long, 2009; Srivastava & Teo, 2010). A plausible explanation for this can be seen through the lenses of the Layne and Lee (2001) sophistication model. When e-government matures, it evolves into a more complex technological platform, thus a specialised and better-trained workforce would be required to support and manage this increasing complexity.

On the other hand, the Kruskal-Wallis analysis shows that human capital is different across degrees of sophistication, except between the groups with medium and high degrees of sophistication that show no statistical differences. This lends partial support to the argument that some countries might show similar levels of human capital development, but with different levels of e-government sophistication. In addition, the result also shows, as indicated in the regression analysis, that these differences influence the sophistication of e-government. This result suggests that the indicator human capital requires a closer examination in future studies. For example, as mentioned before, Armenia and Tonga show human capital components at the same level as those countries with high e-government sophistication but unequal levels of e-government sophistication.

This paradox presents an opportunity for further research. Thus, future research should examine specific cases to study the relationship between human capital and e-government sophistication within a specific country or region. This closer examination would help understand the underlying causes for those countries, where their human capital development is not different from others, but they are showing different levels of success with the sophistication of e-government.

5.2.3 GDP per capita

The regression analysis did not provide support for the indicator GDP per capita as an indicator influencing the sophistication of e-government. This result lends evidence to support studies from researchers who argued that the sophistication of e-government goes beyond countries' economic conditions (Azad et al., 2010; Weerakkody et al., 2011). However, the literature also shows the existence of an ongoing debate in the study of the relationship between GDP per capita and the sophistication of e-government. Most notably, several studies support a positive relationship between GDP per capita and the development of e-government (Das et al., 2011; Ifinedo, 2012b), whilst there are studies that show non-significant contributions from the economic context (Azad et al., 2010; Ifinedo, 2012b). An answer to these contrasting views might be found in how the variable GDP per capita has been traditionally utilised by these studies. Specifically, an approach for future examination could evaluate the relationship between investments destined specifically to e-government projects and its development. The discussion in the second part of this analysis brings some insights for reasoning in more detail into this ongoing debate.

In contrast to the results in the first part of the examination, the analysis shows differences across high, medium and low degrees of sophistication. This sequence of results suggests that countries might show different economic conditions across degrees of sophistication, but as noted from the regression analysis, this does not necessarily translate into an influence in the sophistication of e-government. In other words, wealthier countries might have the potential to capitalise on more sophisticated e-government platforms, and as noted from the analysis, there might be differences across degrees of sophistication. However, these results suggest that having the economic means is not necessary conducive to better e-government. The contrary is also possible, where countries with a lower GDP per capita might show a high level of e-government sophistication. Paradoxes

like this one are opportunities for future research. For example, a closer examination of the dataset shows that although Colombia, at the time the data was collected, has the lowest GDP per capita in 2010 (GDP = USD6220.60), it has a high level of e-government sophistication.

However, these results should not be interpreted as though GDP per capita has no role on the sophistication of e-government. These results on the influence of GDP per capita should be considered within the context of the analysed model, as other factors beyond the scope of this research might mediate the relationship between GDP per capita and the development of e-government.

5.2.4 Corruption control

The regression analysis did not provide statistical evidence to support corruption control as an indicator that influences the sophistication of e-government. This result is in agreement with the findings from prior researchers (Ifinedo, 2012a; Ifinedo & Singh, 2011). A closer examination of the dataset utilised for this study shows several noteworthy cases of the aforementioned situation. For example, Bahrain and Colombia, three top ranked e-government developed countries, according to the United Nations e-government survey report (2010), show perception of corruption control scores of 4.9 and 3.5, respectively, on a scale of 1 (more corrupted) to 10 (less corrupted). In other words, these examples show that although these countries have high levels of developed e-government services, they rank on the low side of the corruption perception scale.

The Kruskal-Wallis analysis for the indicator corruption control shows significant differences across high, medium and low degrees of sophistication. These differences are observed across all group combinations. The coupled evidence from both parts of this study suggests that a country might show different levels of corruption perception across groups. However, it is not likely that these differences across groups influence the sophistication of e-government as noted by the results in the regression analysis. Thus, there is no clear indication of the influence from the indicator corruption on the sophistication of e-government. These results should not be generalised as suggesting that government control of corruption exercises no role in the sophistication of e-government. What has been suggested is that the relationship between the control of corruption and e-government needs to be examined within the context of the country or region under study.

More clearly, there might be other factors influencing the relationship between corruption perception and e-government sophistication that are not evident when the aggregated data of several countries around the globe is examined as a single unit of study.

5.2.5 Press freedom

The regression analysis did not provided support for the indicator press freedom as an influence in the sophistication of e-government. In other words, a decrease of the indicator, which in the context of this study signifies better press freedom, does not show significant influence over the sophistication of e-government. This lends support to the argument from prior researchers, who argue that e-government is not an immediate solution to the issue of openness and transparency (Wong & Welch, 2004). Whilst the findings from some researchers have supported the indicator press freedom (Azad et al., 2010) , others have not supported it as an indicator of e-government sophistication (Ifinedo & Singh, 2011).

The second part of the analysis indicates that differences across groups for press freedom are significant, except between the groups with medium and high degrees of sophistication. This combination of results does not provide statistical support to suggest that differences or similarities across groups influence the sophistication of e-government. However, as noted by the results between the groups of medium and high, there is partial support to the viewpoint that countries might show similar levels of press freedom, but different sophistication levels. These results are not implying that the adoption of press freedom does not play a role in the sophistication of e-government. The coupled evidence from both parts suggests that differences or similarities on the perception of press freedom across sophistication groups do not necessarily translate into higher levels of e-government sophistication.

5.3 Chapter Conclusion

The results from testing each variable in the hypothesised model were examined and the research questions were answered. This chapter also unravelled the complexities involved in analysing what influences the sophistication of e-government when cross-sectional data is utilised.

Some new perspectives were provided, specifically from the analysis across different levels of sophistication. This chapter highlighted the importance of conducting future studies on e-government at a country or regional level. This closer examination at the country or regional level would help disentangle the specific socioeconomic and technological circumstances that might influence the sophistication of e-government.

Chapter 6 Conclusion

6.1 Chapter overview

This study employed a cross-sectional study design to the analysis of what influences the sophistication of e-government. Above all, this research was motivated by the disparity of results across e-government studies and by the lack of studies guiding an examination across different degrees of e-government sophistication. In the attempt to examine these gaps in the literature, publicly recent secondary sources of data were utilised. A linear regression analysis was undertaken in the first part of the study to examine the influence of indicators of technological, economic and institutional factors. The results from the analysis provided support to ICT infrastructure and human capital as significant indicators of e-government sophistication. No support was provided for the indicators GDP per capita, corruption control and press freedom as significant contributors of the sophistication of e-government.

In order to examine these indicators of technological, economic and institutional factors with greater granularity, a Kruskal-Wallis test was undertaken. Except for press freedom and human capital, differences across all groups were found for the indicators ICT infrastructure, GDP per capita, and corruption control. The observed paradoxes lead this study to suggest that for future research, government institutions and policymakers would benefit from exploring these indicators of technological, economic and institutional factors within specific country or regional circumstances.

6.2 Limitations

There are some inherent limitations in the use of sources of secondary data as the ones employed in this cross-sectional study. Researchers have recognised limitations, most noteworthy the selection bias, the lack of control over the development of variables, and missing potentially significant variables from the research model (Azad et al., 2010; Das et al., 2011; Ifinedo, 2012a; Kovacic, 2005). Nonetheless, this study has justified the appropriateness of the methods employed, thus it is plausible to consider that the results meet academic rigor. Notwithstanding, in order to consider opportunities for future research, a discussion of these limitations is well deserved. These limitations are examined in more detail as follows.

