Socioeconomic and Sociopolitical Transformations Through Information and Communication Technologies: Evidence from Transition Economies

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ABSTRACT

The aim of this research is to identify the transformative role of information and communication technologies (ICT) in transition economies (TEs). We investigated how ICT spending influences the socioeconomic and sociopolitical changes in TEs belonging to two regional groups (Central and Eastern European and Latin American) from 2004 to 2010. Moreover, we compare the effects of ICT in TEs to those in developed OECD countries. Our results show that while ICT spending is positively associated with overall economic freedom and job creation, it does not significantly improve the TEs' democratic values or mitigate their existing wealth inequality levels. The results also show that the impact of ICT spending on transition processes varies across regional groups. In addition, we confirm the different roles of ICTs in TEs and developed countries. These findings provide insights to future researchers on the role of ICT and its impact on societal changes (economic and political) in transition economies.

Keywords:

Information and communication technologies, transition economy.

INTRODUCTION

The rapid pace of technological progress has been recognized as a significant driver of accelerating economic growth and dramatic structural changes in societies around the world. There is ample evidence in academic research studies and mass media reports suggesting that investment in and utilization of recent information and communication technologies (ICT) is a critical factor for stimulating economic and sociopolitical changes in developing and developed countries (Cumps et al., 2006; Dewan and Kraemer, 1998; World Bank, 2010). However, there have been few studies on the consequences of introducing ICTs in new economies known as transition economies (TEs) that are undergoing significant socioeconomic and sociopolitical liberalization or reforms. The International Monetary Fund (2000) defines transition economies as the "countries moving from centrally planned economies to market-driven economies." In general, they have experienced transition processes that include one or more of the following transformations: economic and social liberalization, privatization of government-owned enterprises and resources, and creation of a financial sector.

Even though most TEs continuously increase ICT spending after their transitional years, the role of ICTs in facilitating such transition processes is not well understood. Figure 1 illustrates the annual ICT spending of two regional groups of TEs and the OECD countries from 2004 to 2010. While the OECD countries consistently spent around 6.2 % of GDP for ICTs over the seven years, the two regions undergoing economic transition doubled their amounts of ICT spending in the same period albeit with considerable variations between groups. Such increased ICT spending implies not only a growing demand for and use of ICT in transitional economies, but also increased access to ICT applications required by societies in the process of transformation. With a significant spend of national wealth being directed to ICT, we expect its impacts manifest itself in both political and economic markers for these economies.

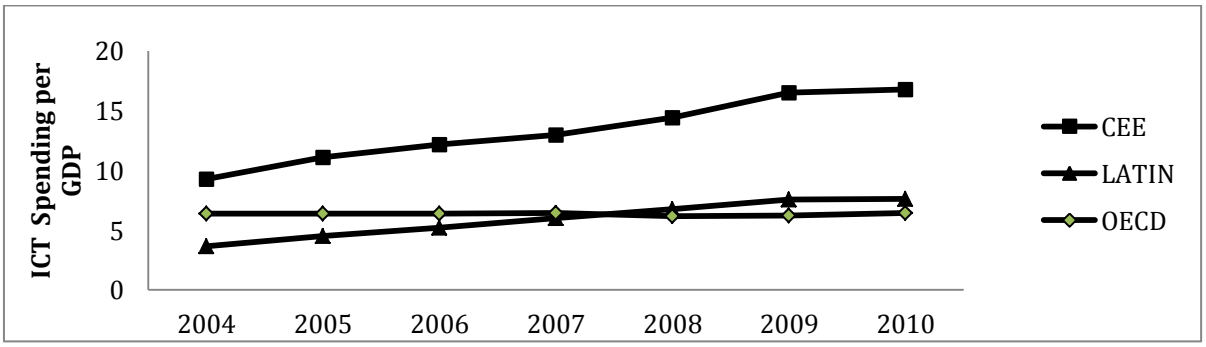

Figure 1. Annual ICT Spending per GDP

Recent politics, economics, and information systems (IS) studies have attempted to assess the changes in economic values (Piatkowski, 2004; Samoilenko and Osei-Brynson, 2010) and the level of democratization (Shiraz, 2008; Soper et al., 2011) resulting from ICT investments in transition economies. They have found that ICT has contributed a great deal to the overall economic growth and sociopolitical changes. However, the research in this area has been conducted without solid theoretical foundations or distinction of TEs from developing or developed countries. This has consequently led to ill-measured effects of ICT. Thus, a specific appreciation of key properties of transition economies is required. Furthermore, the role of ICT in transition economies may vary with different uses of ICT. While some TEs adopted ICT as a tool for accelerating economic growth, others utilized ICT to change sociopolitical structures. As such we broaden the definition of TEs.

Prior studies have also mostly concentrated on examining the role of ICT in the early stages of transition process where drastic economic and societal shifts occurred rather than in the later stages that were typically associated with significant ICT investments and widespread ICT use. This focus on early stages makes it hard to substantiate the exact transformative power of ICT in TEs. Our aim is to fill this research gap by examining how ICT has been able to contribute to restructuring socioeconomic and sociopolitical environments in more recent periods of transition process, where the role of ICT became more critical and essential to TEs.

