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RESEARCH PAPER

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The Role of ICT as a Double-Edged Sword in Fostering Societal Transformations

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Abstract

Information and communication technologies (ICT) have been central to economies seeking improvements in societal conditions. The impacts of ICT advancements manifest themselves in both socioeconomic and sociopolitical changes. While socioeconomic restructuring and, more recently, sociopolitical changes have often been attributed to ICT, research on its impacts and nuances in countries differentiated by economic levels remains sparse. The focus has been on the two ends of the strata for developing and developed economies and restricted to the impacts of ICT on economic metrics like GDP growth. In this study, we explore the pivotal role of ICT in societal transformations for countries categorized as developing, transition, and developed economies. Leveraging endogenous growth theory and social network theory, we hypothesize about the different impacts of ICT across the three economic classifications. Using panel data from 1995 to 2012 for 37 countries belonging to the three economic groups, we empirically investigate the associations between ICT investments and societal outcomes. Our results reveal that ICT has an impact on societal outcomes for transformations, but the nature of its contributions to social change varies with the stage of a country's economic development. The analysis suggests that developing economies benefit the most from ICT investments with an overall improvement in socioeconomic and sociopolitical conditions, while the ICT effects are either insignificant or negatively inclined for developed economies. Transition economies show mixed ICT effects in stimulating socioeconomic and sociopolitical transformations. These results provide insights for actionable policies and suggest directions for building an ICT-enabled Bright Society.

Keywords: Information and Communication Technologies (ICT), Developing, Transition and Developed Economies, Societal Transformations, Endogenous Growth Theory, Social Network Theory

29, 2016 and went through 2 revisions.

1 Introduction

Rapid technological change has been recognized as an enabler of economic growth and structural societal changes. Prior research has focused on the investments and use of information and communication technology (ICT) for driving socioeconomic and sociopolitical changes (Cumps et al., 2006; Dewan and Kraemer, 1998). While the importance of ICT is widely accepted (Chang & Gurbaxani, 2012; Lu & Ramamurthy, 2011), returns on ICT investment are often difficult to measure. While there has been a steady increase in ICT spending, the empirical justification for such investments remains mixed and often conflicting.

The Digital Planet's reports have documented a doubling of global ICT spending—from $1.61 trillion in 1995 to $3.25 trillion in 2010. A closer look, however, reveals significant variations across countries. Differentiating countries into three general

categories (i.e., developing, transition, and developed economies) makes these variations even more pronounced. This leads us to ask crucial questions: What spurs differences in ICT investments? How do varied ICT investments effect changes for countries undergoing societal transformations? Who benefits most from ICT investments and how those that benefit less can use ICT to create positive societal outcomes for a bright future?

Figure 1 depicts the annual ICT spending per GDP across 16 years for the different economic categories considered in this study. While developed economies recognized the importance of ICT and hence invested heavily earlier on, both developing and transition economies (TEs) also built up critical capacities during the dot-com boom (i.e., 1997-2001). Afterwards, ICT spending patterns dramatically changed. ICT investments dropped in both developed and transition economies while developing economies continued their contributions to ICT investments. In more recent years (2004-2010), we see a consistent and convergent ICT spending level across the three groups. Such a pattern suggests that ICT may be both a source of and a catalyst for societal transformations.

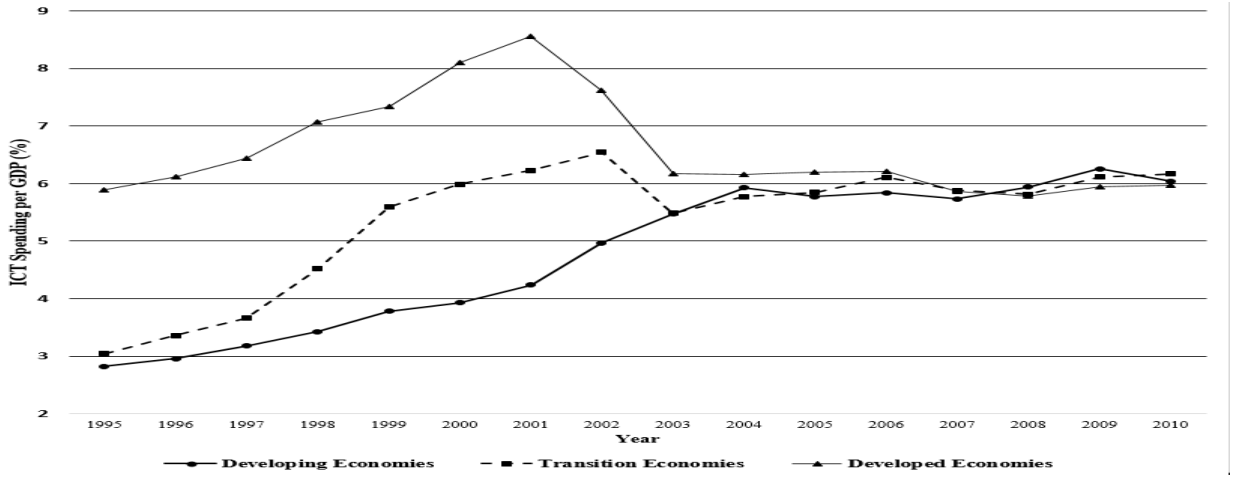

Figure 1. Annual ICT Spending per GDP

Sources: Global ICT Spending, Digital Planet (2000 & 2010); Global ICT Trends, ITU (2012)

ICT investments are believed to have a significant impact on economic development, but the findings are anecdotal. Empirical studies tend to focus on the two ends of the spectrum, i.e., developing and developed economies (Dewan & Kraemer, 1998). While Nielsen (2011) maintains that a distinction does exist at the two extremes, he also argues for a different effect of ICT for countries in transition. In essence, rapid technological advances do not always translate uniformly, and the manifestation of ICT effects may vary depending on the absorption capacity of a society. Thus, ICT investments and their transformational effects should be examined in a broader context. In our study, we aim to understand whether and how ICT investments translate differently across economic groups by including transition economies. We argue for differing ICT contributions for different economic, political, and social conditions among societies with a focus on two perspectives—sociopolitical and socioeconomic changes enabled by ICTs.

While the promising stories of ICTs for societal transformations have been emphasized, unfavorable ICT impacts are also reported (e.g., potential job replacement by automation). Examples from Google's AI program AlphaGo and self-driving vehicle to Apple's personal assistant Siri and IBM's Watson system illustrate their socioeconomic implications. Smart machines are projected to take over many "humans only" tasks (Brynjolfsson & McAfee, 2012; Economist, 2014b), as automation is not only replacing low-skill jobs, but is also moving up the ladder. Technological innovations are harnessed mainly for productivity in developed economies, but their diffusion and impacts may play out differently in other countries; thus, they may shed light on the brighter aspects of ICT. For example, many Bangladesh villages have adopted mobile phone use (Asian Development Bank, 2013), and job seekers in Kenya often use short message service (SMS)-driven services (Unimondo, 2007). Examples such as these dramatically alter social and economic structures.

ICT can reshape the employment composition of a country and hence influence its unemployment rate. Over time, economies typically shift from agriculture

and manufacturing industries to service-oriented ones (Galup et al., 2009). These changes eliminate jobs in the industries being replaced but create new jobs in ICT-enabled sectors. In the process, technological progress may increase polarization and lead to rising income disparity. A shift in demand for skilled workers may widen the income gap and result in two dominant groups based on workers' skill levels. On the political front, ICT-enabled services help promote democratic values in societies. By allowing the sharing of political opinions, social networks such as Facebook and Twitter stimulate democratization within societies, as evidenced by the Arab Spring of 2011 and by the 2014 revolution in Ukraine (Economist, 2014a).

The impacts of ICT on socioeconomic and sociopolitical outcomes may differ according to an economy's developmental stage, societal endowment, and specific motivation for using ICT. Some economies may utilize ICT to leverage their highly developed industrial infrastructures and rich human resources and to achieve comparative advantage, whereas others may adopt ICT mainly to improve sociopolitical structures or to mitigate social problems. We examine ICT-enabled societal transformation processes and the way they play out across the three economic groups (i.e., developing, transition, and developed economies) by addressing whether ICT investments are a double-edged sword at an aggregate level through the following research questions: 1) What are the different roles ICT plays in societal transformations? 2) How does ICT influence socioeconomic and sociopolitical changes in such transformations? 3) How do ICT impacts vary across countries at different stages of economic development? 4) How can a country utilize ICT for positive societal transformations to foster a Bright Society? To empirically answer these questions, we analyzed panel data from 1995 to 2012 from 37 countries and tested hypotheses based on endogenous growth theory and social network theory.

Considering both opportunities and challenges rendered by ICT, our intended contribution to the literature is to bring a broader perspective to the role of ICT as providing both positive and negative outcomes in the shaping of a promising future. This wider view is reflected in the various outcome measures chosen to represent both socioeconomic and sociopolitical transformations. Our intercountry analysis identifies the stage of economic development as one key factor in influencing how ICT affects societal transformations and offers implications for government policy-making and strategy formation concerning ICT adoption and usage. Specifically, we show that depending on the stage of economic development ICT has a nonuniform impact on societal transformations. Developing countries benefit the most from ICT; however, developed countries must cope with digital disruptions in terms of technical unemployment and income inequality. Meanwhile, TEs experience both benefits and downsides.

We take a comprehensive approach to studying ICT's impacts on societal transformations by considering economic freedom and unemployment as socioeconomic transformations and wealth inequality and political freedom as sociopolitical transformations. This multilens approach produces insightful findings and affirms that ICT shapes societies as a double-edged sword, bringing both benefits and unfavorable consequences that represent opportunities and challenges in moving toward a Bright Society.

2 Literature Review

2.1 Classifying Countries into Economic Groups

As a first step, we differentiate countries in terms of economic development by leveraging existing literature to ensure consistency in categorization. While developed and developing economies are the anchor points, TEs are a somewhat wide-ranging midpoint and typically refer to economies that are transforming from centrally planned to market-driven economies (Feige, 1994; IMF, 2000a & 2000b). These countries tend to be industrialized, with upper-middle to high-income levels. Although the traditional definition of TEs concerns only economic transformation, recent specifications note that TEs also undergo radical societal transformation. Arnold and Quelch (1998), for example, described TEs as "countries with absolute, but fast-growing economies and authorities committed to economic and political liberalization." Soubbotina and Sheram (2007) characterized them as having "frequent changes in the regulatory environment and thus a degree of economic uncertainty with social implications." These broader definitions distinguish TEs from the other economic groups. Table 1 presents the key properties of each of three economic groups.

Table 1. Key Properties of Economic Groups

Groups	Key properties	Examples	References
Developing economies	- Low standards of living - Undeveloped industrial base - Low Human Development Index - Lack of necessary commitment toward economic liberalization	Southeast Asian and African countries	United Nations (2008) Roztocki & Weistroffer (2008a)
Transition economies	- A centrally planned economy with free-market liberalization - Macroeconomic stabilization - Restructuring and privatization - Legal and institutional reforms	Central Eastern European (CEE) and Latin American countries	Feige (1994) Arnold & Quelch (1998) IMF (2000a & 2000b) Soubbotina & Sheram (2007)
Developed economies	- High standards of living - A well-developed infrastructure - Self-sustaining economic growth	OECD countries	Roztocki & Weistroffer (2008b)

In prior studies, TEs are also referred to as new economies (Meng & Li, 2001) or emerging societies (Soper et al., 2012). Although TEs and emerging economies share some properties, such as rapid economic growth and authorities committed to economic liberalization, not all emerging economies are TEs. Instead, emerging economies are generally characterized by having "a long free market tradition, but have recently started to have a major economic impact on a global scale" (Roztocki & Weistroffer, 2008a). Some emerging economies like South Africa have achieved remarkable economic growth and liberalization over the past few decades but have not experienced drastic societal structural changes until recently. Interestingly, several countries in Central Eastern Europe (CEE) described themselves as being in a transition process but are sometimes grouped with developed countries because of their high levels of industrialization; however, they should be distinguished from developed economies.

The term "developing" is typically associated with the profile of TEs, but "developing" also implies less-developed or, in many instances, underperforming economies. Thus, many developing countries do not fit the key attributes of TEs. Unlike TEs, developing economies are characterized as having a lower standard of living, underdeveloped industrial infrastructure, and a low commitment to economic and political liberalization (United Nations, 2008; Roztocki & Weistroffer, 2008b). Developed economies are self-sustaining and evince a high standard of living. They typically exhibit high overall economic and societal indicators, as distinguished from TEs and developing economies. They are often clubbed together as Organization of Economic Cooperation and Development (OECD) countries and are recognized as such by the European and OECD classification (World Bank 2012).

In summary, the three country classifications are fairly distinct. TEs have special characteristics that distinguish them from developing and developed economies and vice versa. Considering these economic distinctions, ICT is likely to play different roles in these three country groups that vary in terms of growth and development. Leveraging the categorization of economic groups, we study the effects of ICT investments on two main components of societal transformation: socioeconomic change and sociopolitical change.

2.2 ICT and Socioeconomic Changes

To investigate the social transformation effects of ICT investments, we have reviewed prior works related to ICT dynamics and IT productivity. The payoffs associated with IT investments have been one of the main information systems (IS) research topics explored over the past two decades. A large volume of IS research conducted at the firm level has investigated the relationship between IT investments and traditional factors of production, such as capital and labor, as well as their impacts on organizational performance. Although most studies have substantiated the positive productivity gains from IT (Hitt & Brynjofsson, 1996; Mukhopadhyay et al., 1997), the findings differ with the variables chosen and the level at which the variables were collected. Barua et al. (1995) found that IT inputs (e.g., IT capital, IT purchase, and IT labor) were positively related to intermediate measures of profitability for manufacturers in the 1990s, and Devaraj and Kohli (2003) showed that actual usage of IT is positively associated with hospital performance. Moreover, some studies found a positive impact from IT investments (Kelley, 1994; Mukhopadhyay et al., 1995; Dewan & Min, 1997; Devaraj & Kohli, 2000), while others reported no significant benefit (Berndt & Morrison, 1995; Barua et al., 1995).