First, the selection bias is an expected effect that might result from the process of assembling a dataset from disparate sources of secondary data (Kovacic, 2005). The reason for this is that countries are selected, conditioned to the availability of data across all prediction variables, and depend on how well the data meet the assumptions in the regression model. Therefore, some countries are left out from the analysis, as not all data meets these conditions. Some researchers (Azad et al., 2010) have suggested that in order to avoid leaving countries out of the analysis, alternative sources of secondary data should be considered. However, it was not possible to undertake that course of action in this study. As this research was intended to incorporate the most recent data, not every variable, at the best of the author's knowledge, has a source of reputable secondary data publicly available corresponding to the year 2010. Still, considering the representative number of countries included in the data set, it is practical then to consider that the effect from the selection bias in this study is from minimal to marginal.

Second, a limitation underscored from the use of secondary data is the researcher lack of involvement in the variables definition process (Ifinedo, 2012a). This distance between the researcher and the secondary data makes it impractical for the researcher to define the soundness of the indexes and scores for the various variables (Ifinedo, 2012a). Variables are already defined by the secondary sources of data, and thus, the researcher is incapable of getting involved in the specificity and validity design of these measurements. For example, ICT infrastructure is utilised in this study to assess a country's communication and information infrastructure. Whilst the indicator is properly operationalised, a holistic view of this variable involves recognising that a country's infrastructure goes beyond its ICT infrastructure and encompasses infrastructure that might affect citizens wellbeing (e.g. electrical infrastructure) (Dada, 2006). Likewise, a lack of standardisation (e.g. uniform security protocols) across a country's infrastructure platform might impede the development of e-government (Weerakkody et al., 2011). It is therefore suggested that greater specificity is needed to examine the relationship between infrastructure and the sophistication of e-government.

A similar simplification occurs with the variables human capital and GDP per capita. Instead of employing overarching measurements for these variables, it will be more sensible to study how different levels of educational attainment influence its sophistication. Likewise, an examination of GDP per capita in terms of ICT investments

could lessen the uncertainty of the actual relationship between economic conditions and the sophistication e-government. Therefore, it is not always feasible to operationalise variables in narrower or more specific terms when secondary sources of data are utilised. In this study, the lack of control over the variables definition was minimised by selecting independent variables that show a theoretical relationship with the dependent variable (Hair Jr et al., 1995).

Third, a series of transformations were employed in this study. Transformations can be used to meet the statistical tests assumptions (e.g., improve linearity and/or reduce variation), however, one must be careful in the interpretation from these transformations (Hair Jr et al., 1995). The interpretation of how much change is influenced by a transformed variable in the dependent variable must be taken with caution. However, this study was concerned in understanding the influences from the independent variables and the examination of these variables across degrees of sophistication, and not in the interpretation of the amount of variation.

Lastly, since e-government could evolve over time, cross-sectional studies do not account for these changes, thus leading to potentially missing information in the research model (Das et al., 2011). Future studies might offset the limitation by employing, if possible, a longitudinal approach. Even with these limitations, cross-sectional studies offer a practical and plausible scholarly approach to examine a research problem as a snapshot bounded to the context of the selected timeframe. The following section considers opportunities for future research.

6.3 Implications for research and practice

Having tested the hypothesised model, the results from this study have contributed with a scholarly understanding of the influence from indicators of technological, economic and institutional factors on the sophistication of e-government. Several directions for future research have emerged from this analysis. First, although global studies utilising secondary data can provide valuable information on the state of e-government, an analysis at the country or regional level can help unravel the specific circumstances on what influences the sophistication of e-government. In particular, studies focused on a country or region provide with a higher level of granularity that is not possible to achieve through global studies employing secondary data. For example, several countries show e-

government platforms on high levels of sophistication under non-optimal economic and institutional conditions. Specifically, there are cases where highly developed e-government services are noted in countries indicating lower levels of transparency (e.g. Singapore, Bahrain, and Colombia). Also, there are examples of countries with incidents to silence the media (e.g. Bahrain and Colombia), but still these countries show high levels of e-government sophistication. These noted paradoxes suggest that there are potentially other factors mediating the sophistication of e-government that must be considered in future studies. Therefore, going beyond this study encourages other researchers to examine the sophistication of e-government at the country or regional level to disentangle these apparent contradictions.

Second, going forward future research should consider definitions of the indicators of technological, economic and institutional factors with a higher degree of specificity. For example, in examining a country's infrastructure, this variable should consider not only ICT infrastructure, but also other levels of infrastructure (e.g., roads, transportation facilities) that might affect a citizen's activities and pose an impediment to the use of e-government. Another example of this lack of specificity is human capital. Future studies should consider this variable from a different viewpoint, recognising that the diverse levels of educational attainment might potentially influence the demand and supply for e-government services. In other words, operationalising human capital as different variables to examine how different educational attainment levels influence the sophistication of e-government.

Lastly, a country's wealth should be considered, in terms of actual investment on e-government. Governments might possess the financial and economic conditions, but it is important to understand how these resources are utilised specifically in the context of e-government services. However, it is not always possible to add specificity to the study variables, more evidently when sources of secondary data are utilised. For all of the reasons stated above, this study argues that global studies should be utilised as a starting point, whilst future studies should contemplate collecting primary data bounding the research to the context of a specific country or region.

There are also practical implications. Government administrators and policymakers should prioritise a closer examination of the indicators ICT infrastructure and human capital. More specifically, governments should consider how their institutional environment provides support to their ICT infrastructure and human capital development

efforts. In addition, governments should not compare their national e-government initiatives with other countries based only on technological and economic conditions. Although technological and economic conditions offer some basic points of reference as to conduct comparisons, each country has specific social, political and cultural circumstances that might influence the sophistication of e-government.

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Appendix 1- Linear regression analysis data set (untransformed)

Data sources:

United Nations e-government survey report (2010), International Monetary Fund (2010), Reporters Without Borders (2010), Transparency International (2010)

Country Name	Sophistication	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Albania	0.3111	0.1629	3616.097	0.886	21.5	3.3
Algeria	0.0984	0.1248	4477.798	0.7377	47.33	2.9
Angola	0.3397	0.045	4812.226	0.5473	28.5	1.9
Argentina	0.4127	0.2811	8662.986	0.9502	16.35	2.9
Armenia	0.1746	0.128	2676.517	0.9117	27.5	2.6
Austria	0.4762	0.5736	43723.317	0.9598	0.5	7.9
Azerbaijan	0.3238	0.1329	5764.702	0.9185	56.38	2.4
Bahrain	0.7302	0.5855	19641.188	0.8932	51.38	4.9
Bangladesh	0.3556	0.033	640.847	0.5182	42.5	2.4
Belarus	0.3016	0.208	5606.782	0.9659	57	2.5
Belgium	0.6254	0.5697	42596.55	0.9751	4	7.1
Benin	0.1175	0.0454	673.439	0.4447	19	2.8
Bhutan	0.1873	0.0619	2042.169	0.5324	17.75	5.7
Bolivia	0.3048	0.0914	1839.749	0.8914	28.13	2.8
Bosnia & Herzegovina	0.2762	0.2504	4157.505	0.8885	13.5	3.2