Drawing on the key tenets of theories of skill-biased technological change and endogenous growth, this study attempts to determine whether ICT plays a transformative role in TEs and examine how the outcomes of transition processes differ according to the intentional uses of ICT.

In order to investigate the association between ICT investments and transition processes, we use data on two regions housing transition economies with very different histories (i.e., Central and Eastern Europe and Latin America) from 2004 to 2010 and measure the effects of ICT-related spending on changes in macro economic conditions, employment, wealth equality, and the level of democratization. Then, we examine whether such outcomes of ICT spending in TEs are different from those in the five developed OECD countries.

In this study we focus on the following research questions: 1) Does ICT play a transformative role in transition economies? 2) How do ICT investments influence socioeconomic and

sociopolitical changes in transition economies? 3) Do these associations vary across different groups over time? 4) What are the unique contributions of ICT to TEs as compared with the developed countries?

This study may contribute to the extant literature on IT payoff at the macro level. The studies of ICT dynamics and their impacts on the transition are important issues in various research areas. Thus, this study will provide opportunities to make new contributions to the existing body of knowledge on these subjects.

THEORY DEVELOPMENT

Although research on the impact of ICT on TEs is still scarce, related literature on economics, politics, and information systems (IS) provides a theoretical groundwork for addressing the research questions. The following sections review the literature that is relevant to the impacts of ICT on economic and sociopolitical changes, and derive a set of implications for our research hypotheses.

Literature Review

Our study draws on the extant literature on ICT dynamics and IT productivity at the country level. This stream of research has commonly found positive relationships between ICT investment and economic changes (i.e., GDP growth and labor productivity). For instance, Dewan and Kraemer (1998) and Kraemer and Dedrick (2001) noted that for the developed countries, IT investment is more positively associated with economic returns (i.e., GDP per capita) than for developing countries. Cumps et al. (2006) found a sustainable competitive advantage from ICT investment in the developing countries.

The research concerning the effects of ICT investments on TEs is still growing. A few recent economics and IS studies have attempted to measure the economic growth contribution from ICT investments (Smoilenko and Osei-Brynson, 2010) and IT-induced labor productivity in TEs (Piatkowski, 2004). However, those studies examined the immediate contributions of ICT on the transition process during the earlier stage of transition, in particular from the early 1990s to the early 2000s. Since, in the initial periods of transitional years, transition economies experienced drastic economic and societal shifts such as changes in fundamental economy structure from planned economies to market-driven economies and changes in liberalization of economies through privatization, the significant transformation might be more influential to the transition process than what was initially attributed to ICTs. Thus, the

transformative role of ICT in TEs may be observed inadequately or underestimated.

With respect to the impacts of ICT on employment, prior studies suggested that technological innovations have replaced the low-skill workers with new technologies (Bresnahan et al., 2002; Meng and Li 2002) and the progress of ICT implies that job could be lost through the causes of obsolesce, automation, and disintermediation (Ubraru, 2010). However, these unbalanced job opportunities do not imply job destruction. The ICTs also have capabilities of spurring new job opportunities by creating innovative ICT-related tasks and occupations such as system designers, telecommunication equipment providers, or installers.

In addition to economic changes, the transformative role of ICT in facilitating sociopolitical change has caught researchers' attention. A few studies have examined the association between ICTs and wealth inequality. Flores (2003) and Katagiri (2010) found that the utilization and progress of ICT have broadened income dispersion. In terms of transition economies, such income disparity became more severe during the first decade after the transition year mainly due to the progressive shift toward market-driven economy. Thus, the questions on how income inequality changed after market structural adjustment and whether ICT contributed to closing a widening gap of income inequality remain largely unanswered.

Several studies have found that ICT can stimulate rapid democratization in certain regions of the world: underdeveloped countries (Ferdinand, 2000; Meier, 2000) and developed countries (Gronlund, 2001) alike. Falch (2006) also argued that ICT had a positive impact on future conditions for democratic governance. However, these studies presented mere conjectures mainly based on theories alone (e.g., IT diffusion) or particular indicators without solid empirical data and rigorous analyses. Although several recent studies (Shirazi, 2008; Soper et al. 2011) have measured a country's democratization level with civil liberties and political rights, we do not observe significant variations of these democratic values over the last decade for most countries. These indicators of democratization may not reflect well the effect of ICT on democratic reforms. They are more likely to be influenced by macro-level structural changes such as alterations of ruling party or religion.

In summary, the research on ICT impact on economic and sociopolitical changes to date is fragmented and still not well established for investigating the transformative role of ICT in transition economies. While most studies conclude that ICT is positively associated with economic growth and democratization but negatively associated with job creation and income

disparity, these findings highly focused on specific country groups (i.e., developed and developing countries), early periods of the transition process, and limited research variables chosen. This study contributes to the existing literature by investigating the role of ICT in transition processes and addressing the concerns identified above.

Hypotheses Development

The research hypotheses draw on the existing literature discussed in the previous section. Table 1 presents a set of relevant studies and the implications for each of our research hypothesis.