Apart from the research conducted at the firm level, some studies have also examined the payoffs of ICT at the country level. Table 2 presents and compares these studies on ICT dynamics and economic changes. The conflicting results found in the firm-level IT payoff studies seem to be absent from country-level studies, which overwhelmingly indicate a positive relationship between ICT investments and economic changes (e.g., GDP growth and labor productivity). The degree of impact, however, was found to vary across different economic groups.

Table 2. Country-Level Studies of ICT Impact on Socioeconomic Changes

Study	Region	Data period	Focus	Key measures	Key finding
Ssewanyana & Busler (2007)	Developing economies: Uganda	2003	The associations between the level of adoption and usage of ICT and production in Uganda	ICT usage; contributions of ICT	The adoption and usage of ICT contributes to economic performance.
Kraemer & Dedrick (2001)	Developing and developed economies: 43 countries	1985-1995	Economic growth and productivity	Growth in IT investment; GDP growth; labor productivity growth	IT investment can speed up economic growth development.
Dewan & Kraemer (1998)	Developed economies: G-5 countries	1985-1995	The impact of IT on economic output	Output per worker in IT; capital per worker in IT	IT investment contributes to increased output and productivity.
Bresnahan et al. (2002)	Developed economies: United States	1987-1995	The impact of IT on demand for skilled labor	IT Capital; worker skill level (education and work experience)	Technological innovations tend to use more skilled labor.
Brynjolffson & McAfee (2011)	Developed economies: United States	1990s	The impact of IT on employment	Employment rate	Technological progress increases productivity and overall wealth but decreases jobs for low-skilled workers.
Meng & Li (2002)	Transition economies: China	1990s	The impact of ICT advance and diffusion on economic development	ICT production; ICT investment	ICT can reduce the demand for low-skilled labor and accelerate the speed of economic growth.
Piatkowski (2004)	Transition economies: CEE countries	1995-2000	The impact of ICT on economic growth	ICT investment; GDP growth; labor productivity	ICT investment increases GDP growth and labor productivity.
Samoilenko & Osei-Brynson (2010)	Transition economies: 18 countries	1993-2002	The association between ICT investment and total factor productivity	ICT Capitalization; total factor productivity	TEs with high level of ICT investment have a significant association between total factor productivity and ICT capitalization.

Dewan and Kraemer (2000) and Kraemer and Dedrick (2001) noted that IT investments are more positively associated with economic returns (i.e., annual GDP per capita) for developed countries than for developing countries. On the other hand, Cumps et al. (2006) found a sustainable competitive advantage from ICT investments for developing countries as well. Thus far, the research has considered the effects of ICT investments on TEs at early stages. Recent TE-focused studies have attempted to measure ICT contribution to economic growth (Samoilenko & Osei-Bryson, 2010) or IT-induced labor productivity (Piatkowski, 2006). These studies examined the immediate contributions of ICT to the economic transition process by focusing on the earlier stages of transition, in particular from the early 1990s to the early 2000s. Because transition economies during initial years of transition tend to experience drastic economic and societal shifts (e.g., changes in fundamental macroeconomic structure from planned economies to market-driven economies and liberalization of economies through privatization), the drastic societal transformations induced by structural shifts might be more influential to the transition process than the those initially attributed to ICT. Thus,

the transformative role of ICT in TEs may be underestimated and measured incorrectly.

With respect to the impacts of ICT on employment, prior studies suggest that technological innovations have replaced low-skill workers with new technologies (Bresnahan et al., 2002; Meng & Li, 2002). This implies that as ICT continues to advance, more jobs could be lost through the causes of obsolescence, automation, and disintermediation. However, these unbalanced job impacts do not necessarily imply net job loss because ICT can also spur new job opportunities by creating innovative ICT-related tasks and occupations in such areas as system design, telecommunication equipment provision, and installation. To the best of our understanding, few studies have examined whether ICT at an aggregate level creates more job opportunities, especially across economic groups. The difficulties of examining direct ICT impacts in the face of continued global economic downturn and high unemployment worldwide remain a major hurdle for conducting research in this area.

2.3 ICT and Sociopolitical Changes

Evaluating the role of ICT in facilitating sociopolitical shifts presents another interesting challenge, as there is minimal consensus on how ICT stimulates sociopolitical changes. Table 3 summarizes our review of the literature in this area. The findings suggest a number of possible directions for analyzing the effects of ICT on sociopolitical reforms. Studies have examined the association between ICT and wealth inequality. Flores (2000) and Katagiri (2010) found that the utilization and advance of ICT has widened income inequality in both developing and developed economies. In transition economies, such income disparity tends to be more severe in early transition years, mainly due to the progressive shift toward a market-driven economy. This finding raises the questions of how income inequality changes after market structural adjustment and whether ICT contributes to closing or widening the gap in income inequality.

Table 3. Country-Level Studies of ICT Impact on Sociopolitical Changes

Study	Region	Data period	Focus	Key measures	Key finding
Flores (2003)	Developing economies: Chile	2000	The impact of ICT use on income inequality	Education level; ICT use; Theil index	ICT users present a broader dispersion of earning than nonusers.
Katagiri (2010)	Developed economies: OECD countries	1996-2005	The association between income inequality and ICT	ICT spending per GDP; Gini index	ICT has widened income inequality in OECD countries.
Lansing & Markiewicz (2011)	Developed economies: United States	1980-2007	The impact of ICT diffusion on income inequality	Top 10% income share; capital share; ICT diffusion	ICT diffusion has contributed to the widening gap in income distribution.
Ferdinand (2000)	Developing economies	1999	The impact of the Internet on democratization	Usage of the Internet	The Internet has the potential to contribute to the promotion of a democratic society.
Meier (2000)	Developing economies: African countries	1999	The relationship between IT and quality of life in the poorest countries	Happiness; serenity	IT is a potential lever for rapid growth in quality of life concerning levels of happiness and serenity.
Grönlund (2001)	Developed economies	1998-2000	The impact of ICT use on democracy	Formal politics; administration; civil rights	The use of ICT improves democratic values.
Shirazi (2008)	Developing economies: 12 Middle Eastern countries	1995-2003	The association between ICT and the level of democratization	Government intervention index; civil liberties; Political Rights	ICT use in Middle East has had a positive impact on promoting democracy and freedom of expression.
Soper et al. (2012)	Transition and emerging economies of 48 countries	2001-2007	The impact of ICT on societal changes	Foreign direct investment; Political freedom	ICT investments produce positive impacts on future levels of democracy and foreign direct investment.

Studies have also found that ICT stimulates rapid democratization in certain regions of the world, including developing countries (Ferdinand, 2000; Meier, 2000) and developed countries (Grönlund, 2001). In addition, Falch (2006) argued that ICT had a positive impact on conditions for democratic governance. While interesting, the findings in these studies tend to be conjectures based on theoretical assertions (e.g., IT diffusion) or developed from particular indicators without significant empirical evidence. Although recent studies have evaluated the improvements of democratic values attributed by technological advances (Shirazi, 2008; Soper et al., 2012), the findings were again restricted to the early stage of ICT diffusion (e.g., prior to the emergence of social media) and to a short time span (e.g., less than a decade).

The widespread use of the Internet, mobile phones, and social media has demonstrated the potential of ICT to influence democratic values. The Internet, for example, has enabled people in countries like Tunisia, Egypt and Libya to publish and share their opinions and to learn quickly about current liberation movements. A similar experience was evidenced more recently during the 2014 Ukraine revolution when ICT infrastructure helped supplement citizen action. Prior work on this topic suggests possible directions for studying the effects of ICT on sociopolitical reforms. Table 4 summarizes the prior studies and the implications of their findings for each of the four ICT-driven societal changes studied in this paper.

Table 4. Prior Studies and Implications

Process	Study	Implications
Economic conditions	Dewan & Kraemer (1998, 2000) Kraemer & Dedrick (2001) Piatkowski (2004) Piatkowski (2006) Samoilenko & Osei-Brynson (2010)	*Positive* impact of ICT investment on economic growth and environmental changes
Unemployment	Bresnahan et al. (2002) Brynjolffson & McAfee (2011) Meng & Li (2002) Steinmueller (2001) The World Bank (2013)	*Positive* impact of ICT investment on overall job creation, but *negative* impact on job opportunities for unskilled workers
Wealth inequality	Breisinger et al. (2009) Flores (2003) Katagiri (2010)	*Positive* impact of ICT investment on wealth inequality
Democratization	Falch (2006) Grönlund (2001) Meier (2000) Shirazi (2008) Soper et al. (2012)	*Positive* impact of ICT investment on democratic values

Overall, prior studies have concentrated on examining the early stages of ICT diffusion, during which drastic economic and societal shifts occurred, rather than the later and more mature stages typically associated with significant ICT investments and widespread ICT use. The focus on the early stages of ICT impact makes it difficult to assess the exact transformative power of ICT for economic groups. Our aim is to fill this gap by examining the contributions of ICT in restructuring socioeconomic and sociopolitical settings with a longer period of time such that both early and later stages of ICT diffusion are included and the role that ICT consistently plays becomes salient.

3 Hypotheses Development

Endogenous growth theory and social network theory can help explicate socioeconomic and sociopolitical conditions in developing, transition, and developed economies, and are leveraged in our hypotheses development. In laying out the basis of our assertions and hypotheses, we focus on key arguments that account for the role of ICT in the societal transformation processes. Table 5 summarizes these theories and their implications.

Table 5. Theories for the Components of Societal Transformation

Social transformation	Component	Theory (supporting literature)	Implications
Socioeconomic change	Economic conditions	Endogenous growth theory (Romer, 1990)	Economic changes resulting from ICTs are influenced by people, firms, and governments that have incentives to push for sustained economic growth. Sustained economic growth not only means continuous increases in economic indicators such as GDP, but also improvement in overall economic conditions that can stimulate societal transformation in a sustainable and effective way.
	Unemployment	Endogenous growth theory (Romer, 1990; Eicher, 1996)	A shift in the production frontier function that favors skilled (more educated and more experienced) over unskilled labor is referred to as skill-biased technological change. Moreover, the dynamics of IT advancement replaces human labor with smart machines.
Sociopolitical change	Wealth inequality	Endogenous growth theory (Romer, 1990; Galor & Moav, 2000)	Skill-biased technological change also suggests that drastic technological progress has contributed to the emergence of two extremes in income groups based on the value of workers' skills. Technological advances have increased the productivity of high-skilled labor more than that of low-skilled labor. Consequently, high-skilled workers receive greater rewards than low-skilled workers, affecting the earnings distribution in an economy.
	Democratization	Social network theory (Wasserman & Faust, 1994)	Social network theory can explain the spreading processes of democratic values among individuals inside and outside of a country. ICT applications enable individuals to communicate their opinions over geographical or censorship barriers and to form a social network for sharing and promoting democratic values.

To address socioeconomic issues, we focus on *economic conditions* and *unemployment* (*job loss*) as the topics of exploration for our study. To elucidate the impact of ICT on economic conditions, we utilize endogenous growth theory (Romer, 1990). We leverage the skill-biased technological change (SBTC) derived from endogenous growth theory (Galor & Moav, 2000) to explore ICT impact on unemployment in different countries. To examine sociopolitical issues, we consider *wealth inequality* and *democratization* as key markers. SBTC also provides a rationale for the societal segregation that may emerge due to ICT-induced income inequality. Social network theory, on the other hand, helps explain how ICT applications may spread democratic values among individuals inside and outside of a country (Wasserman & Faust, 1994). Figure 2 presents a conceptual view of our research framework.

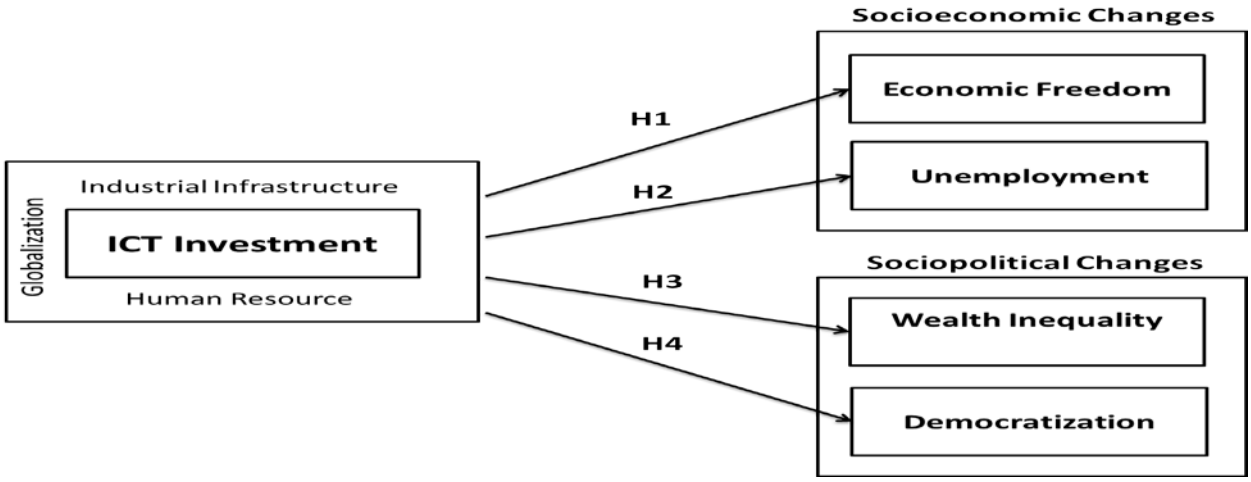

Figure 2. Research Model

The main hypotheses testing the impacts of ICT investments on overall societal transformation processes at an aggregate level (across economic groups) draw from the findings in extant literature presented in Table 4. Moreover, the subhypotheses for individual economic groups are also formulated based on each economic group's economic/political endowments and societal status quo.