Country Name	Sophistication	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Botswana	0.2	0.108	6795.931	0.788	17.5	5.8
Brazil	0.3683	0.2538	10470.898	0.8837	16.6	3.7
Brunei Darussalam	0.2825	0.2703	28340.041	0.8917	51	5.5
Bulgaria	0.4095	0.337	5954.724	0.935	19	3.6
Burundi	0.0413	0.009	177.663	0.5587	28.88	1.8
Cambodia	0.1365	0.0297	795.034	0.7019	43.83	2.1
Cameroon	0.1524	0.0411	1071.406	0.6268	44.3	2.2
Cape Verde	0.2698	0.1645	3007.42	0.7858	8	5.1
Chile	0.6095	0.271	11587.092	0.9232	10.5	7.2
China	0.3683	0.1912	4282.894	0.8535	84.67	3.5
Colombia	0.7111	0.2421	6220.604	0.8813	51.5	3.5
Comoros	0.0286	0.0203	819.77	0.6553	19	2.1
Costa Rica	0.3048	0.2423	7350.236	0.8826	8.08	5.3
Côte d'Ivoire	0.3238	0.0622	1016.255	0.454	36	2.2
Croatia	0.4222	0.422	13527.658	0.9181	17.5	4.1
Czech Republic	0.454	0.4258	18721.626	0.9429	7.5	4.6
Djibouti	0.0476	0.0148	1382.134	0.5599	30.5	3.2
Dominican Republic	0.3651	0.1657	5152.047	0.8391	26.13	3
Ecuador	0.3175	0.1595	4295.635	0.823	27.5	2.5
Egypt	0.5302	0.1255	2771.414	0.6973	43.33	3.1
El Salvador	0.4254	0.1923	3717.062	0.7935	15.83	3.6
Equatorial Guinea	0.0317	0.06	11080.862	0.7868	79	1.9

Country Name	Sophistication	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Eritrea	0.0222	0.0113	423.498	0.529	105	2.6
Estonia	0.5016	0.6272	14416.523	0.9666	2	6.5
Ethiopia	0.2	0.0073	364.872	0.4027	49.38	2.7
France	0.6825	0.5953	40591.434	0.9772	13.38	6.8
Gabon	0.0794	0.111	8395.303	0.8436	28.75	2.8
Gambia	0.0825	0.0955	605.872	0.4609	40.5	3.2
Georgia	0.2476	0.1164	2559.692	0.9156	27	3.8
Germany	0.5492	0.6955	40511.825	0.9533	4.25	7.9
Ghana	0.1492	0.0592	761.978	0.6215	8	4.1
Greece	0.3556	0.3828	27264.83	0.9803	19	3.5
Guatemala	0.3079	0.1528	2839.029	0.7229	20.25	3.2
Guinea-Bissau	0.0159	0.0358	497.656	0.4206	18.25	2.1
Guyana	0.181	0.1284	2844.299	0.9395	16.63	2.7
Haiti	0.019	0.0669	659.058	0.542	16.38	2.2
Honduras	0.2952	0.1268	2014.695	0.8007	51.13	2.4
Hungary	0.5048	0.4338	13210.402	0.9597	7.5	4.7
Iceland	0.3968	0.6394	39562.893	0.9811	0	8.5
India	0.3683	0.0583	1176.062	0.6432	38.75	3.3
Indonesia	0.2444	0.1142	2963.284	0.854	35.83	2.8
Iran (Islamic Republic of)	0.2667	0.2157	4484.44	0.7926	94.56	2.2
Iraq	0.1524	0.0552	2625.502	0.6955	45.58	1.5
Israel	0.5841	0.4333	27085.13	0.9501	23.25	6.1
Italy	0.2889	0.4914	33828.552	0.9683	15	3.9
Jamaica	0.2286	0.2819	5055	0.836	7.67	3.3

Country Name	Sophistication	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Japan	0.673	0.5241	42325.232	0.9496	2.5	7.8
Jordan	0.5333	0.1806	4434.861	0.8694	37	4.7
Kazakhstan	0.527	0.1796	8326.453	0.9677	68.5	2.9
Kenya	0.2381	0.0636	887.923	0.7026	19	2.1
Kuwait	0.4603	0.2523	32530.479	0.8764	23.75	4.5
Kyrgyzstan	0.3175	0.0917	816.22	0.9196	63	2
Lao People's Democratic Republic	0.0794	0.0329	984.153	0.6844	80.5	2.1
Latvia	0.4159	0.3762	10377.782	0.9608	8.5	4.3
Lebanon	0.2667	0.1964	10019.026	0.8583	20.5	2.5
Lesotho	0.2635	0.0399	707.956	0.7528	24	3.5
Liberia	0.0635	0.0189	226.683	0.5621	22.5	3.3
Lithuania	0.4825	0.4413	10765.341	0.9691	2.5	5
Luxembourg	0.381	0.7137	104390.269	0.9156	4	8.5
Madagascar	0.1651	0.03	391.082	0.6757	34.88	2.6
Malawi	0.0159	0.0181	354.271	0.6797	21	3.4
Malaysia	0.6317	0.3437	7754.988	0.8542	50.75	4.4
Maldives	0.1619	0.2885	4478.087	0.8754	16	2.3
Malta	0.4698	0.4862	18586.225	0.887	4	5.6
Mauritania	0.0889	0.0798	1096.336	0.5434	25.38	2.3
Mauritius	0.2952	0.2646	7303.315	0.8388	18	5.4
Mexico	0.4413	0.2161	9243.029	0.8898	47.5	3.1
Mongolia	0.5556	0.1036	2111.257	0.9127	19.42	2.7
Morocco	0.2381	0.1768	2868.147	0.5739	47.4	3.4

Country Name	Sophistication	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Mozambique	0.1714	0.025	473.098	0.4918	26.5	2.7
Namibia	0.0667	0.1219	5454.39	0.8135	7	4.4
Nepal	0.1683	0.0226	536.031	0.582	36.38	2.2
Netherlands	0.6794	0.7666	46418.334	0.987	0	8.8
Nicaragua	0.254	0.0757	1096.131	0.7625	22.33	2.5
Nigeria	0.0952	0.0593	1324.337	0.6567	51.5	2.4
Norway	0.7365	0.683	84543.435	0.9884	0	8.6
Oman	0.3683	0.2091	18040.539	0.798	40.25	5.3
Pakistan	0.2476	0.077	1049.31	0.5025	56.17	2.3
Panama	0.2825	0.2201	7712	0.8884	21.83	3.6
Papua New Guinea	0.073	0.0228	1358.427	0.521	13.33	2.1
Paraguay	0.2635	0.1433	2681.644	0.8711	16.25	2.2
Peru	0.4095	0.1789	5195.977	0.8911	30	3.5
Philippines	0.3937	0.1115	2011	0.8881	60	2.4
Poland	0.3873	0.3373	11521.637	0.9551	8.88	5.3
Portugal	0.3873	0.4189	21030.607	0.9356	12.36	6
Qatar	0.2794	0.3168	74422.604	0.8886	38	7.7
Republic of Moldova	0.2952	0.1933	1503.157	0.8999	19.13	2.9
Romania	0.4159	0.3092	7390.707	0.9226	16	3.7
Russian Federation	0.3302	0.2765	10521.786	0.9396	49.9	2.1
Rwanda	0.1746	0.0203	569.389	0.6329	81	4
Samoa	0.1429	0.0818	3023.236	0.9049	33	4.1