3.1 ICT and Socioeconomic Changes

To assess socioeconomic changes, we follow prior studies and focus on *economic freedom* and *unemployment changes* (Dewan & Kraemer, 2000; Kraemer & Dedrick, 2001; Brynjolfsson & McAfee, 2011).

3.1.1 Economic Freedom

According to the Heritage Foundation (2012), economic freedom indicates not only a country's economic growth, such as increases in GDP per capita and labor productivity, but also a set of economic conditions for sustained economic advances, including the degree of free market development, investment freedom, and financial freedom. To investigate the impact of ICT on a country's overall socioeconomic improvements, researchers should seek a genuine understanding of the specific role that ICT plays in cultivating economic freedom.

Prior work on ICT-driven economic growth principally relies on a neoclassical framework that would assume that the resources invested in ICT are equivalent in nature to those in other types of capital. This treatment overlooks the unique properties of ICT diffusion and usage and ignores how ICT functions in different economic groups; thus, this neoclassical framework can be restrictive when applied to ICT. For instance, using the growth accounting methodology developed by Solow (1956 and 1957), Piatkowski (2006) showed that ICT investments may increase long-term economic growth in transition economies by stimulating productivity growth at the industry level. Solow's growth model, however, treats technological progress as exogenous and extraneous, since it does not explain the sources of technological progress.

Countries adopt ICT applications with different orientations and intentions based on their existing societal conditions. To reflect this reality, we employ endogenous growth theory to illuminate the links between technological innovation and economic growth and to provide an explanation for the ICT impacts of innovation adoption decisions. Romer (1990) proposed endogenous growth theory for technological innovation, which attributes technological progress to systematic efforts made by goal-seeking economic agents. Per this theory, an agent performs a cost-benefit analysis to determine innovation investments. Thus, decision makers are incentivized to pursue sustained economic growth and cultivate economic changes resulting from investments in technological innovations. It is noted that sustained economic growth refers not only to continued increases in such economic indicators as GDP but also to the improvement in the overall economic condition (i.e., economic freedom) that can stimulate societal transformations in an effective way unique to each economic group.

In transition economies, ICT serves as a tool for improving economic conditions, primarily for transforming centrally planned economies into market-driven economies with a strong absolute power (Meng & Li, 2002; Piatkowski, 2004). This argument is supported by the observation that many governments in TEs take charge of economic planning, and their key officials make critical resource allocation decisions (Shleifer, 1997).

Additionally, relatively high levels of industrialization provide TEs with better infrastructures for facilitating economic improvements through ICT (Meng & Li, 2002; Samoilenko & Osei-Brynson, 2010).

In terms of adoption and usage of ICT, developed and developing economies may also introduce ICT applications and use them to boost their economies. However, unlike TEs, these economies are not committed to economic liberalization or to achieving drastic improvements in economic indicators (Roztocki & Weistroffer, 2008b). In other words, developing and developed economies adopt ICT mainly to improve labor productivity and economic growth (Baliamoune-Lutz, 2003), but do not typically use ICT to specifically improve economic freedom indicators.

Economic freedom indicators include the degree of trade freedom, investment freedom, and financial freedom (Heritage Foundation, 2012). Trade freedom measures tariff and nontariff barrier restrictions according to quantity, price, regulation, customs, and government intervention. Among the three economic groups we address, transition economies have experienced a loosening of such restrictions during the past two decades, and ICT can help with this development by facilitating relevant information nsharing in a timely fashion (Roztocki & Weistroffer, 2011). For investment freedom, ICT-related foreign investments have been identified as a crucial component for the development of TEs, especially concerning investments by well-established global companies (Soja & de Cunha, 2015; Roztocki & Weistroffer, 2015). Financial freedom refers to an accessible financial banking system that can ensure the availability of diversified savings, credit, payment, and investment services. Because a sound banking system relies on a functioning ICT infrastructure, ICT use in transition economies can enhance their financial freedom (Leonardi et al., 2016). Taken together, we expect ICT adoption and usage to benefit TEs in the area of economic freedom.

Investments in ICT, coupled with the purposeful utilization of the economic benefits gained, have a positive impact on the overall economic conditions in TEs; however, we do not expect such investments to be associated with improved economic conditions in developing or developed economies (although they will still contribute to growth in GDP and labor productivity). Based on these arguments, our first main hypothesis indicates a positive effect at the aggregate level for economic freedom, while its subhypotheses indicate a substantive effect expected for transition economies and a limited effect for developing and developed economies.

- **H1:** Investments in ICT are positively associated with overall economic freedom.
- **H1a:** For developing economies, investments in ICT are not associated with overall economic freedom.
- **H1b:** For transition economies, investments in ICT are positively associated with overall economic freedom.
- **H1c:** For developed economies, investments in ICT are not associated with overall economic freedom.

3.1.2 Unemployment

Introducing and harnessing of new technologies for economic activities (e.g., production) can be skill intensive and create a skill-biased labor demand (Eicher, 1996). In line with this assertion, prior studies suggest that ICT adoption can lead to job loss for unskilled workers. Meng and Li (2001) examined the displacement effect associated with ICT on unemployment in developing and developed countries and found that IT dynamics have replaced low-skilled labor but increased the demand for skilled laborers, which, being more educated and experienced, tend to cope better with technological change (Galor & Moav, 2000).

The negative impact of ICT on overall job creation can be articulated through skill-biased technological change (SBTC). Skill-biased technological change refers to the “shift in the production technology that favors skilled over unskilled labor” (Violante, 2007), implying that technological change is complementary with human capital. SBTC is viewed as an extension of endogenous growth theory (Eicher, 1996; Hollanders & Weel, 1998). Endogenous growth theory assumes that technological change is endogenously determined by innovators’ economic incentives based on exogenous homogeneous human capital (i.e., labor skill). Consequently, the theory considers technology as a complement for both high- and low-skilled labor (Romer, 1990). SBTC takes one step farther to posit that endogenous technological change influences innovators’ incentives to leverage human capital distributions (i.e., supply and demand of different skilled labor), and accordingly considers technology as a complement for high-skilled labor only and as a substitute for low-skilled labor (Eicher, 1996; Violante, 2007). Recent studies have found that innovations in IT lead to skill-biased technological changes, and such an increase in skill demand arises from falling IT prices and the increasing use of IT (Brynjolfsson & McAfee, 2011). Bresnahan et al. (2002) found that U.S. firms adopting innovations in IT, complementary workplace reorganization, and new products and services tend to employ more skilled labor.

The transition from low-skilled to high-skilled labor within a country can be reflected by changes in labor compositions. While professional workers are generally engaged in highly skilled occupational categories, such as business service and high-tech sectors, low-skill workers are mostly employed by agricultural and manufacturing sectors. Figure 3 illustrates the labor compositions of the three economic groups in our study across three major industry sectors—agriculture, manufacturing, and service—over the 18 years spanning 1995 and 2012.

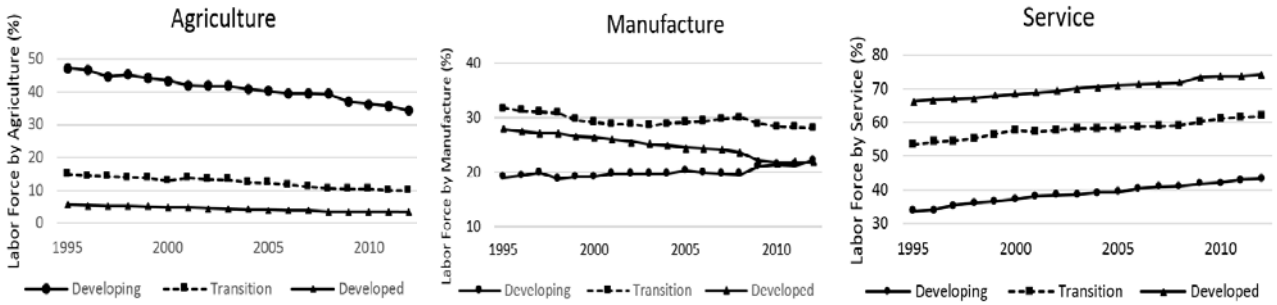

Figure 3. Composition of Labor Force by Industry

Notably, each economic group shows the highest percentage of labor forces in a different sector. Agriculture has been the dominant employment sector in developing economies. Meanwhile, manufacturing and service industries have been the main employers for TEs and developed economies, respectively. Overall, all three economic groups have rapidly shifted toward the service-oriented employment sector over the past two decades.

We examine the strategic roles of IT—automate, informate, and transform (Dehning et al., 2003)—deployed by each economic group to assess the different impact of ICT on its employment. For *automate*, the role of IT is to replace inefficient human labor with information technology, reflecting how developing economies utilize technologies to substitute IT-based machinery for unproductive labor work (e.g., using automatic harvesters in place of humans for farming). For *informate*, IT is used to provide information to higher and lower levels of an organization to aid decision-making and empower employees with relevant information and knowledge. The informate role of IT becomes especially prominent for transition economies as the division of labor at plants requires a smooth flow of accurate, timely information in the manufacturing sector. Finally, for *transform*, IT alters industry structures and competitive forces. Developed economies have experienced this transition in the last two decades with their transformation from manufacturing-based economies to service-based economies (Chou & Shao, 2014). Therefore, developed countries that use IT in a transformative manner are more prone to radical economic changes (Dehning et al., 2003).

In developing countries, ICT is a key instrument in creating more new jobs, as opposed to replacing old ones (Steinmueller, 2001; Heeks, 2008). At the early stages of ICT adoption, technological advances take on a pivotal role in creating job opportunities for skilled workers, who can utilize newly introduced technologies in the agriculture and manufacturing sectors that account for 70% of the workforce in developing countries. In the later stages of ICT adoption, ICT applications have made labor markets more inclusive and global as these countries move toward service-oriented infrastructure, as depicted in Figure 3. Many ICT-enabled services have increased international trade as a result of technological advances. One case in point is India, where ICT-enabled telecommunication outsourcing and offshore software development have gained tremendous momentum over the past decade. Low levels of existing infrastructure have actually enabled countries like India to leapfrog generations of existing technologies by directly adopting state-of-the-art solutions that became prevalent through substantial ICT injection. Moreover, the growing investment in human resources across developing economies has fostered their ability to create more new jobs faster than the jobs that are lost due to new technologies. Therefore, we would expect the impact of ICT on job creation to be positive in such countries.

In TEs, the structural makeup and job distribution across the three main industrial sectors position TEs well for the creation of jobs that require specialized skills and domain knowledge of ICT for related industries. Over the years covered in our study, CEE countries have increased their average ICT spending per GDP from 2.9% to 8.9%, and TE countries in Latin America have increased theirs from 3.1% to 5.5%. According to the World Bank's 2012 report on ICT and its impact on job creation, the demand for ICT goods and services has created new jobs, and each additional job in the ICT sector also generates between two and four new ones in other fields.

By contrast, in developed economies, ICT-enabled changes have led to the displacement of many jobs, especially in the service sector (Ford, 2015). As the pace of ICT advancement continues to accelerate and machines become smarter, fewer people will be needed and many good jobs are disappearing. Office workers, paralegals, cab drivers, accountants, journalists and other service jobs are being replaced by robots, driverless cars, and smart software (Brynjolfsson & McAfee, 2014). As the technological displacement of labor plays out, both blue- and white-collar jobs disappear, which pressures working- and middle-class families further and leads to higher unemployment and inequality (Ford, 2015). In other words, in developed economies that are highly reliant on service-related industries, technological unemployment has become a prevalent issue. While ICT creates jobs such as software design and information system management that require a highly trained workforce, it also causes the displacement of other, less-skilled workers and a net loss of job opportunities (Pistono, 2014).

Based on the above arguments, we expect varied impacts of ICT investments on job creation:

- **H2:** Investments in ICT are negatively associated with the rate of unemployment.
- **H2a:** For developing economies, investments in ICT are negatively associated with the rate of unemployment.
- **H2b:** For transition economies, investments in ICT are negatively associated with the rate of unemployment.
- **H2c:** For developed economies, investments in ICT are positively associated with the rate of unemployment.

3.2 ICT and Sociopolitical Changes

To assess the impact of ICT investments on sociopolitical changes in each economic group, we focus on *wealth inequality* and *democratic values*, both of which are frequently used for measuring sociopolitical improvements (Alesina & Perotti, 1994).

3.2.1 Wealth Inequality

Since the Great Recession began in December 2007, wealth distribution has become a serious concern and a hot topic for debate by academics and policy makers (Deaton, 2013; Piketty, 2014). It has been suggested that this social polarization is caused by income disparity resulting from increasing globalization and rapid technological progress (Summers, 2014). Studies on income inequality, for example, have identified globalization (Dreher & Gaston, 2008; Freeman, 2009), changes in household structure (Daly & Valletta, 2006), and regulatory reforms (Bassanini & Duval, 2006) as sources of widening income inequality.

Several recent studies have examined the association between ICTs and income inequality based on skill-biased technological change. Both Flores (2003) and Katagiri (2010) found that advances in ICT favoring highly skilled workers have broadened income dispersion and aggravated the struggles of workers with low skills. According to the IMF (2007), technical change is a driver for increased wage dispersion, even more powerful than globalization and international trade integration. Technological progress has contributed to the widening wealth gap based on the value of labor skills, as high-skilled workers are well compensated and low-skilled workers are paid less or even risk losing their jobs (OECD, 2011). One main reason for the greater inequality is that the salaries of higher earners have been rising faster than those of lower earners in all OECD countries (Moffett, 2011). With the aid of ICT, free trade and globalized markets have generated a shift in labor demand in favor of high-skilled workers at the expense of low-skilled labor.

An economy's employment composition as depicted in Figure 3 can be an important factor in determining job opportunities for workers of different skill levels and consequently may contribute to widening income inequality. For developed economies, low-skilled laborers in the low income group have seen their slice of the pie reduced. Between 1975-2008, in most OECD countries, the incomes of the richest 10% grew at a much higher rate than those of the poorest 10%, and the average income of the top 10% of the population is about nine times that of the bottom 10% (OECD, 2011). This widening income gap in developed economies can be attributed in part to the service-oriented job composition. This technological displacement results in high unemployment and widening inequality. That is, developed economies are more prone to wealth inequality caused by technology (Katagiri, 2010). Thus, many lower-skilled workers in developed countries drop further in the income distribution. Many economists argued that in developed countries, top 1% incomes are now mostly salaries, not capital incomes, and the rise is due mainly to globalization and technological change (Summers, 2014; Piketty, 2014).

In developing economies, the indices of income inequality have decreased over the past two decades, with a drop in Gini index from 40.12 to 36.46. Several factors may influence this improving trend. Among them is the utilization of ICT, which helps close the gap of income dispersion. In the early periods of ICT adoption, investments in ICT may dramatically change the income distribution across labor's skill levels because agriculture-centric

developing economies still require intensive physical labor, the productivity of which can benefit greatly from automation. Meanwhile, the growing demand in ICT-enabled manufacturing and service sectors allows workers to take advantage of new jobs with higher compensation in these sectors.

In principle, centrally planned economies distribute income more evenly than market-based economies. At the beginning stages of a transition, increased income inequality is a common phenomenon for TEs. Kolodko (1999) suggested three reasons for rising income inequality in transition economies: 1) the reduction of state subsidies; 2) reduced employment from the state sector; and 3) the shift of labor from the state to the private sector, which offers a wider range of compensation. At the later stages of transition, however, the sources that previously increased income disparity may influence income distribution less than at the early stages.

Compared with developing economies, TEs have better and richer human resources (i.e., a larger portion of high-skilled labor), allowing them to utilize and harness new technologies more easily. This is supported by the fact that human development indices (HDI) in TEs surpass those in developing economies, indicating that ample numbers of skilled workers are available for better-paying jobs.

With regard to the use of ICT across economies, we expect that technological advances favor skilled and educated workers but lead to greater wealth inequality in developed economies, and that ICT closes the income disparity in developing and transition economies either by helping lower-skilled labor become more productive and better compensated or by creating more jobs for skilled workers in ICT-related sectors. As such, we hypothesize:

- **H3:** Investments in ICT are positively associated with wealth inequality.
- **H3a:** For developing economies, investments in ICT are negatively associated with wealth inequality.
- **H3b:** For transition economies, investments in ICT are negatively associated with wealth inequality.
- **H3c:** For developed economies, investments in ICT are positively associated with wealth inequality.

3.3 Democratization

ICT can play a pivotal role in facilitating democratization in countries. Democracy ("rule by the people") requires active engagement of citizens, which is considered a critical prerequisite condition for facilitating the democratization processes. Naturally, democratization can be influenced by various factors, including economic development, history, and civil society, among others (Rummel, 1994). ICT investments have been regarded as an enabler for democracy, especially for stimulating civic involvement in social causes. For instance, ICT provides effective tools for promoting public participation in the democratization process in the forms of e-democracy (Clift, 2004), e-government (Anttiroiko, 2003; Olphert & Damodaran, 2007), and quicker dissemination of opinions, thoughts and ideas; it also offers a mechanism for rallying concerned citizens into taking social action (Shirazi, 2008).

Studies on ICT for development (ICT4D) have highlighted the significant role of the Internet and mobile phones in facilitating a country's evolution (Heeks, 2008) and have emphasized such "hybrid solutions" for social development as the combined use of conventional media—such as TV, newspaper and radio—with ICT applications (SIDA, 2009). Researchers have devoted sustained interest and attention to the relationship between communication media and democracy. As Rummel (1994) argued, one of the conditions for achieving democracy is that "the newspapers and other communication media are free to criticize government policies and leaders." In various parts of the world, such democratic citizen-engagement with the media has sped up in recent years due to new ICT applications, such as the Internet, mobile phone services, online forums, and short message services (SMS). Social networking also has become a valid catalyst for spreading democratic values among individuals within and across countries.

Social network theory concerns the structure of relationships among social entities such as persons, organizations and countries. It identifies the diffusion patterns of new thoughts and ideas as well as information and rumors (Wasserman & Faust, 1994). A network is a map of the relevant ties between nodes (i.e., individuals or organizations). These ties are dynamically connected, ranging from regular forms (i.e., one-to-one or one-to many relationships) to full randomness (i.e., many-to-many relationships), as the network evolves (Watts & Stogatz, 1998; Watts, 1999). Recent studies on "small world networks" have presented an evolutionary network in the Internet era and have shown how the Internet helps people in different locations link together effectively. Backstrom et al. (2012) found that only four degrees of separation exist on Facebook, which is significantly closer than the six degrees of separation in the general population identified in the 1960s (Milgram, 1967). ICT diffusion radically changes the way information flows and stimulates active interactions among citizens through network effects. This suggests that ICT applications enable individuals to communicate their opinions and

ideas, uninhibited by geographical or temporal limitations, and allow them to form social networks for sharing common beliefs (e.g., the democratic values examined in this study). Accordingly, ICT can be viewed as a medium for creating networks that transform relationships and facilitate interaction for the purpose of promoting democratization.

For economic development, ICT plays a key role in integrating isolated economies into the global market and spurring the rise of worldwide electronic business activities (Zembylas & Vrasidas, 2005). Similarly, for social movement, ICT can play a mediating role in civil democratic processes by facilitating citizen participation and decision-making (Noveck, 2000). The sharing of democratic values through ICT is more likely to influence democratization processes in developing and transition economies than in developed countries, which already enjoy a high level of democracy.

The varying strengths of interpersonal ties in economic groups also help determine the effects of ICT on sociopolitical change. The strength of interpersonal connections in a network is determined by the similarity of two individuals (Granovetter, 1979). Strong-tie relationships are often formed between like-minded people who share similar interests, needs, and goals. Moreover, strongly attached relationships can be easily connected within close interpersonal networks (Granovetter, 1983). In general, high anxiety and a passion for democratization among citizens creates stronger ties in developing and transition economies than in developed economies. Increased connections with other people motivate individuals in developing and transition economies to become more involved with social networking in the process of achieving democratization through ICT. Moreover, because sociopolitical liberalization generally comes after the stabilization of economic conditions (Soper et al., 2012), we expect the enhancement of democracy via ICT to occur in TEs.

In developing economies, ICT may have different impacts on democratic values at different stages of development (Shirazi, 2008). At the early stages, for example, ICT infrastructure issues, such as the lack of resources to invest in ICT, limited public access to digital services, and insufficient ICT education and training, are likely to exist. Over time, with economic development, increasing interest in the use of ICT in these countries—seen in attempts to develop and support e-government, e-health, and e-commerce, for example—reflects efforts to enhance democracy through ICT. In summary, we present our fourth and final set of hypotheses:

- **H4:** Investments in ICT are positively associated with democratization.
- **H4a:** For developing economies, investments in ICT are positively associated with democratization.
- **H4b:** For transition economies, investments in ICT are positively associated with democratization.
- **H4c:** For developed economies, investments in ICT are not associated with democratization.

4 Data Analysis

4.1 Classification of Economic Groups

For the purposes of this study, we defined three economic groups: developing, transition, and developed economies (see Table 6) and collected sample data to instantiate each of these groups. Based on data availability, we identified a total of 37 countries using the IMF and World Bank's classifications (IMF, 2000a and 2000b; World Bank, 2004).

Table 6. Classification of Economic Groups

Economic groups (IMF 2000a & b)	Group by income (World Bank 2004)	GDP per capita range (World Bank 2004)	Countries (Ordered by GDP per capita)
Developing economies (7)	Low-income to lower-middle-income	$658-$3,212 (avg: $1,536)	Malaysia, Thailand, Indonesia, Egypt, Philippines, India, Vietnam
Transition economies (12)	Upper-middle-income to high-income	$3,290-$11,925 (avg: $7,540)	Slovenia, Czech Republic, Slovakia, Hungary, Poland, Chile, Venezuela, Brazil, Bulgaria, Argentina, Romania, Colombia
Developed economies (18)	High-income OECD	$16,918-$64,545 (avg: $35,804)	Norway, Switzerland, Denmark, United States, Sweden, Netherlands, United Kingdom, Belgium, Japan, Canada, France, Australia, Germany, Italy, New Zealand, Spain, Portugal, South Korea

4.1.1 Developing Economies

This group is categorized by the World Bank report as having low- to lower-middle incomes (World Bank, 2004). The countries in this group are principally in Southeast Asia and Northeast Africa. Typically, their economies depend heavily on the exploitation of natural resources, and a large portion of the labor force works in the agriculture sector. ICT usage in these developing economies has explicitly been targeted for stimulating economic growth and enhancing the possibilities of global engagement.

4.1.2 Transition Economies

Countries included in this group classification are typically in the CEE and Latin America. The CEE countries included in this study were previously part of the Soviet Union's sphere of influence. As such, their transitions all began in 1990 with the collapse of the USSR and the subsequent dismantling of communism in Eastern Europe. While the overall economic and societal indicators of these CEE countries are now relatively stable, their economic markers have remained below the European and OECD average benchmark (World Bank, 2012). Exemplar economic indicators, such as GDP per capita and employment ratio, for this group of countries are much lower when compared with OECD countries. These countries continue to strive for higher living standards, and there tends to be a broad expectation that ICT will contribute in a balanced way to economic and political improvements. Interestingly, this group of CEE countries has relatively high rates of ICT spending, as approximately 6.9% of its GDP was spent on ICT—which is 1.5 times higher than the average spending of Latin American countries and higher than some of other OECD countries. This emphasis on ICT investments likely reflects their intentions and aspirations for leveraging ICT.

Our study also includes seven countries in Latin America because, in a broader sense, the definition of transition economies applies to these countries, which have low absolute but fast-growing income levels as well as authorities who are committed to economic and political liberalization (Arnold & Quelch, 1998). Since their respective transitional years, the selected Latin American countries have experienced significant economic and political restructurings, which were mainly triggered by political liberalization. These TEs have healthier economic indicators than other countries in the region but are still undergoing political and economic liberalization and societal changes. Across these countries, GDP per capita has continuously increased over the past decade, yet the gap in income distribution is still higher than that in the group of CEE in TEs. Moreover, ICT-related social issues, such as limited public access to digital services and education, lack of legal frameworks that encourage ICT investments, and unaffordability of ICT goods and services, are still unsettled hurdles. Over the last decade, these countries have increasingly promoted the use of ICT and have attempted to develop and support e-government, e-health, and e-commerce systems (Santos, 2009).

4.1.3 Developed Economies

The countries included in this group classification are high-income OECD members and hence are labeled as "developed." Unlike the other two economic groups, these OECD countries are geographically dispersed. This group is characterized by strong economic markers as well as a mature industrial base and stable infrastructures, as well as long histories of political stability. These countries have the highest levels of achievement in economic performances, such as GDP per capita. However, in the recent past, sociopolitical problems have arisen in some of these developed economies. For instance, income inequality has led to outbreaks such as the "Occupy Wall Street" movement in the United States (Denning, 2011), political turmoil in Japan (Nakai & Nishimoto, 2011), and street protests in the United Kingdom and France (Townsend, 2011). Still, when compared globally, countries in this group of developed economies have sound economic conditions and stable political structures.

4.2 Data Description and Measurement

We conducted our analysis on a comprehensive country-level dataset over 18 years (from 1995 to 2012). The results of the study are based on 37 countries (see Table 6) that cover the three economic groups—developing, transition, and developed. Data were consolidated from publicly available sources, including the World Bank, CIA, United Nations, World Trade Organization, Heritage Foundation, and Digital Planet. Economies are grouped using variables extracted from these datasets. We present descriptive statistics providing an initial comparison of economies in Table 7.

Since the data for ICT spending are not publicly available (especially for the early period of 1995 to 2003), our sample included a smaller number of representative countries for developing and transition economies (7 and 12 countries respectively) when compared with the dataset from developed economies (18 countries).