Country Name	Sophistication	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Saudi Arabia	0.3111	0.4031	16641.407	0.8346	61.5	4.7
Senegal	0.1778	0.071	964.133	0.425	25	2.9
Serbia	0.2222	0.2694	5262.189	0.891	23	3.5
Seychelles	0.0571	0.3036	10713.718	0.9038	18	4.8
Sierra Leone	0.0032	0.0179	324.996	0.4931	24.25	2.4
Singapore	0.6857	0.6386	42652.759	0.9203	47.5	9.3
Slovakia	0.346	0.4211	15906.378	0.931	11.5	4.3
Slovenia	0.4	0.5025	23008.587	0.977	13.44	6.4
South Africa	0.3079	0.1443	7100.809	0.8432	12	4.5
Spain	0.7651	0.51	29875.089	0.9792	12.25	6.1
Sri Lanka	0.2603	0.1081	2364.623	0.8342	62.5	3.2
Sudan	0.1556	0.071	1642.75	0.5388	85.33	1.6
Swaziland	0	0.0612	3072.831	0.7742	57.5	3.2
Sweden	0.527	0.7522	47667.019	0.9698	0	9.2
Switzerland	0.4444	0.7687	67074.31	0.9358	0	8.7
Syrian Arab Republic	0.0413	0.1208	2892.021	0.7768	91.5	2.5
Tajikistan	0.0889	0.0614	732.137	0.9005	34.5	2.1
Thailand	0.3333	0.1746	4620.705	0.8919	56.83	3.5
The former Yugoslav Republic of Macedonia	0.3206	0.3804	4633.971	0.8835	18.4	4.1
Timor-Leste	0.1333	0.0067	536.024	0.5445	25	2.5
Togo	0.0698	0.0453	441.429	0.5341	17	2.4

Country Name	Sophistication	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Tonga	0.0698	0.1269	2907.1	0.9212	23.75	3
Tunisia	0.4825	0.1941	4159.921	0.771	72.5	4.3
Turkey	0.346	0.2581	10206.788	0.8338	49.25	4.4
Uganda	0.1016	0.0479	503.89	0.6996	25.5	2.5
Ukraine	0.346	0.2486	3002.8	0.9647	46.83	2.4
United Arab Emirates	0.2508	0.5434	47406.66	0.8192	23.75	6.3
United Kingdom of Great Britain and Northern Ireland	0.7746	0.7163	36298.387	0.9542	6	7.6
United Republic of Tanzania	0.1746	0.0336	542.555	0.673	13	2.7
Uruguay	0.4794	0.3182	12129.724	0.9598	11.75	6.9
Uzbekistan	0.3778	0.0853	1335.549	0.8883	71.5	1.6
Venezuela	0.3048	0.2321	9773.206	0.9004	47.33	2
Viet Nam	0.3048	0.226	1155.565	0.8097	75.75	2.7
Yemen	0.0476	0.0297	1230.555	0.5739	82.13	2.2
Zambia	0.1048	0.0426	1286.13	0.7008	22	3
Zimbabwe	0.127	0.0586	475.154	0.7894	39.5	2.4

Appendix 1- Regression analysis data set (transformed variables)

Data sources:

United Nations e-government survey report (2010), International Monetary Fund (2010), Reporters Without Borders (2010), Transparency International (2010)

Transformations:

GDP per capita, Corruption Control = Log10 Transform

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Albania	0.3111	0.1629	3.56	0.886	21.5	0.5185
Algeria	0.0984	0.1248	3.65	0.7377	47.33	0.4624
Angola	0.3397	0.045	3.68	0.5473	28.5	0.2788
Argentina	0.4127	0.2811	3.94	0.9502	16.35	0.4624
Armenia	0.1746	0.128	3.43	0.9117	27.5	0.4150
Austria	0.4762	0.5736	4.64	0.9598	0.5	0.8976
Azerbaijan	0.3238	0.1329	3.76	0.9185	56.38	0.3802
Bahrain	0.7302	0.5855	4.29	0.8932	51.38	0.6902
Bangladesh	0.3556	0.033	2.81	0.5182	42.5	0.3802
Belarus	0.3016	0.208	3.75	0.9659	57	0.3979
Belgium	0.6254	0.5697	4.63	0.9751	4	0.8513
Benin	0.1175	0.0454	2.83	0.4447	19	0.4472
Bhutan	0.1873	0.0619	3.31	0.5324	17.75	0.7559

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Bolivia	0.3048	0.0914	3.26	0.8914	28.13	0.4472
Bosnia & Herzegovina	0.2762	0.2504	3.62	0.8885	13.5	0.5051
Botswana	0.2	0.108	3.83	0.788	17.5	0.7634
Brazil	0.3683	0.2538	4.02	0.8837	16.6	0.5682
Brunei Darussalam	0.2825	0.2703	4.45	0.8917	51	0.7404
Bulgaria	0.4095	0.337	3.77	0.935	19	0.5563
Burundi	0.0413	0.009	2.25	0.5587	28.88	0.2553
Cambodia	0.1365	0.0297	2.90	0.7019	43.83	0.3222
Cameroon	0.1524	0.0411	3.03	0.6268	44.3	0.3424
Cape Verde	0.2698	0.1645	3.48	0.7858	8	0.7076
Chile	0.6095	0.271	4.06	0.9232	10.5	0.8573
China	0.3683	0.1912	3.63	0.8535	84.67	0.5441
Colombia	0.7111	0.2421	3.79	0.8813	51.5	0.5441
Comoros	0.0286	0.0203	2.91	0.6553	19	0.3222
Costa Rica	0.3048	0.2423	3.87	0.8826	8.08	0.7243
Côte d'Ivoire	0.3238	0.0622	3.01	0.454	36	0.3424
Croatia	0.4222	0.422	4.13	0.9181	17.5	0.6128
Czech Republic	0.454	0.4258	4.27	0.9429	7.5	0.6628
Djibouti	0.0476	0.0148	3.14	0.5599	30.5	0.5051
Dominican Republic	0.3651	0.1657	3.71	0.8391	26.13	0.4771
Ecuador	0.3175	0.1595	3.63	0.823	27.5	0.3979
Egypt	0.5302	0.1255	3.44	0.6973	43.33	0.4914

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
El Salvador	0.4254	0.1923	3.57	0.7935	15.83	0.5563
Equatorial Guinea	0.0317	0.06	4.04	0.7868	79	0.2788
Eritrea	0.0222	0.0113	2.63	0.529	105	0.4150
Estonia	0.5016	0.6272	4.16	0.9666	2	0.8129
Ethiopia	0.2	0.0073	2.56	0.4027	49.38	0.4314
France	0.6825	0.5953	4.61	0.9772	13.38	0.8325
Gabon	0.0794	0.111	3.92	0.8436	28.75	0.4472
Gambia	0.0825	0.0955	2.78	0.4609	40.5	0.5051
Georgia	0.2476	0.1164	3.41	0.9156	27	0.5798
Germany	0.5492	0.6955	4.61	0.9533	4.25	0.8976
Ghana	0.1492	0.0592	2.88	0.6215	8	0.6128
Greece	0.3556	0.3828	4.44	0.9803	19	0.5441
Guatemala	0.3079	0.1528	3.45	0.7229	20.25	0.5051
Guinea-Bissau	0.0159	0.0358	2.70	0.4206	18.25	0.3222
Guyana	0.181	0.1284	3.45	0.9395	16.63	0.4314
Haiti	0.019	0.0669	2.82	0.542	16.38	0.3424
Honduras	0.2952	0.1268	3.30	0.8007	51.13	0.3802
Hungary	0.5048	0.4338	4.12	0.9597	7.5	0.6721
Iceland	0.3968	0.6394	4.60	0.9811	0	0.9294
India	0.3683	0.0583	3.07	0.6432	38.75	0.5185
Indonesia	0.2444	0.1142	3.47	0.854	35.83	0.4472
Iran (Islamic Republic of)	0.2667	0.2157	3.65	0.7926	94.56	0.3424
Iraq	0.1524	0.0552	3.42	0.6955	45.58	0.1761

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Israel	0.5841	0.4333	4.43	0.9501	23.25	0.7853
Italy	0.2889	0.4914	4.53	0.9683	15	0.5911
Jamaica	0.2286	0.2819	3.70	0.836	7.67	0.5185
Japan	0.673	0.5241	4.63	0.9496	2.5	0.8921
Jordan	0.5333	0.1806	3.65	0.8694	37	0.6721
Kazakhstan	0.527	0.1796	3.92	0.9677	68.5	0.4624
Kenya	0.2381	0.0636	2.95	0.7026	19	0.3222
Kuwait	0.4603	0.2523	4.51	0.8764	23.75	0.6532
Kyrgyzstan	0.3175	0.0917	2.91	0.9196	63	0.3010
Lao People's Democratic Republic	0.0794	0.0329	2.99	0.6844	80.5	0.3222
Latvia	0.4159	0.3762	4.02	0.9608	8.5	0.6335
Lebanon	0.2667	0.1964	4.00	0.8583	20.5	0.3979
Lesotho	0.2635	0.0399	2.85	0.7528	24	0.5441
Liberia	0.0635	0.0189	2.36	0.5621	22.5	0.5185
Lithuania	0.4825	0.4413	4.03	0.9691	2.5	0.6990
Luxembourg	0.381	0.7137	5.02	0.9156	4	0.9294
Madagascar	0.1651	0.03	2.59	0.6757	34.88	0.4150
Malawi	0.0159	0.0181	2.55	0.6797	21	0.5315
Malaysia	0.6317	0.3437	3.89	0.8542	50.75	0.6435
Maldives	0.1619	0.2885	3.65	0.8754	16	0.3617
Malta	0.4698	0.4862	4.27	0.887	4	0.7482
Mauritania	0.0889	0.0798	3.04	0.5434	25.38	0.3617
Mauritius	0.2952	0.2646	3.86	0.8388	18	0.7324

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Mexico	0.4413	0.2161	3.97	0.8898	47.5	0.4914
Mongolia	0.5556	0.1036	3.32	0.9127	19.42	0.4314
Morocco	0.2381	0.1768	3.46	0.5739	47.4	0.5315
Mozambique	0.1714	0.025	2.67	0.4918	26.5	0.4314
Namibia	0.0667	0.1219	3.74	0.8135	7	0.6435
Nepal	0.1683	0.0226	2.73	0.582	36.38	0.3424
Netherlands	0.6794	0.7666	4.67	0.987	0	0.9445
Nicaragua	0.254	0.0757	3.04	0.7625	22.33	0.3979
Nigeria	0.0952	0.0593	3.12	0.6567	51.5	0.3802
Norway	0.7365	0.683	4.93	0.9884	0	0.9345
Oman	0.3683	0.2091	4.26	0.798	40.25	0.7243
Pakistan	0.2476	0.077	3.02	0.5025	56.17	0.3617
Panama	0.2825	0.2201	3.89	0.8884	21.83	0.5563
Papua New Guinea	0.073	0.0228	3.13	0.521	13.33	0.3222
Paraguay	0.2635	0.1433	3.43	0.8711	16.25	0.3424
Peru	0.4095	0.1789	3.72	0.8911	30	0.5441
Philippines	0.3937	0.1115	3.30	0.8881	60	0.3802
Poland	0.3873	0.3373	4.06	0.9551	8.88	0.7243
Portugal	0.3873	0.4189	4.32	0.9356	12.36	0.7782
Qatar	0.2794	0.3168	4.87	0.8886	38	0.8865
Republic of Moldova	0.2952	0.1933	3.18	0.8999	19.13	0.4624
Romania	0.4159	0.3092	3.87	0.9226	16	0.5682

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Russian Federation	0.3302	0.2765	4.02	0.9396	49.9	0.3222
Rwanda	0.1746	0.0203	2.76	0.6329	81	0.6021
Samoa	0.1429	0.0818	3.48	0.9049	33	0.6128
Saudi Arabia	0.3111	0.4031	4.22	0.8346	61.5	0.6721
Senegal	0.1778	0.071	2.98	0.425	25	0.4624
Serbia	0.2222	0.2694	3.72	0.891	23	0.5441
Seychelles	0.0571	0.3036	4.03	0.9038	18	0.6812
Sierra Leone	0.0032	0.0179	2.51	0.4931	24.25	0.3802
Singapore	0.6857	0.6386	4.63	0.9203	47.5	0.9685
Slovakia	0.346	0.4211	4.20	0.931	11.5	0.6335
Slovenia	0.4	0.5025	4.36	0.977	13.44	0.8062
South Africa	0.3079	0.1443	3.85	0.8432	12	0.6532
Spain	0.7651	0.51	4.48	0.9792	12.25	0.7853
Sri Lanka	0.2603	0.1081	3.37	0.8342	62.5	0.5051
Sudan	0.1556	0.071	3.22	0.5388	85.33	0.2041
Swaziland	0	0.0612	3.49	0.7742	57.5	0.5051
Sweden	0.527	0.7522	4.68	0.9698	0	0.9638
Switzerland	0.4444	0.7687	4.83	0.9358	0	0.9395
Syrian Arab Republic	0.0413	0.1208	3.46	0.7768	91.5	0.3979
Tajikistan	0.0889	0.0614	2.86	0.9005	34.5	0.3222
Thailand	0.3333	0.1746	3.66	0.8919	56.83	0.5441

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
The former Yugoslav Republic of Macedonia	0.3206	0.3804	3.67	0.8835	18.4	0.6128
Timor-Leste	0.1333	0.0067	2.73	0.5445	25	0.3979
Togo	0.0698	0.0453	2.64	0.5341	17	0.3802
Tonga	0.0698	0.1269	3.46	0.9212	23.75	0.4771
Tunisia	0.4825	0.1941	3.62	0.771	72.5	0.6335
Turkey	0.346	0.2581	4.01	0.8338	49.25	0.6435
Uganda	0.1016	0.0479	2.70	0.6996	25.5	0.3979
Ukraine	0.346	0.2486	3.48	0.9647	46.83	0.3802
United Arab Emirates	0.2508	0.5434	4.68	0.8192	23.75	0.7993
United Kingdom of Great Britain and Northern Ireland	0.7746	0.7163	4.56	0.9542	6	0.8808
United Republic of Tanzania	0.1746	0.0336	2.73	0.673	13	0.4314
Uruguay	0.4794	0.3182	4.08	0.9598	11.75	0.8388
Uzbekistan	0.3778	0.0853	3.13	0.8883	71.5	0.2041
Venezuela	0.3048	0.2321	3.99	0.9004	47.33	0.3010
Viet Nam	0.3048	0.226	3.06	0.8097	75.75	0.4314

Country Name	Sophistication	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
Yemen	0.0476	0.0297	3.09	0.5739	82.13	0.3424
Zambia	0.1048	0.0426	3.11	0.7008	22	0.4771
Zimbabwe	0.127	0.0586	2.68	0.7894	39.5	0.3802