Table 7. Summary Statistics of the Dataset

Variables	Description and data source	Overall (*N*=666) Mean (Std. Dev.)	Developing economies (*N*=126) Mean (Std. Dev.)	Transition economies (*N*=216) Mean (Std. Dev.)	Developed economies (*N*=324) Mean (Std. Dev.)
Dependent variables (societal outcomes)					
Econ_freedom	Overall economic freedom -Value: 0 (not free) ~ 100 (free) -Source: Heritage Foundation	65.186 (9.492)	56.819 (7.307)	61.005 (8.487)	71.227 (6.424)
Unemployment	Unemployment rate (%) -Value: 0 (low) ~ 100 (high) -Source: The World Bank	7.591 (3.989)	5.306 (3.329)	10.095 (3.872)	6.810 (3.414)
Gini	Gini coefficient -Value: 0 (equality) ~ 100 (inequality) -Source: The World Bank	35.467 (9.114)	37.998 (5.933)	38.689 (12.666)	32.334 (5.598)
Political_freedom	Overall political freedom -Value: 1 (free) ~ 7 (not free) -Source: Freedom House	2.222 (1.432)	4.159 (1.176)	2.227 (1.061)	1.466 (0.949)
Independent variable (ICT Investments)					
ICT_spending	ICT-related spending per GDP (%) -Source: Digital Planet; The World Bank	5.897 (2.054)	4.912 (2.373)	5.503 (2.208)	6.542 (1.538)
Control variables (economic & industrial heterogeneities and globalization effects)					
HDI	Human Development Index -Value: 0.0 (low) ~ 1.0 (high) -Source: United Nations Development Programme (UNDP)	0.779 (0.123)	0.589 (0.087)	0.756 (0.071)	0.868 (0.050)
Agriculture	Labor force by occupation-Agriculture (%) -Source: CIA the World Factbook	13.922 (16.163)	41.104 (15.115)	12.395 (9.497)	4.370 (2.841)
Industry	Labor force by occupation -Industry (%) -Source: CIA the World Factbook	25.474 (6.371)	19.988 (5.318)	29.496 (6.790)	24.926 (4.369)
Service	Labor force by occupation-Service (%) -Source: CIA the World Factbook	60.289 (14.478)	38.891 (11.312)	57.961 (10.045)	70.163 (5.903)
Trade_export	International Trade Amount in Export (1 billion USD) -Source: World Trade Organization (WTO)	178.426 (242.785)	76.882 (66.089)	47.538 (46.096)	305.173 (294.378)
Trade_import	International trade amount in import (1 billion USD) -Source: World Trade Organization (WTO)	191.048 (300.806)	82.411 (81.106)	46.319 (43.942)	329.782 (380.187)

In addition, since our research variables include missing values for a few countries (mostly developing economies) in certain years, we supplemented those missing values using a two-step approach. In the first step, the missing economic and political indicators from the primary data sources (e.g., The World Bank) were imputed from other alternative data repositories proving the same information. For example, Gini Index values for a number of developing economies in 1990s were missing in the World Bank database (e.g., null values from 1995 to 1997 for Vietnam) and the empty values were filled out from the Trading Economics database and Google Public Data, which provide country-level historical data based on multiple official sources. Then, the remaining null values (e.g., the values are available in every other

year from 2002 to 2014 for Vietnam) after the first step were replaced with the mean of previous and next years' values. As such, we were able to minimize the loss of important information/values for our empirical analyses.

Finally, the dataset aggregated into each economic group was used to study the associations hypothesized between the related variables. In order to avoid the dominant impacts of certain variables on economies' societal outcomes, the variables were converted into comparable scales (e.g., *ICT_spending* [%] and *HDI* [0.0-1.0]). In addition, variables with a wide range of values were normalized by using a log transformation (e.g., *Trade_export*). To examine the impacts of ICT investments on socioeconomic and sociopolitical changes, we utilized four dependent variables of societal transformation processes, an independent variable of ICT investments, and a set of control variables.

- **Unemployment**: This dependent variable indicates the proportion of an economy's working-age population that was unemployed.
- **Gini**: This dependent variable indicates the level of wealth inequality in a country on a scale of 0 (perfect equality) to 100 (maximal inequality). A lower Gini coefficient indicates a more even income distribution.
- **Political_freedom**: This dependent variable indicates the level of democracy. The Freedom House annually assesses overall political freedom based on surveys measuring political rights and civil liberties in a country, and determines an overall status of democratic freedom on a scale from 1.0 (most free) to 7.0 (least free). Note the scale for political freedom is reversed for subsequent result interpretations. These political ratings have been widely used for measuring democracy by country-level studies (Shirazi, 2008; Soper et al., 2012).
- **HDI**: This variable is a composite measure of human development in a country. It combines three indices of life expectancy (life expectancy at birth), education (years of schooling), and income (GNI per capita).
- **Industry** and **Service**: These two variables indicate the respective percentage distributions of the labor force according to occupations in the industry and service sectors. The remaining percentage belongs to the labor force of the agriculture sector, which serves as the benchmark and is excluded from the model to avoid perfect collinearity in estimation.
- **Trade_export** and **Trade_import**: These variables indicate a country's annual international trade amounts (in billion USD) in commercial goods/services export and import. International trade measures the exchange of goods and services among countries in the world and has been widely used to evaluate the continuance of globalization of a country (e.g., Hummels, 2007).
- **ICT_spending**: This independent variable represents domestic spending on computer hardware and software, communication services, and communication equipment as a percentage of GDP. To compute a country's ICT spending per GDP, we utilized two data sources: annual ICT spending (in million USD) from Digital Planet and annual GDP from The World Bank.
- **Econ_freedom**: This dependent variable indicates overall economic freedom. It measures aggregated economic freedom in terms of rule of law, limited government, regulatory efficiency, and open markets with ten components of economic freedom for macroeconomic stabilization on a scale of 0 (not free) to 100 (free).

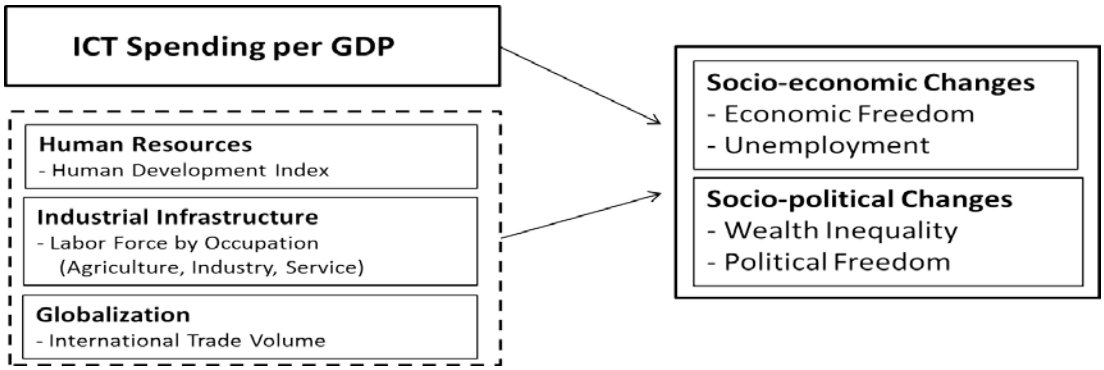

Figure 4. Empirical Framework

5 Research Methodology

5.1 Model Specification

Using our country-level dataset, we tested the proposed hypotheses. The research framework presented in Figure 4 leads to the following empirical model in Equation 1.

The hypotheses were tested using multiple dynamic panel models. Each model includes a socioeconomic (i.e., *Econ_freedom* or *Unemployment*) or sociopolitical (i.e., *Gini* or *Political_freedom*) outcome of a country *i* at time *t* as the dependent variable and an explanatory variable (*ICT_spending*), as well as a set of control variables for human resources factor (*HDI*), economic/industrial infrastructure (*Industry* and *Service*), and globalization effects (*Trade_export*) in each country to control for potential sources of endogeneity. Since *Trade_export* and *Trade_import* are highly correlated (p=0.94), we include only *Trade_export* to deal with globalization effects.

The possibility of an ongoing impact on societal outcomes is taken into account through the autoregressive term, $Outcome_{it-1}$, as specified in prior literature (e.g., Belogey et al., 2006). That is, the current societal process depends on its past realizations. η_t is a time fixed-effect term. A country-specific term α_i was used to account for unobserved heterogeneity among countries. Finally, ε_{it} is the error term and assumed to be correlated with (a subset of) regressors.

$$\begin{aligned} Outcome_{it} = {} & \beta_0 + \beta_1 (Outcome)_{it-1} + \beta_2 (ICT\_Spending)_{it-1} \\ & + \beta_3 (HDI)_{it} + \beta_4 (Industry)_{it} + \beta_5 (Service)_{it} + \beta_6 \ln(Trade\_export)_{it} \\ & + \eta_t + \alpha_i + \varepsilon_{it} \end{aligned} \quad (1)$$

To reflect a delayed causal effect between societal outcomes and ICT spending, we considered a time lag of one year, through which we longitudinally assessed the impact of ICT spending on subsequent transition processes. We estimated coefficients βs using multiple panel models for all the countries across three economic groups with societal outcomes.

5.2 Model Estimation

Since the right-hand side explanatory variables in equation (1) are likely to be endogenous and be highly correlated with the error term (ε_{it}), we utilized the Arellano-Bover (1995) and Bundell-Bond (1998) system generalized method of moments (GMM) estimator to investigate the dynamics in societal transformation processes driven by ICT and to control for potential endogeneity issues. The system GMM estimator for dynamic panel models combines moment conditions for the regression model in first differences with those for the model in levels (Bundell & Bond, 1998). It controls for endogeneity by using lagged values of the differences and levels of endogenous regressors as instruments, and produce efficient estimator. Accordingly, all the explanatory variables are modeled as GMM-style instruments and the year dummies are considered only as instruments in the level equation. As a result, we avoid the assumption of strict exogenous explanatory variables in our model specifications.

In order to remove the country-specific effects (α_i), we take first differences of the original model as follows:

$$\begin{aligned} \Delta Outcome_{it} = {} & \beta_1 \Delta(Outcome)_{it-1} + \beta_2 \Delta(ICT\_Spending)_{it-1} \\ & + \beta_3 \Delta(HDI)_{it} + \beta_4 \Delta(Industry)_{it} + \beta_5 \Delta(Service)_{it} + \beta_6 \Delta \ln(Trade\_export)_{it} \\ & + \eta_t + \Delta\varepsilon_{it} \end{aligned} \quad (2)$$

Because the differenced lagged dependent variable with the first lag $\Delta(Outcome)_{it-1}$ is likely to be correlated with the error term $\Delta\varepsilon_{it}$ (i.e., Cov[$Outcome_{it-1}$,ε_{it-1}] $\neq$ *0*), we constructed instruments for the lagged dependent variable from the second lag of *Outcome*. Because of the relatively small number of countries in our sample (especially in developing economies), too many instrument variables can cause an overidentification issue. Therefore, instead of longer lags, we used only the second lag of the variables as instruments. To validate our lag specification and its corresponding instruments, we performed the Sargan test of overidentifying restrictions (Sargan, 1958) by lengthening the lag durations from second lag to all lags, and failed to reject the null hypothesis of "over-identifying restrictions are valid" only when we restricted lag duration to the second lag across almost all the models. It suggests the second lags of the

variables are valid instruments. Since some models had overidentification issues mainly due to small number of countries (e.g., 7 developing economies) and long time period (i.e., 18 years), we considered the control variables (assumed to be endogenous in the main model) as exogenous instrument variables to reduce the total number of instruments, and the estimation outcomes were compared with those from the original models with GMM-style instruments. Overall, the estimates from the models with less GMM-style instruments are very similar to those from the original model with overidentification problems.

Furthermore, we conducted the Arellano-Bond test (1991) for autocorrelation (AR) test to examine whether the residuals of the differenced equation created serial correlation. Insignificant AR(2) statistics across all the models indicate that the second lags of valuables are appropriate instruments by not rejecting the null of no autocorrelation. The model specification test outcomes are presented in the estimation results tables.

Finally, we performed additional diagnostic tests to validate our model specification. First, the presence of multicollinearity was checked with variance inflation factors (VIF) for each explanatory variable in each regression model. None of the VIF values exceeded 2.99, indicating that multicollinearity was not an issue in our models. Next we checked whether time-specific effects needed to be incorporated for running a model by performing a joint test to see if all time (year) dummies are equal to zero. We rejected the null hypothesis that all time coefficients are jointly equal to 0, so we added year-specific effects to our models.

System GMM estimators are less efficient than fixed effects estimators, especially when the sample size is relatively small and the time period is relatively long. In this regard, the equivalent model specification was estimated using a fixed effects approach to check the robustness of our model specifications. We present the estimation results and robustness checks of the fixed effect models in Appendix A. Overall, the two estimators present qualitatively similar outcomes.

6 Results

We report two sets of results from the system GMM estimator. The first set of results includes the estimates from a pooled sample across the three economic groups and the second set of results presents the estimates from each economic group. As presented in Tables 8-10, we find the significant effects of ICT investment on certain societal outcomes at the aggregate-level analysis while the effects are insignificant at the individual-level analysis (e.g., the inconsistent estimation outcomes on economic freedom in the different levels of analyses) or vice versa. Such incongruent outcomes occur mainly because an aggregate-level analysis (or a pooled regression) aims at assessing the overall effects of explanatory variables on the outcome variable across the subject groups (i.e., common/homogenous intercept and slops) instead of fully considering heterogeneity between the groups (Bass & Wittink, 1975). Furthermore, the estimates from an aggregate-level analysis are significantly affected by larger observations in the subject groups. In our dataset, the developed and transition economic groups have much larger records (over time) than the developing economies. As a result, we highlight the findings from economic group-level analyses to understand the different roles of ICT in fostering social transformation for the three economic groups. In addition, the estimation results from fixed effects (FE) are presented in Table A1 in Appendix A for comparison.

6.1 ICT Impact on Societal Changes across Economic Groups

To test our main research hypotheses, we estimated the overall effects of ICT spending on societal transformation outcomes in the sampled 37 countries across the economic groups. The estimation results are presented in Table 8.

Table 8. Analysis Results of Societal Changes across Economic Groups

Variable	Socioeconomic outcomes		Sociopolitical outcomes	
	Economic freedom estimate (std. error)	Unemployment rate estimate (std. error)	Wealth inequality estimate (std. error)	Political freedom (on a reverse scale) estimate (std. error)
$ICT\_spending_{it-1}$	0.251 (0.078)**	-0.043 (0.0170)*	0.015 (0.027)	0.005 (0.008)
HDI_{it}	6.695 (3.207)*	-1.565 (0.986)	-1.971 (2.496)	-0.628 (0.322)
$Industry_{it}$	-0.024 (0.031)	0.017 (0.011)	-0.016 (0.024)	0.001 (0.003)
$Service_{it}$	-0.020 (0.019)	0.027 (0.008)***	0.004 (0.017)	0.003 (0.002)
$ln(Trade\_export)_{it}$	-0.532 (0.209)*	-0.254 (0.081)**	-0.013 (0.150)	0.016 (0.021)
$Econ\_freedom_{it-1}$	0.951 (0.024)***		.	.