Appendix 2- Kruskal-Wallis analysis data set (untransformed)

Data sources:

United Nations e-government survey report (2010), International Monetary Fund (2010), Reporters Without Borders (2010), Transparency International (2010)

Groups: High (3), Medium (2), Low (1)

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
3	Bahrain	0.5855	19641.188	0.8932	51.38	4.9
3	Colombia	0.2421	6220.604	0.8813	51.5	3.5
3	France	0.5953	40591.434	0.9772	13.38	6.8
3	Japan	0.5241	42325.232	0.9496	2.5	7.8
3	Netherlands	0.7666	46418.334	0.987	0	8.8
3	Norway	0.683	84543.435	0.9884	0	8.6
3	Singapore	0.6386	42652.759	0.9203	47.5	9.3
3	Spain	0.51	29875.089	0.9792	12.25	6.1
3	United Kingdom of Great Britain and Northern Ireland	0.7163	36298.387	0.9542	6	7.6
1	Albania	0.1629	3616.097	0.886	21.5	3.3
1	Algeria	0.1248	4477.798	0.7377	47.33	2.9

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Angola	0.045	4812.226	0.5473	28.5	1.9
1	Armenia	0.128	2676.517	0.9117	27.5	2.6
1	Azerbaijan	0.1329	5764.702	0.9185	56.38	2.4
1	Belarus	0.208	5606.782	0.9659	57	2.5
1	Benin	0.0454	673.439	0.4447	19	2.8
1	Bhutan	0.0619	2042.169	0.5324	17.75	5.7
1	Bolivia	0.0914	1839.749	0.8914	28.13	2.8
1	Bosnia and Herzegovina	0.2504	4157.505	0.8885	13.5	3.2
1	Botswana	0.108	6795.931	0.788	17.5	5.8
1	Brunei Darussalam	0.2703	28340.041	0.8917	51	5.5
1	Burundi	0.009	177.663	0.5587	28.88	1.8
1	Cambodia	0.0297	795.034	0.7019	43.83	2.1
1	Cameroon	0.0411	1071.406	0.6268	44.3	2.2
1	Cape Verde	0.1645	3007.42	0.7858	8	5.1
1	Comoros	0.0203	819.77	0.6553	19	2.1
1	Costa Rica	0.2423	7350.236	0.8826	8.08	5.3
1	Côte d'Ivoire	0.0622	1016.255	0.454	36	2.2
1	Djibouti	0.0148	1382.134	0.5599	30.5	3.2
1	Ecuador	0.1595	4295.635	0.823	27.5	2.5

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Equatorial Guinea	0.06	11080.862	0.7868	79	1.9
1	Eritrea	0.0113	423.498	0.529	105	2.6
1	Ethiopia	0.0073	364.872	0.4027	49.38	2.7
1	Gabon	0.111	8395.303	0.8436	28.75	2.8
1	Gambia	0.0955	605.872	0.4609	40.5	3.2
1	Georgia	0.1164	2559.692	0.9156	27	3.8
1	Ghana	0.0592	761.978	0.6215	8	4.1
1	Guatemala	0.1528	2839.029	0.7229	20.25	3.2
1	Guinea-Bissau	0.0358	497.656	0.4206	18.25	2.1
1	Guyana	0.1284	2844.299	0.9395	16.63	2.7
1	Haiti	0.0669	659.058	0.542	16.38	2.2
1	Honduras	0.1268	2014.695	0.8007	51.13	2.4
1	Indonesia	0.1142	2963.284	0.854	35.83	2.8
1	Iran (Islamic Republic of)	0.2157	4484.44	0.7926	94.56	2.2
1	Iraq	0.0552	2625.502	0.6955	45.58	1.5
1	Italy	0.4914	33828.552	0.9683	15	3.9
1	Jamaica	0.2819	5055	0.836	7.67	3.3
1	Kenya	0.0636	887.923	0.7026	19	2.1
1	Kyrgyzstan	0.0917	816.22	0.9196	63	2
1	Lao People's Democratic Republic	0.0329	984.153	0.6844	80.5	2.1
1	Lebanon	0.1964	10019.026	0.8583	20.5	2.5
1	Lesotho	0.0399	707.956	0.7528	24	3.5

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Liberia	0.0189	226.683	0.5621	22.5	3.3
1	Madagascar	0.03	391.082	0.6757	34.88	2.6
1	Malawi	0.0181	354.271	0.6797	21	3.4
1	Maldives	0.2885	4478.087	0.8754	16	2.3
1	Mauritania	0.0798	1096.336	0.5434	25.38	2.3
1	Mauritius	0.2646	7303.315	0.8388	18	5.4
1	Morocco	0.1768	2868.147	0.5739	47.4	3.4
1	Mozambique	0.025	473.098	0.4918	26.5	2.7
1	Namibia	0.1219	5454.39	0.8135	7	4.4
1	Nepal	0.0226	536.031	0.582	36.38	2.2
1	Nicaragua	0.0757	1096.131	0.7625	22.33	2.5
1	Nigeria	0.0593	1324.337	0.6567	51.5	2.4
1	Pakistan	0.077	1049.31	0.5025	56.17	2.3
1	Panama	0.2201	7712	0.8884	21.83	3.6
1	Papua New Guinea	0.0228	1358.427	0.521	13.33	2.1
1	Paraguay	0.1433	2681.644	0.8711	16.25	2.2
1	Qatar	0.3168	74422.604	0.8886	38	7.7
1	Republic of Moldova	0.1933	1503.157	0.8999	19.13	2.9
1	Russian Federation	0.2765	10521.786	0.9396	49.9	2.1
1	Rwanda	0.0203	569.389	0.6329	81	4
1	Samoa	0.0818	3023.236	0.9049	33	4.1
1	Saudi Arabia	0.4031	16641.407	0.8346	61.5	4.7

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Senegal	0.071	964.133	0.425	25	2.9
1	Serbia	0.2694	5262.189	0.891	23	3.5
1	Seychelles	0.3036	10713.718	0.9038	18	4.8
1	Sierra Leone	0.0179	324.996	0.4931	24.25	2.4
1	South Africa	0.1443	7100.809	0.8432	12	4.5
1	Sri Lanka	0.1081	2364.623	0.8342	62.5	3.2
1	Sudan	0.071	1642.75	0.5388	85.33	1.6
1	Swaziland	0.0612	3072.831	0.7742	57.5	3.2
1	Syrian Arab Republic	0.1208	2892.021	0.7768	91.5	2.5
1	Tajikistan	0.0614	732.137	0.9005	34.5	2.1
1	Thailand	0.1746	4620.705	0.8919	56.83	3.5
1	The former Yugoslav Republic of Macedonia	0.3804	4633.971	0.8835	18.4	4.1
1	Timor-Leste	0.0067	536.024	0.5445	25	2.5
1	Togo	0.0453	441.429	0.5341	17	2.4
1	Tonga	0.1269	2907.1	0.9212	23.75	3
1	Uganda	0.0479	503.89	0.6996	25.5	2.5
1	United Arab Emirates	0.5434	47406.66	0.8192	23.75	6.3