Unemployment$_{it-1}$	.	0.888 (0.017)***	.	.
Gini$_{it-1}$	.	.	0.964(0.019)***	.
Political_freedom$_{it-1}$	.	.	.	0.962 (0.0161)***
Sargan test (p-value)	0.159	0.336	0.111	0.307
Autocorrelation test (p-value) - AR(1) / AR(2)	0.000 / 0.959	0.003 / 0.315	0.000 / 0.645	0.000 / 0.291
Controls as GMM-style instruments	Yes	Yes	Yes	Yes
Sample size	629	629	629	629
*= p <.05, **=p <.01, ***= p <.001 *Notes:* η_{it} variable was included in the analysis, but not reported here.				

The findings from the aggregate-level analysis support the hypotheses regarding the ICT impacts on socioeconomic outcomes (H1: economic freedom and H2: job creation) derived from extant literature. ICT spending per GDP significantly improved the overall economic conditions and decreased unemployment rates across the three economic groups. Meanwhile, ICT investments had insignificant associations with wealth inequality and political freedom, which deviate from the findings of prior studies in Table 4. The following subsection presents the detailed results based on the economic groups.

6.2 ICT Impact on Societal Changes within Economic Groups

The results of ICT impacts on socioeconomic and sociopolitical changes within economic groups are presented in Tables 9 and 10. Overall, the group-specific findings from our analysis mostly support our subhypotheses on different associations between ICT and societal changes in the three economic groups. Notably, while the estimates of *ICT_spending* in developing and transition economies are negatively associated with unemployment rates, it is positively associated with job loss in developed economies. However, we do not find significant ICT impacts on economic freedom in any economic group. In terms of sociopolitical outcomes, only developing economies have seen their income inequality reduced with *ICT_spending*, but transition economies have experienced increased gaps in income distribution as ICT spending increases. Lastly, with regard to the relationship between ICT spending and political freedom across economic groups, the results suggest that only transition economies have enhanced political freedom from ICT.

Table 9. Analysis Results of Socioeconomic Changes within Economic Groups

Variable	Developing economies estimate (std. error)	Transition economies estimate (std. error)	Developed economies estimate (std. error)
Economic freedom			
ICT_spending$_{it-1}$	0.094 (0.232)	0.199 (0.148)	-0.120 (0.102)
HDI$_{it}$	6.275 (12.870)	-1.319 (6.124)	-4.117 (5.414)
Industry$_{it}$	-0.018 (0.069)	0.041 (0.061)	0.047 (0.073)
Service$_{it}$	0.021 (0.042)	-0.038 (0.025)	0.094 (0.058)
ln(Trade_export)$_{it-1}$	0.133 (0.341)	0.069 (0.343)	-0.207 (0.149)
Econ_freedom$_{it-1}$	0.830 (0.083)***	0.947 (0.028)***	0.941 (0.027)***
Sargan test (p-value)	0.130	0.294	0.190
Autocorrelation test (p-value) - AR(1) / AR(2)	0.003 / 0.549	0.000 / 0.823	0.000 / 0.107
Controls as GMM-style instruments	No	Yes	Yes
Sample size	119	204	306
Unemployment rate			
ICT_spending$_{it-1}$	-0.105 (0.048)*	-0.309 (0.076)***	0.077 (0.034)*
HDI$_{it}$	-3.429 (2.815)	-4.758 (2.322)*	-7.799 (2.007)***

$Industry_{it}$	0.012 (0.021)	0.041 (0.025)	-0.027 (0.025)
$Service_{it}$	0.035 (0.022)	0.026 (0.010)*	0.001 (0.020)
$ln(Trade\_export)_{it-1}$	-0.075 (0.106)	-0.180 (0.133)	-0.046 (0.049)
$Unemployment_{it-1}$	0.889 (0.063)***	0.852 (0.031)***	0.962 (0.015)***
Sargan test (p-value)	0.526	0.238	0.671
Autocorrelation test (p-value) - AR(1) / AR(2)	0.000 / 0.236	0.008/0.109	0.000 / 0.183
Controls as GMM-style instruments	No	No	Yes
Sample size	119	204	306

*= p <.05, **=p <.01, ***= p <.001

Notes: η_{it} variable was included in the analysis, but not reported here.

Next, we examine the detailed socioeconomic and sociopolitical changes derived from ICT spending across the economic groups, as follows:

6.2.1 ICT and Socioeconomic Changes

In regard to the relationship between ICT and changes in economic freedom, the estimates of *ICT_spending* in Table 9 present insignificant associations across the economic groups. These findings support the subhypotheses on the ICT spending in developing (H1a) and developed (H1c) economies. Since these two economic groups are less likely than transition economies to have a strong commitment to stimulating economic liberalization and to achieving drastic improvements in economic freedom indicators using ICT applications, the role of ICT is not manifest in this perspective. The evolving directions of estimates, however, suggest potentially significant ICT impacts on economic freedom. For developed economies, the negative sign suggests that although they have achieved economic prosperity aided by ICT in labor productivity and economic growth (Dewan & Kraemer, 1998; Meng & Li, 2002), they may also face unintended consequences regarding overall economic conditions that are required for sustaining prosperity. The growing influence of leading global firms in developed economies, for example, has diminished the role of governments as an economic coordinator.

We find that ICT spending significantly decreases unemployment rates in developing and TEs; thus, H2a and H2b are supported. This implies that ICT has led to net job gains in developing and transition economies by creating new ICT-related jobs and by transforming existing jobs to fit the requirements of new tasks. Notably, developed economies have experienced net job reductions with increased ICT spending where a unit increase in ICT spending per GDP led to a 0.309% increase in unemployment rate, so H2c is also supported. This result provides empirical evidence for the IT-based job-displacement argument in developed countries (Bresnahan et al., 2002; Brynjolfsson & McAfee, 2011). For developed countries, many lost jobs have been associated with or replaced by ICT applications that created demand for skilled workers who could adapt to ICT dynamics while reducing the need for many more lower-skilled workers. Brynjolfsson and McAfee (2011) reported a negative association between technological progress and job creation for the U.S. industries, but our results suggest that such a negative association may be prevalent in other developed countries as well. In summary, ICT indeed is a double-edged sword, as it not only plays a key role in improving socioeconomic changes for developing and transition economies, but it also has negative overtones for developed economies.

Table 10. Analysis Results of Sociopolitical Changes within Economic Groups

Variable	Developing economies estimate (std. error)	Transition economies estimate (std. error)	Developed economies estimate (std. error)
Wealth inequality			
$ICT\_spending_{it-1}$	-0.106 (0.021)***	0.072 (0.034)*	-0.003 (0.086)
HDI_{it}	22.260 (8.284)**	-1.632 (3.260)	-6.724 (4.870)
$Industry_{it}$	-0.129 (0.061)*	-0.042 (0.043)	-0.028 (0.062)
$Service_{it}$	-0.024 (0.035)	0.032 (0.010)**	0.021 (0.047)

ln(Trade_export)$_{it-1}$	0.377 (0.295)	0.073 (0.177)	0.103 (0.125)
Gini$_{t-1}$	0.803 (0.070)***	0.963 (0.021)***	0.981 (0.021)***
Sargan test (p-value)	0.103	0.065	0.913
Autocorrelation test (p-value) - AR(1) / AR(2)	0.001 / 0.576	0.000 / 0.379	0.000 / 0.736
Sample size	119	204	306
Controls as GMM-style instruments	Yes	No	Yes
Political freedom (on a reverse scale)			
ICT_spending$_{it-1}$	0.008 (0.028)	-0.050 (0.018)**	0.001 (0.006)
HDI$_{it}$	1.435 (1.138)	-2.675 (0.800)***	0.371 (0.344)
Industry$_{it}$	0.010 (0.010)	0.012 (0.007)	0.000 (0.004)
Service$_{it}$	-0.010 (0.006)	0.008 (0.003)**	-0.001 (0.003)
ln(Trade_export)$_{it-1}$	-0.123 (0.068)	0.007 (0.037)	-0.002 (0.009)
Political_freedom$_{it-1}$	0.924 (0.042)***	0.852 (0.049)***	1.003 (0.006)***
Sargan test (p-value)	0.361	0.163	0.435
Autocorrelation test (p-value) - AR(1) / AR(2)	0.002 / 0.476	0.000 / 0.666	0.000 / 0.700
Controls as GMM-style instruments	No	Yes	Yes
Sample size	119	204	306

**= p <.05, **=p <.01, ***= p <.001*

Notes: η_{it} variable was included in the analysis, but not reported here.

6.2.2 ICT and Sociopolitical Changes

In our analysis of the impacts of ICT spending on sociopolitical changes as presented in Table 10, we find significant but differing associations between ICT spending and wealth inequality across the economic groups. The estimates of *ICT_spending* on *Gini* coefficient show different effects for different economic groups. ICT spending significantly reduced income disparity in developing economies, so H3a is supported. Deviating from our expectation, income gaps widened with ICT spending in TEs, and ICT spending did not impact the income distribution in developed economics. This result suggests that the negative impact of ICT on income distribution occurs sooner with transition economies than expected with developed economies. Although developed economies have lost jobs as a result of their ICT spending, this has not further widened their income discrepancy between skilled and unskilled workers. Moreover, a significant positive association between ICT spending and income inequality in TEs shows that the benefits of ICT likely accrue to high-income people more than others. This finding suggests that TEs have been undergoing the sociopolitical problem of a widening income gap that developed economies had experienced in the past.

Regarding political freedom, TEs benefited from ICT spending, so H4b is supported. This finding corresponds to those reported in the extant literature (Grönlund, 2001; Shirazi, 2008; Soper et al., 2012). Strong societal liberalizations in CEE and Latin America (Galperlin & Mariscal, 2007) have led to the promotion of democratic values through ICT investments. Although we expected ICT spending to increase democratization in developing economies, our results indicate that the efficacy of ICT in stimulating democratic values in these societies was yet apparent. While the results of economic liberalization and macroeconomic stabilization often appear relatively quickly, as evidenced by the swift privatization of small enterprises during the early stages of the societal transformation process, improvements in sociopolitical values like democratization typically take longer to manifest. Such sociopolitical changes generally take root through significant and wide-ranging legal and institutional reforms.

In developed economies, not surprisingly, ICT did not improve overall democratic values, so H4c is supported. Since these developed countries already achieved a high level of democratic maturity, technological advances were less likely to further improve political freedom, thus showing limited

impact. Once again, this illustrates the double-edged role of ICT investments from a sociopolitical perspective. Table 11 summarizes our test results.

Table 11. Hypothesis Test Summary

	Overall	Developing economies	Transition economies	Developed economies
Hypothesis H1 (Economic freedom)	Supported	Supported	No	Supported
Hypothesis H2 (Unemployment)	Supported	Supported	Supported	Supported
Hypothesis H3 (Wealth inequality)	No	Supported	No	No
Hypothesis H4 (Democratization)	No	No	Supported	Supported

6.3 ICT Impacts on Societal Transformation over Time

Our main results are restricted to the overall impacts of ICT investment on societal transformation outcomes across the economic groups over the entire 18 years. We next investigated how the associations between ICT investments and the societal changes evolve over time. We divided the original dataset into two periods. Period 1 includes the years 1995-2003, and Period 2 encompasses the years 2004-2013. As presented in Figure 1, while the patterns of ICT spending varied among the economic groups in the first period, their ICT investment levels became consistent and converged in the second period. In addition, new ICT applications such as smartphones and social media via the Internet had become pervasive, and ICT-driven economic and political activities (e.g., e-government and Internet transactions) were more pronounced in Period 2 as compared with Period 1. Thus, we expect different impacts of ICT on fostering societal transformations across the economic groups between the two periods. We present a summary comparison of estimation outcomes from the two periods in Table 12, and the estimation results from system GMM are provided in Tables B1 and B2 in Appendix B.

Table 12. The Impact of ICT Investments on Social Changes in Different Periods

	Overall		Developing economies		Transition economies		Developed economies	
	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
Economic freedom 0 (not free) ~ 100 (free)	+***	+	–	–	+	+	+	–
Unemployment 0 (Low) ~ 100 (high)	–**	+**	–*	+	–**	+***	+*	+*
Wealth inequality 0 (equality) ~ 100 (inequality)	–	+**	+	+*	–	+**	–	+
Political freedom 1 (free) ~ 7 (not free)	–	+	+	+	+	–*	+	–
***= p <.05, **=p <.01, ***= p <.001**								

At the aggregate level, the countries benefited from ICT in improving economic freedom and creating more jobs in Period 1. Meanwhile, they experienced significant job loss and worsened income inequality in Period 2. Particularly, both developing economies and TEs created new job opportunities with more ICT spending in Period 1, but they confronted a widening gap in income distribution in Period 2. In addition, TEs significantly enhanced political freedom values in the second period. Regarding developed economies, more jobs were lost with ICT spending in both periods. Consequently, these results give us more confidence in characterizing the role of ICT as a double-edged sword in fostering societal transformations.

7 Discussion

Many studies on the impacts of ICT argue that ICT investments in developing and developed economies are beneficial, but few of them have accounted for the links between ICT and the unique societal properties of each economy. Unique attributes of societal transformation processes may be influential when

ICT use is coupled with an economy's societal endowment, and in certain instances, selective factors can influence the impacts of ICT. As an example, in developing economies, the concentration of the labor force in the agriculture sector may impede the deployment of ICT. Developed countries with mature economies and stable political systems encounter economic and societal challenges of a different nature. For instance, while GDP per capita has continuously increased over the past decade across all developed countries, the unemployment rate has increased significantly more when compared with those in the other economic groups. Therefore, to strengthen and extend the findings on this topic, more research is needed to investigate the potential downsides of ICT investments for different economic groups. Our study provides the first step taken in this direction.

Based on the proposed theoretical framework of Figure 4, we have investigated the distinctive role of ICT for three economic groups and the different contributions of ICT to each group's societal transformation outcomes. Our findings suggest that different economic groups experienced different impacts of ICT on societal transformations.

The results of our research suggest that the benefits of ICT to socioeconomic and sociopolitical changes depend on each country's stage in the economic development trajectory. As summarized in Table 13, distinctive contributions of ICT exhibit unique patterns in each of the three economic groups.

Table 13. Summary of Results across Economic Groups

	Overall	Developing economies	Transition economies	Developed economies
Economic freedom 0 (not free) ~ 100 (free)	**+****	+	+	–
Unemployment 0 (Low) ~ 100 (high)	**–***	**–***	**–*****	**+***
Wealth inequality 0 (equality) ~ 100 (inequality)	+	**–*****	**+***	–
Political freedom 1 (free) ~ 7 (not free)	+	+	**–****	+

*= p <.05, **=p <.01, ***= p <.001

While developing economies seem to benefit the most from ICT investments based on improvements in both socioeconomic and sociopolitical conditions indicated by the unemployment rate and wealth inequality, developed economies experienced a negative ICT impact on unemployment rates. In between, transition economies witnessed mixed effects of ICT investments on societal conditions. Synthesizing our results, Figure 5 presents the respective impacts of ICT investments across the economic groups. On the horizontal axis is GDP per capita. The the two dividing ranges ($3,212-$3,290 and $11,925-$16,198) are based on Table 6 and distinguish between developing and transition economies and also between transition and developed economies. On the vertical axis is the summation of the ICT benefits found in Table 13 for each economic group across the four outcome measures of economic freedom, unemployment, wealth inequality, and political freedom. For developing economies, we note that all the ICT effects are positive (i.e., lower unemployment and a closing wealth gap), so the trend curve is increasing. On the other hand, developed countries are associated only with negative ICT impacts (i.e., higher unemployment and a widening wealth inequality), so the trend curve is sloping downward. In between, transition economies experience some positive ICT effects (i.e., lower unemployment and greater political freedom) as well as a negative ICT effect (i.e., widening wealth gap). So in essence, transition economies move from the positive side of developing economies to the negative side of developed economies, and their trend curve reflects that transition. These three salient patterns identified in Figure 5 for the three economic groups are next discussed individually.

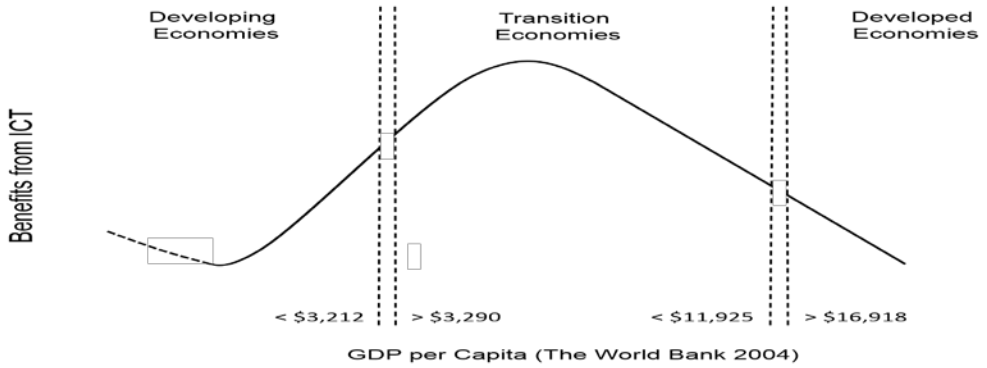

Figure 5. Trend of ICT Benefits across Economic Groups

7.1 An Increasing Trend of ICT Benefits in Developing Economies

Overall, developing economies benefit the most from ICT. The countries in this economic group demonstrate a strong motivation to leverage ICT to boost economic and political status, which translates to overall improvements in socioeconomic and sociopolitical changes. In particular, ICT-related investments have assisted countries in this economic group in creating more jobs and closing income gaps. As such, they have leveraged ICT investments to achieve increasing societal benefits. The findings highlight the role of ICT as an enabler that stimulates societal transformation processes by enhancing economic and political markers in order to move toward the next stage of societal development.

7.2 A Decreasing Trend of ICT Benefits in Developed Economies

We find a decreasing trend of ICT benefits in developed economies. Prior literature argues that developed economies have enjoyed the benefits of ICT in economic growth, but our findings suggest that based on prior experience, developed countries may not sustain such desired benefits with additional ICT spending. Instead, developed economies have already begun to experience higher unemployment rates as well as greater income inequality associated with ICT investments because these economies have perhaps already achieved the ceiling level of societal transformations that can be spurred by ICT investments. Furthermore, while a service-oriented economic structure facilitates ICT-related benefits for skilled labor, it tends to exclude other, lower-skilled workers from sharing such benefits.

7.3 A Transitional Trend of ICT Benefits in Transition Economies

The trajectory and trends emanating from ICT investments for transition economies are different when compared with developing and developed economies. The impacts of ICT on TEs reveal a transitional disposition (i.e., from increasing to decreasing) moving from developing to developed economies. Overall, ICT investments translate into strong positive effects for TEs, especially in terms of job opportunities and political freedom. Relatively high levels of industrialization and rich human resources that can be leveraged with ICT have helped the countries in this TE group migrate toward a mature, developed economy. However, like developed economies, TEs also experienced a negative impact of ICT on income disparity.

7.4 Moving toward an ICT-Enabled Bright Society

Our empirical findings yield significant implications for each economic group concerning how best to take advantage of ICT to further sustain societal improvements and minimize adverse effects.

7.4.1 Developing Economies

There is still room to leverage ICT for developing countries. Most of these countries still cope with severe problems regarding overall economic conditions and should strive for increased leverage of ICT leverage in order to facilitate the societal transformation processes that require long-term structural changes. As noted earlier, increased ICT spending has not yet been found to play an active role in improving levels of economic or political freedom. The relatively low utilization and slow diffusion of ICT within developing economies may be attributed to the immaturity of societal conditions. In addition, prevalent social issues, such as limited public access

to digital services, lack of legal frameworks, and the unaffordability of ICT goods and services, are also influential factors. Therefore, crafting the right policy and regulatory framework to promote better ICT utilization and creating ICT-friendly environments for citizens will be key to building a solid foundation conducive to fostering overall societal improvements in developing economies.

7.4.2 Transition Economies

Most prior studies on TEs have examined ICT-driven economic and political changes in the initial stages of the transition process. The typical argument these studies present is that the effects of ICT-enabled restructurings are biased toward economic outcomes and fade away after the initial transition years. In fact, these economies have experienced drastic socioeconomic changes in terms of economic reforms and the privatization of government-owned enterprises over the past two decades and are expected to face the undesirable consequences (e.g., job replacements by technologies) related to ICT, as already clearly manifest in developed economies. In addition, the sociopolitical shifts in democratization and political liberalization have not been fully completed. Substantial societal transformations may take longer to develop and their impacts would play out only at the later stages of transition. Therefore, key decision makers in this economic group are advised to carefully evaluate their transitional stage to determine the intent of ICT uses in the later years of transition, since ICT will become more essential and universal as the transition progresses.

7.4.3 Developed Economies

Although ICT generally has a diminishing impact in this economic group, as shown in our results, this does not imply that developed countries should cease ICT investments. The overall benefits from ICT investments are substantial, and also critical to ensuring a vibrant economy in a global setting. However, as we have shown, ICT is a disruptive innovation for developed economies. These advanced economies are already equipped with stronger economic indicators and more stable political systems than the other economic groups. As such, maintaining ICT investments should be viewed as a competitive necessity for sustaining a successful mature economy in the modern digital age.

The contribution of our study to the literature is two-fold. First and foremost, our results show that ICT exerts a nonuniform effect on societal transformations that varies with the stage of economic development. Developing countries benefit the most from ICT investments, while developed countries have to deal with the downside of digital disruptions, such as unemployment caused by automation and technical displacement. TEs, being at the intermediate stage of transiting from developing to developed economies, experience both benefits (lower unemployment and more political freedom) and pitfalls (a widening income gap). Second, our study takes a comprehensive approach to examining the impacts of ICT on societal transformations. Unlike most prior studies that focus on one particular measure (e.g., productivity), our study looks at economic freedom and unemployment as socioeconomic transformations and wealth inequality and political freedom as sociopolitical transformations. Deviating from prior studies, this multilens perspective not only leads to more insightful findings but also confirms the role of ICT as a double-edged sword that presents both opportunities and challenges in fostering a Bright Society.

On the theoretical front, our study also makes contributions. Endogenous growth theory argues that economic growth is mainly the result of endogenous forces, and not just external forces, and argues that investments in human capital, innovation, and knowledge are key to economic growth. Our study lends support to this argument by showing how investments in ICT can be one such endogenous force for promoting economic growth and, in the process, help lead to better socioeconomic and sociopolitical outcomes for a Bright Society. More importantly, our findings suggest that the impact of ICT is not uniform but dependent on the stage of economic endowment. As a result, there are associated challenges that should be made clear before they can be addressed. For instance, skill-biased technological change may lead to a higher unemployment rate and widening income inequality in developed economies by favoring skilled workers. These challenges and related issues should be carefully addressed by ICT initiatives with the aim of building a brighter and safer digital society.

Overall, our findings translate into different implications for policy-making and strategy formation concerning ICT adoption and usage. Because ICT offers tremendous value for creating jobs and narrowing income gaps for developing economies, these countries should adopt best practices and lessons learned from other, more developed countries in order to stimulate ICT use and further its development. Transition economies, on the other hand, should pay attention not only to the benefits, but also to the potential downsides of ICT use. The core issue is how to strike a balance between the two. Finally, developed countries must take a cautious approach by ensuring that true payoffs from ICT investments can be secured while negative impacts, such as displaced unemployment and a widened income divide, can be addressed.

8 Conclusion

This research illustrates that the role that ICT investments play is contingent on the stage of development of a nation-state. The results substantiate the different transformative effects that ICT has exerted for each economic group. Our evaluation of ICT investments ranges from no significant impact to a strong positive contribution for socioeconomic outcomes. These results are interesting and warrant further attention. For example, it would be important and interesting to investigate the nature and characteristics of increased unemployment in developed economies. Is ICT now displacing knowledge workers and, if so, what are the implications for developing and transition economy countries? On the sociopolitical front, our results are equally interesting and varied. We expected, for example, that concerning wealth inequality, ICT investment would narrow the gap in developing economies, and our results supported this expectation. However, we hypothesized a similar relationship for transition economies and a reverse association for developed economies, but these expectations proved to be either opposite or insignificant. These variations deserve follow-up attention.

It is interesting to note that at an aggregate level, ICT investments have an increasingly positive impact on developing economies. This impact, while initially increasing, slowly trends downward for TEs. This initially positive and subsequently negative trending suggests there are other, broader factors at play that warrant research attention. These results also suggest that policy makers should take a broad-based approach to ICT investments as a country matures economically, socially, and politically. For developed economies, our research showed that ICT investments have a negative impact from a socioeconomic (i.e., job creation) perspective. Looking at these results together, we suggest that ICT investments, combined with societal endowment and stage of economic development, do indeed represent a double-edged sword and can lead to varied positive or negative transformation outcomes.

By examining ICT investments over the last two decades, the findings of our study add to the extant literature. We provide new insights into the role of ICT investments for countries in different stages of economic development. We also identify a diverse set of issues for future research. While ICT has often been viewed as a silver bullet for growth and development, our study suggests that the specific effects and the utility of ICT investments are more nuanced and warrant a closer look. The results suggest ICT impacts are manifested in both socioeconomic and sociopolitical terms, and the orientation of these impacts is contingent on a broader set of factors that make such impacts salient in different ways at different growth stages—from developing, through transition, to developed. The double edge of ICT investments is highlighted by transition economies wherein increasing benefits are evidenced in the early stages but socioeconomic and sociopolitical inhibitors show up in the later stages of development.

In summary, our cross-country study shows that the stage of economic development is one key factor that affects the impacts of ICT on societal transformations in a country. Our findings thus carry significant implications for policy-making and strategy formulation related to ICT investment, deployment, and adoption.