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	United Republic of Tanzania	0.0336	542.555	0.673	13	2.7
1	Venezuela	0.2321	9773.206	0.9004	47.33	2
1	Viet Nam	0.226	1155.565	0.8097	75.75	2.7
1	Yemen	0.0297	1230.555	0.5739	82.13	2.2
1	Zambia	0.0426	1286.13	0.7008	22	3
1	Zimbabwe	0.0586	475.154	0.7894	39.5	2.4
2	Austria	0.5736	43723.317	0.9598	0.5	7.9
2	Oman	0.2091	18040.539	0.798	40.25	5.3
2	Argentina	0.2811	8662.986	0.9502	16.35	2.9
2	Bangladesh	0.033	640.847	0.5182	42.5	2.4
2	Belgium	0.5697	42596.55	0.9751	4	7.1
2	Brazil	0.2538	10470.898	0.8837	16.6	3.7
2	Bulgaria	0.337	5954.724	0.935	19	3.6
2	Chile	0.271	11587.092	0.9232	10.5	7.2
2	China	0.1912	4282.894	0.8535	84.67	3.5
2	Croatia	0.422	13527.658	0.9181	17.5	4.1
2	Czech Republic	0.4258	18721.626	0.9429	7.5	4.6
2	Dominican Republic	0.1657	5152.047	0.8391	26.13	3
2	Egypt	0.1255	2771.414	0.6973	43.33	3.1
2	El Salvador	0.1923	3717.062	0.7935	15.83	3.6
2	Estonia	0.6272	14416.523	0.9666	2	6.5
2	Germany	0.6955	40511.825	0.9533	4.25	7.9
2	Greece	0.3828	27264.83	0.9803	19	3.5

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
2	Hungary	0.4338	13210.402	0.9597	7.5	4.7
2	Iceland	0.6394	39562.893	0.9811	0	8.5
2	India	0.0583	1176.062	0.6432	38.75	3.3
2	Israel	0.4333	27085.13	0.9501	23.25	6.1
2	Jordan	0.1806	4434.861	0.8694	37	4.7
2	Kazakhstan	0.1796	8326.453	0.9677	68.5	2.9
2	Kuwait	0.2523	32530.479	0.8764	23.75	4.5
2	Latvia	0.3762	10377.782	0.9608	8.5	4.3
2	Lithuania	0.4413	10765.341	0.9691	2.5	5
2	Luxembourg	0.7137	104390.269	0.9156	4	8.5
2	Malaysia	0.3437	7754.988	0.8542	50.75	4.4
2	Malta	0.4862	18586.225	0.887	4	5.6
2	Mexico	0.2161	9243.029	0.8898	47.5	3.1
2	Mongolia	0.1036	2111.257	0.9127	19.42	2.7
2	Peru	0.1789	5195.977	0.8911	30	3.5
2	Philippines	0.1115	2011	0.8881	60	2.4
2	Poland	0.3373	11521.637	0.9551	8.88	5.3
2	Portugal	0.4189	21030.607	0.9356	12.36	6
2	Romania	0.3092	7390.707	0.9226	16	3.7
2	Slovakia	0.4211	15906.378	0.931	11.5	4.3
2	Slovenia	0.5025	23008.587	0.977	13.44	6.4
2	Sweden	0.7522	47667.019	0.9698	0	9.2

Group	Country Name	Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
2	Switzerland	0.7687	67074.31	0.9358	0	8.7
2	Tunisia	0.1941	4159.921	0.771	72.5	4.3
2	Turkey	0.2581	10206.788	0.8338	49.25	4.4
2	Ukraine	0.2486	3002.8	0.9647	46.83	2.4
2	Uruguay	0.3182	12129.724	0.9598	11.75	6.9
2	Uzbekistan	0.0853	1335.549	0.8883	71.5	1.6

Appendix 2- Kruskal-Wallis analysis data set (transformed)

Data sources:

United Nations e-government survey report (2010), International Monetary Fund (2010), Reporters Without Borders (2010), Transparency International (2010)

Groups: High (3), Medium (2), Low (1)

Transformations:

GDP per capita = Log10 Transform

ICT Infrastructure, Human capital, Press Freedom, Corruption control = SQRT (indicator + 0.5)

Group	Country Name	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
3	Bahrain	1.0419	4.293	1.1803	7.20	2.3238
3	Colombia	0.8615	3.794	1.1753	7.21	2.0000
3	France	1.0466	4.608	1.2154	3.73	2.7019
3	Japan	1.0120	4.627	1.2040	1.73	2.8810
3	Netherlands	1.1254	4.667	1.2194	0.71	3.0496
3	Norway	1.0877	4.927	1.2200	0.71	3.0166
3	Singapore	1.0671	4.630	1.1918	6.93	3.1305
3	Spain	1.0050	4.475	1.2162	3.57	2.5690
3	United Kingdom of Great Britain and Northern Ireland	1.1029	4.560	1.2059	2.55	2.8460
1	Albania	0.8142	3.558	1.1773	4.69	1.9494
1	Algeria	0.7904	3.651	1.1125	6.92	1.8439

Group	Country Name	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Angola	0.7382	3.682	1.0234	5.39	1.5492
1	Armenia	0.7925	3.428	1.1881	5.29	1.7607
1	Azerbaijan	0.7956	3.761	1.1910	7.54	1.7029
1	Belarus	0.8414	3.749	1.2107	7.58	1.7321
1	Benin	0.7385	2.828	0.9720	4.42	1.8166
1	Bhutan	0.7496	3.310	1.0161	4.27	2.4900
1	Bolivia	0.7690	3.265	1.1796	5.35	1.8166
1	Bosnia and Herzegovina	0.8663	3.619	1.1783	3.74	1.9235
1	Botswana	0.7797	3.832	1.1349	4.24	2.5100
1	Brunei Darussalam	0.8777	4.452	1.1797	7.18	2.4495
1	Burundi	0.7134	2.250	1.0289	5.42	1.5166
1	Cambodia	0.7278	2.900	1.0963	6.66	1.6125
1	Cameroon	0.7356	3.030	1.0615	6.69	1.6432
1	Cape Verde	0.8152	3.478	1.1339	2.92	2.3664
1	Comoros	0.7213	2.914	1.0748	4.42	1.6125
1	Costa Rica	0.8616	3.866	1.1758	2.93	2.4083
1	Côte d'Ivoire	0.7498	3.007	0.9767	6.04	1.6432
1	Djibouti	0.7175	3.141	1.0295	5.57	1.9235
1	Ecuador	0.8121	3.633	1.1502	5.29	1.7321

Group	Country Name	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Equatorial Guinea	0.7483	4.045	1.1344	8.92	1.5492
1	Eritrea	0.7151	2.627	1.0144	10.27	1.7607
1	Ethiopia	0.7122	2.562	0.9501	7.06	1.7889
1	Gabon	0.7817	3.924	1.1591	5.41	1.8166
1	Gambia	0.7717	2.782	0.9803	6.40	1.9235
1	Georgia	0.7851	3.408	1.1898	5.24	2.0736
1	Ghana	0.7478	2.882	1.0590	2.92	2.1448
1	Guatemala	0.8080	3.453	1.1058	4.56	1.9235
1	Guinea-Bissau	0.7320	2.697	0.9595	4.33	1.6125
1	Guyana	0.7927	3.454	1.1998	4.14	1.7889
1	Haiti	0.7529	2.819	1.0208	4.11	1.6432
1	Honduras	0.7917	3.304	1.1405	7.19	1.7029
1	Indonesia	0.7837	3.472	1.1636	6.03	1.8166
1	Iran (Islamic Republic of)	0.8460	3.652	1.1369	9.75	1.6432
1	Iraq	0.7451	3.419	1.0934	6.79	1.4142
1	Italy	0.9957	4.529	1.2117	3.94	2.0976
1	Jamaica	0.8843	3.704	1.1559	2.86	1.9494
1	Kenya	0.7507	2.948	1.0966	4.42	1.6125
1	Kyrgyzstan	0.7692	2.912	1.1915	7.97	1.5811
1	Lao People's Democratic Republic	0.7300	2.993	1.0883	9.00	1.6125
1	Lebanon	0.8345	4.001	1.1655	4.58	1.7321
1	Lesotho	0.7348	2.850	1.1193	4.95	2.0000
1	Liberia	0.7203	2.355	1.0306	4.80	1.9494

Group	Country Name	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Madagascar	0.7280	2.592	1.0843	5.95	1.7607
1	Malawi	0.7198	2.549	1.0861	4.64	1.9748
1	Maldives	0.8880	3.651	1.1728	4.06	1.6733
1	Mauritania	0.7614	3.040	1.0215	5.09	1.6733
1	Mauritius	0.8744	3.864	1.1571	4.30	2.4290
1	Morocco	0.8227	3.458	1.0363	6.92	1.9748
1	Mozambique	0.7246	2.675	0.9959	5.20	1.7889
1	Namibia	0.7886	3.737	1.1461	2.74	2.2136
1	Nepal	0.7229	2.729	1.0402	6.07	1.6432
1	Nicaragua	0.7587	3.040	1.1236	4.78	1.7321
1	Nigeria	0.7479	3.122	1.0755	7.21	1.7029
1	Pakistan	0.7596	3.021	1.0012	7.53	1.6733
1	Panama	0.8486	3.887	1.1783	4.73	2.0248
1	Papua New Guinea	0.7230	3.133	1.0104	3.72	1.6125
1	Paraguay	0.8021	3.428	1.1709	4.09	1.6432
1	Qatar	0.9038	4.872	1.1784	6.20	2.8636
1	Republic of Moldova	0.8326	3.177	1.1832	4.43	1.8439
1	Russian Federation	0.8812	4.022	1.1998	7.10	1.6125
1	Rwanda	0.7213	2.755	1.0644	9.03	2.1213
1	Samoa	0.7628	3.480	1.1853	5.79	2.1448
1	Saudi Arabia	0.9503	4.221	1.1552	7.87	2.2804
1	Senegal	0.7556	2.984	0.9618	5.05	1.8439
1	Serbia	0.8772	3.721	1.1794	4.85	2.0000

Group	Country Name	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
1	Seychelles	0.8964	4.030	1.1848	4.30	2.3022
1	Sierra Leone	0.7197	2.512	0.9965	4.97	1.7029
1	South Africa	0.8027	3.851	1.1590	3.54	2.2361
1	Sri Lanka	0.7798	3.374	1.1551	7.94	1.9235
1	Sudan	0.7556	3.216	1.0192	9.26	1.4491
1	Swaziland	0.7491	3.488	1.1288	7.62	1.9235
1	Syrian Arab Republic	0.7879	3.461	1.1300	9.59	1.7321
1	Tajikistan	0.7493	2.865	1.1834	5.92	1.6125
1	Thailand	0.8213	3.665	1.1798	7.57	2.0000
1	The former Yugoslav Republic of Macedonia	0.9383	3.666	1.1762	4.35	2.1448
1	Timor-Leste	0.7118	2.729	1.0220	5.05	1.7321
1	Togo	0.7384	2.645	1.0169	4.18	1.7029
1	Tonga	0.7918	3.463	1.1921	4.92	1.8708
1	Uganda	0.7402	2.702	1.0953	5.10	1.7321
1	United Arab Emirates	1.0215	4.676	1.1486	4.92	2.6077
1	United Republic of Tanzania	0.7305	2.734	1.0831	3.67	1.7889
1	Venezuela	0.8556	3.990	1.1834	6.92	1.5811
1	Viet Nam	0.8521	3.063	1.1444	8.73	1.7889
1	Yemen	0.7278	3.090	1.0363	9.09	1.6432
1	Zambia	0.7366	3.109	1.0958	4.74	1.8708
1	Zimbabwe	0.7474	2.677	1.1355	6.32	1.7029

Group	Country Name	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
2	Austria	1.0361	4.641	1.2082	1.00	2.8983
2	Oman	0.8421	4.256	1.1393	6.38	2.4083
2	Argentina	0.8838	3.938	1.2042	4.10	1.8439
2	Bangladesh	0.7301	2.807	1.0091	6.56	1.7029
2	Belgium	1.0343	4.629	1.2145	2.12	2.7568
2	Brazil	0.8682	4.020	1.1763	4.14	2.0494
2	Bulgaria	0.9149	3.775	1.1979	4.42	2.0248
2	Chile	0.8781	4.064	1.1930	3.32	2.7749
2	China	0.8314	3.632	1.1634	9.23	2.0000
2	Croatia	0.9602	4.131	1.1908	4.24	2.1448
2	Czech Republic	0.9622	4.272	1.2012	2.83	2.2583
2	Dominican Republic	0.8159	3.712	1.1572	5.16	1.8708
2	Egypt	0.7909	3.443	1.0942	6.62	1.8974
2	El Salvador	0.8320	3.570	1.1373	4.04	2.0248
2	Estonia	1.0617	4.159	1.2110	1.58	2.6458
2	Germany	1.0934	4.608	1.2055	2.18	2.8983
2	Greece	0.9396	4.436	1.2167	4.42	2.0000
2	Hungary	0.9663	4.121	1.2082	2.83	2.2804
2	Iceland	1.0674	4.597	1.2170	0.71	3.0000
2	India	0.7472	3.070	1.0692	6.26	1.9494
2	Israel	0.9661	4.433	1.2042	4.87	2.5690
2	Jordan	0.8250	3.647	1.1702	6.12	2.2804
2	Kazakhstan	0.8244	3.920	1.2115	8.31	1.8439
2	Kuwait	0.8674	4.512	1.1732	4.92	2.2361
2	Latvia	0.9361	4.016	1.2086	3.00	2.1909

Group	Country Name	ICT Infrastructure	GDP per capita	Human Capital	Press Freedom	Corruption Control
2	Lithuania	0.9702	4.032	1.2121	1.73	2.3452
2	Luxembourg	1.1017	5.019	1.1898	2.12	3.0000
2	Malaysia	0.9185	3.890	1.1637	7.16	2.2136
2	Malta	0.9931	4.269	1.1777	2.12	2.4698
2	Mexico	0.8462	3.966	1.1789	6.93	1.8974
2	Mongolia	0.7769	3.325	1.1886	4.46	1.7889
2	Peru	0.8240	3.716	1.1794	5.52	2.0000
2	Philippines	0.7820	3.303	1.1782	7.78	1.7029
2	Poland	0.9150	4.062	1.2063	3.06	2.4083
2	Portugal	0.9586	4.323	1.1982	3.59	2.5495
2	Romania	0.8996	3.869	1.1927	4.06	2.0494
2	Slovakia	0.9597	4.202	1.1962	3.46	2.1909
2	Slovenia	1.0012	4.362	1.2153	3.73	2.6268
2	Sweden	1.1190	4.678	1.2124	0.71	3.1145
2	Switzerland	1.1264	4.827	1.1982	0.71	3.0332
2	Tunisia	0.8331	3.619	1.1274	8.54	2.1909
2	Turkey	0.8707	4.009	1.1549	7.05	2.2136
2	Ukraine	0.8652	3.478	1.2102	6.88	1.7029
2	Uruguay	0.9045	4.084	1.2082	3.50	2.7203
2	Uzbekistan	0.7650	3.126	1.1783	8.49	1.4491