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Appendix A: Estimation Results from Fixed Effects Models

Table A1. Analysis Results of Societal Changes from Fixed Effects (FE)

Variable	Overall estimate (std. error)	Developing economies estimate (std. error)	Transition economies estimate (std. error)	Developed economies estimate (std. error)
Economic freedom				
$ICT\_spending_{it-1}$	0.015 (0.083)	0.166 (0.283)	0.050 (0.192)	-0.134 (0.116)
HDI_{it}	-13.460 (7.265)	1.990 (21.83)	-11.090 (19.190)	-17.910 (10.52)
$Industry_{it}$	0.065 (0.057)	0.072 (0.131)	0.058 (0.163)	-0.002 (0.125)
$Service_{it}$	0.174 (0.047)***	0.283 (0.129)*	0.146 (0.095)	0.092 (0.108)
$ln(Trade\_export)_{it}$	0.845 (0.566)	2.192 (1.323)	2.556 (1.707)	0.133 (0.916)
$Economic\_freedom_{it-1}$	0.798 (0.023)***	0.662 (0.075)***	0.830 (0.040)***	0.674 (0.044)***
Constant	-9.348 (13.990)	-45.970 (29.260)	-51.470 (43.100)	29.720 (24.510)
R^2 (adj. R^2)	0.744 (0.718)	0.686 (0.588)	0.812 (0.776)	0.691 (0.645)
Unemployment rate				
$ICT\_spending_{it-1}$	-0.067 (0.033)*	-0.126 (0.082)	-0.069 (0.005)***	0.035 (0.016)*
HDI_{it}	0.439 (3.241)	7.213 (6.291)	9.934 (7.719)	-16.450 (5.558)**
$Industry_{it}$	-0.095 (0.026)***	-0.099 (0.038)*	-0.275 (0.071)***	-0.112 (0.065)
$Service_{it}$	0.124 (0.021)***	-0.071 (0.037)	0.212 (0.038)***	0.116 (0.053)*
$ln(Trade\_export)_{it}$	-0.290 (0.249)	0.859 (0.365)*	0.092 (0.670)	-0.167 (0.449)
$Unemployment_{it-1}$	0.819 (0.022)***	0.625 (0.067)***	0.702 (0.044)***	0.838 (0.036)***
Constant	3.970 (6.230)	-18.740 (8.079)*	-8.994 (16.980)	14.130 (11.92)
R^2 (adj. R^2)	0.744 (0.751)	0.733 (0.650)	0.833 (0.800)	0.839 (0.680)
Wealth inequality				
$ICT\_spending_{it-1}$	-0.065 (0.056)	-0.760 (0.211)***	0.117 (0.067)	-0.084 (0.092)
HDI_{it}	6.501 (4.853)	27.870 (16.150)	-4.795 (9.751)	8.350 (8.544)
$Industry_{it}$	-0.064 (0.038)	-0.079 (0.095)	-0.139 (0.082)	-0.042 (0.101)
$Service_{it}$	0.090 (0.031)**	-0.104 (0.090)	0.063 (0.047)	0.135 (0.086)
$ln(Trade\_export)_{it}$	-0.060 (0.376)	-0.736 (0.894)	2.193 (0.875)*	-1.471 (0.770)
$Gini_{it-1}$	0.733 (0.028)***	0.582 (0.068)***	0.625 (0.063)***	0.774 (0.039)***
Constant	3.053 (9.530)	25.71 (20.32)	-32.680 (21.450)	30.690 (19.89)
R^2 (adj. R^2)	0.580 (0.537)	0.627 (0.511)	0.624 (0.551)	0.680 (0.633)
Political freedom (on a reverse scale)				
$ICT\_spending_{it-1}$	-0.010 (0.008)	-0.020 (0.038)	-0.012 (0.018)	-0.006 (0.007)
HDI_{it}	-0.726 (0.714)	-6.916 (3.070)*	-0.892 (1.873)	-1.215 (0.645)
$Industry_{it}$	0.006 (0.006)	0.017 (0.018)	-0.003 (0.015)	-0.009 (0.007)
$Service_{it}$	0.006 (0.005)	0.025 (0.017)	-0.001 (0.009)	-0.005 (0.006)
$ln(Trade\_export)_{it}$	-0.011 (0.055)	0.205 (0.167)	0.031 (0.159)	-0.013 (0.054)
$Political\ freedom_{it-1}$	0.779 (0.023)***	0.796 (0.052)***	0.731 (0.053)***	0.737 (0.041)***
Constant	0.820 (1.408)	-1.822 (3.763)	0.635 (4.023)	2.392 (1.405)
R^2 (adj. R^2)	0.713 (0.684)	0.807 (0.747)	0.670 (0.606)	0.716 (0.674)
Sample size	629	119	204	306
$ICT\_spending_{it-1}$	-0.010 (0.008)	-0.020 (0.038)	-0.012 (0.018)	-0.006 (0.007)

Variable	Overall estimate (std. error)	Developing economies estimate (std. error)	Transition economies estimate (std. error)	Developed economies estimate (std. error)
*= p <.10, **=p <.05, ***= p <.01 *Note:* η_{it} variable was included in the analysis, but not reported here.				

Model Validation

We performed several diagnostic tests to validate our fixed-effects approach, as follows:

Multicollinearity: As presented in the main model specification, multicollinearity was not an issue in our models.

Reverse causality: We checked whether a one-year lag effect accounts for a causal effect between societal outcomes and ICT spending. We conducted the Granger causality tests (Granger, 1969) using one- to three-year lags for our panel models. The test results indicated a rejection of the null hypothesis that *ICT_Spending* did not Granger cause *societal outcomes.* However, the results did not support rejection of the null hypotheses that *societal outcomes* did not Granger cause *ICT_Spending*. Therefore, we conclude that *ICT_spending* occurred sooner in time than outcomes. Moreover, a one-year lag effect demonstrated higher explanatory power as compared with the models of two- and three-year lag effects. Consequently, this suggested a need to consider the models of a lag effect of *ICT_spending*.

Autocorrelation: We checked whether the incorporation of a lagged dependent variable (i.e., societal outcomes) in the fixed-effect models creates an autocorrelation and leads to a biased estimator. We performed a Wooldridge test of autocorrelation in fixed-effects models (Wooldridge, 2002) and failed to reject the null of autocorrelation. Additionally, we estimated the models by excluding the AR(1) term, $Outcome_{it-1}$, and did not find any remarkable changes in the significance levels and signs of estimates as compared with those from original model specifications. As a result, serial correlation of residuals is not a concern.

Heterogeneity: To determine whether country-specific fixed-effects models provide consistent and efficient estimates, we conducted two model specification tests: Breusch and Pagan's (1979) Lagrange multiplier (LM) test for heterogeneity effects specification and the Hausman specification test (1978) against random effects model. The test results from Breusch-Pagan LM suggested the model specification should incorporate country-specific heterogeneity (i.e., we rejected the null hypothesis that variances across countries are equal to zero at 1% significant level for all the models). In addition, the Hausman test indicated that fixed-effects model specifications for our models are preferred over random-effects approaches (i.e., we rejected the null hypothesis of using the random-effects model at 5% significant level for all the models).

Heteroscedasticity: Finally, we conducted a modified Wald test for heteroscedasticity in our fixed effects approach, and rejected the null of homoscedasticity at the 5% significance level.

Appendix B: Estimation Results from System GMM Estimator with Two Periods

Period 1 (Years 1995-2003)

Table B1. Analysis Results of Societal Changes in Period 1

Variable	Overall estimate (std. error)	Developing economies estimate (std. error)	Transition economies estimate (std. error)	Developed economies estimate (std. error)
Economic freedom				
$ICT\_spending_{it-1}$	0.479 (0.144)***	-0.110 (0.384)	0.201 (0.255)	0.352 (0.202)
HDI_{it}	7.570 (5.615)	8.117 (13.79)	2.565 (11.860)	-21.430 (11.200)
$Industry_{it}$	0.013 (0.057)	-0.180 (0.102)	0.123 (0.104)	-0.0129 (0.132)
$Service_{it}$	0.014 (0.031)	0.0790 (0.0681)	0.034 (0.041)	0.108 (0.116)
$ln(Trade\_export)_{it}$	-0.578 (0.312)	0.400 (0.498)	1.026 (0.615)	-0.217 (0.258)
$Economic\_freedom_{it-1}$	0.802 (0.046)***	0.842*** (0.0835)	0.809 (0.060)***	0.945 (0.058)***
Unemployment rate				
$ICT\_spending_{it-1}$	-0.166 (0.0564)**	-0.112 (0.050)*	-0.281 (0.101)**	0.102 (0.044)*
HDI_{it}	-5.319 (1.864)**	-5.125 (3.091)	-8.736 (4.148)*	-8.245 (4.312)
$Industry_{it}$	0.048 (0.024)*	-0.071 (0.038)	0.079 (0.042)	-0.003 (0.047)
$Service_{it}$	0.074 (0.014)***	0.078 (0.033)*	0.050 (0.018)**	0.017 (0.044)
$ln(Trade\_export)_{it}$	-0.531 (0.146)***	0.213 (0.130)	0.157 (0.288)	0.162 (0.101)
$Unemployment_{it-1}$	0.804 (0.035)***	0.847 (0.082)***	0.904 (0.044)***	0.868 (0.024)***
Wealth inequality				
$ICT\_spending_{it-1}$	-0.110 (0.097)	0.277 (0.303)	-0.0897 (0.103)	-0.217 (0.126)
HDI_{it}	-4.682 (4.071)	21.820 (10.690)*	-0.957 (4.114)	1.093 (7.892)
$Industry_{it}$	0.021 (0.045)	-0.126 (0.098)	-0.048 (0.065)	-0.080 (0.089)
$Service_{it}$	0.013 (0.024)	-0.020 (0.066)	0.036 (0.018)*	-0.029 (0.076)
$ln(Trade\_export)_{it}$	0.101 (0.213)	0.170 (0.454)	0.144 (0.272)	-0.148 (0.195)
$Gini_{it-1}$	0.984 (0.026)***	0.798 (0.083)***	0.951 (0.032)***	0.979 (0.029)***
Political freedom (on a reverse scale)				
$ICT\_spending_{it-1}$	-0.001 (0.016)	0.030 (0.040)	0.010 (0.025)	0.014 (0.012)
HDI_{it}	-0.634 (0.679)	0.720 (1.179)	-3.391 (1.211)**	-0.418 (0.836)
$Industry_{it}$	0.001 (0.007)	0.014 (0.011)	0.004 (0.010)	-0.008 (0.009)
$Service_{it}$	0.003 (0.003)	-0.006 (0.008)	0.007 (0.004)	-0.003 (0.007)
$ln(Trade\_export)_{it}$	0.001 (0.035)	-0.168 (0.057)**	-0.069 (0.072)	-0.001 (0.018)
$Political\_freedom_{it-1}$	0.949 (0.031)***	0.925 (0.035)***	0.713 (0.079)***	1.016 (0.012)***
Sample size	296	56	96	144

*= $p < .10$, **=$p < .05$, ***= $p < .01$
Note: η_{it} variable was included in the analysis, but not reported here.

Period 2 (Years 2004-2012)

Table B2. Analysis Results of Societal Changes in Period 2

Variable	Overall estimate (std. error)	Developing economies estimate (std. error)	Transition economies estimate (std. error)	Developed economies estimate (std. error)
Economic Freedom				
$ICT\_spending_{it-1}$	0.167 (0.167)	-0.463 (0.411)	0.126 (0.164)	-0.336 (0.537)
HDI_{it}	12.350 (7.588)	56.860 (35.010)	1.763 (5.927)	0.753 (9.014)
$Industry_{it}$	-0.063 (0.062)	0.065 (0.120)	-0.048 (0.063)	-0.077 (0.156)
$Service_{it}$	-0.074 (0.038)	-0.100 (0.075)	-0.099 (0.028)***	0.009 (0.126)
$ln(Trade\_export)_{it}$	-0.035 (0.362)	0.409 (0.416)	-0.529 (0.313)	0.108 (0.427)
$Economic\_freedom_{it-1}$	0.954 (0.036)***	0.512 (0.236)*	0.974 (0.027)***	0.952 (0.075)***
Unemployment Rate				
$ICT\_spending_{it-1}$	0.168 (0.058)**	0.005 (0.192)	0.243 (0.052)***	0.478 (0.197)*
HDI_{it}	8.570 (1.967)***	-6.695 (9.556)	0.239 (2.239)	0.262 (3.981)
$Industry_{it}$	-0.096 (0.019)***	0.056 (0.060)	-0.031 (0.024)	0.040 (0.057)
$Service_{it}$	-0.039 (0.014)**	0.028 (0.070)	0.002 (0.010)	0.039 (0.036)
$ln(Trade\_export)_{it}$	-0.452 (0.135)***	-0.350 (0.273)	-0.398 (0.112)***	-0.454 (0.140)**
$Unemployment_{it-1}$	0.982 (0.025)***	0.882 (0.173)***	0.804 (0.034)***	1.149 (0.032)***
Wealth Inequality				
$ICT\_spending_{it-1}$	0.445 (0.146)**	0.207 (0.102)*	0.570 (0.209)**	0.270 (0.565)
HDI_{it}	-5.893 (5.809)	-5.125 (9.857)	0.057 (6.183)	-4.276 (9.713)
$Industry_{it}$	-0.063 (0.050)	-0.160 (0.090)	-0.049 (0.081)	-0.030 (0.156)
$Service_{it}$	0.040 (0.039)	0.072 (0.033)*	-0.026 (0.030)	0.003 (0.098)
$ln(Trade\_export)_{it}$	-0.188 (0.317)	0.750 (0.285)*	-0.084 (0.351)	0.108 (0.370)
$Gini_{it-1}$	0.966 (0.033)***	0.778 (0.094)***	0.984 (0.044)***	0.970 (0.078)***
Political Freedom (on a reverse scale)				
$ICT\_spending_{it-1}$	0.005 (0.019)	0.097 (0.079)	-0.035 (0.014)*	-0.017 (0.024)
HDI_{it}	-0.361 (0.601)	10.220 (5.489)	-0.192 (0.669)	-0.003 (0.450)
$Industry_{it}$	-0.001 (0.006)	0.008 (0.019)	0.005 (0.006)	-0.005 (0.008)
$Service_{it}$	0.002 (0.004)	-0.076 (0.035)*	0.005 (0.003)	-0.005 (0.005)
$ln(Trade\_export)_{it}$	0.003 (0.041)	-0.628 (0.304)*	-0.012 (0.027)	0.013 (0.017)
$Political\ freedom_{it-1}$	0.980 (0.020)***	0.544 (0.209)*	1.016 (0.030)***	0.972 (0.021)***
Sample size	296	56	96	144

*= $p < .10$, **=$p < .05$, ***= $p < .01$
Note: η_{it} variable was included in the analysis, but not reported here.

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