Transition Process		Study	Implications for the Hypotheses
Socio-economic	Economic Environment	Dewan and Kraemer (1998) Kraemer and Dedrick (2001) Piatkowski (2003) Piatkowski (2004) Samoilenko and Osei-Brynson (2010)	*Positive* impact of ICT investment on Economic growth and environment changes.
	Employment	Bresnahan et al. (2002) Meng and Li (2002) Brinjoffson and Mcacy (2011)	*Positive* impact of ICT investment on overall job creation, but *negative* impact on job opportunities for unskilled workers,
Socio-political	Wealth Equality	Flores (2003) Katagiri (2010)	*Negative* impact of ICT investment on wealth inequality
	Democratization	Meier (2000) Gronlund (2001) Falch (2006) Shirazi (2008) Soper et al.(2011)	*Positive* impact of ICT investment on democratic values

Table 1. Prior Studies and Implications for the Research Hypotheses

ICT and Socioeconomic Changes

While prior literature concludes that investments in ICT contribute to positive economic growth and higher socio-technological development in TEs, these studies do not provide a solid theoretical framework or comprehensive measures for evaluating the transition process in TEs. Although there are differences between TEs and developed countries, researchers use common theoretical frameworks to investigate the impacts of ICT investments on macroeconomic outcomes in both settings. In terms of economic growth contribution from ICT investments, numerous studies still merely utilize production functions, regardless of unique properties of TEs. For instance, Piatkowski (2006) showed that ICT has a large potential to increase long-term economic growth in TEs by stimulating productivity growth at the industry level based on the growth accounting methodology developed by Solow (1957). In the Solow's growth model, technical progress is exogenous. That is, the model does not

explain the source of technological progress. However, most transition economies have adopted ICT with the intention to boost economic growth and accelerate democratic values. In line with this argument, Romer (1990) presented endogenous growth theory for technological change innovation that attributes technological progress to systematic efforts by profit-maximizing economic agents. Thus, the endogenous technological change model explains that economic changes from ICTs are effected by people or countries that have incentives to push for sustained economic growth. Most transition economies have used ICT as a tool to improve their economic conditions, not only for keeping pace with rapidly changing global economic conditions but also for transforming centrally planned economies into market-driven economies effectively. Thus, we predict that the investment in ICT, coupled with the purposeful utilization of gained economic benefits, has a positive impact on overall economic environment in TEs. This leads us to the following hypothesis:

Hypothesis 1a (Economic Freedom): ICT investments will be positively associated with overall economic changes in transition economies.

The creation of job opportunities from ICT investments can be regarded as an indicator of sound economic policy at the country level. Many countries have adopted ICT in order to mitigate rising unemployment rates (Bresnahan et al., 2002). However, some prior studies are concerned that the adoption of ICT has led to lost jobs for unskilled workers. Meng and Li (2001) examined the pressure of unemployment from ICT's displacement effect in developing and developed countries and found that the dynamics of IT replace human labor and increase the demand for skilled labor. Such a negative impact of ICT on job creation can be explained by the theory of skill-biased technical change. Violante (2008) defined skill-biased technical change as "a shift in the production technology that favors skilled (more educated and more experienced) over unskilled labor." Some studies in the economics literature provide a foundation for skilled-biased technical change. Galor and Moav (2000) argued that more educated and experienced labor deals better with technological change. Since it is easier to teach skilled workers a new technology, firms generally prefer skilled laborers to unskilled ones. IS studies have also found that innovations in IT led to skill-biased technical changes. They mostly argued that such an increase in skill demand arises from reduced IT prices and increased use of IT (Bresnahan et al., 2002; Brynjolffson and McAfee, 2011).

Regarding transition economies, many new jobs have been created in ICT-related industries, and there is soaring demand for skilled workers. Over the years, CEE TE countries have increased average ICT spending per GDP from 8.8% to 16.8% and Latin America TE countries have increased from 3.1% to 7.6%. The increasing ICT spending over the past decade indicates TEs are eager to adopt new technologies. Such active technological adoptions have led to creation of more highly skilled jobs. In addition, while ICT has radically replaced conventional tasks and jobs through automation, new technologies also have created new tasks and jobs in TEs. According to the World Bank's recent report on ICT and its impact on job creation (2009), the demand for ICT goods and services created new jobs and each new job in ICT sectors creates between two and four new jobs in other fields across transition economies (e.g., IT and telecommunication outsourcing and offshore software development in China and India). In this regard, we tested how ICT investments influence job creation in transition economies.

Hypothesis 1b (Job Creation): The investments of ICT will be positively associated with job creation in transition economies.

ICT and Sociopolitical Changes

In addition to the socioeconomic transition process, the role of ICT in facilitating sociopolitical shifts should be identified. After the transition process was launched, most transition economies have faced severe income disparity. Generally, centrally planned economies distribute income more evenly than market-driven economies (including TEs). Since the beginning of the transition, increased income inequality is a common phenomenon for transition economies. In this regard, 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.

From the perspective of the widespread use of ICT in transition economies, the theory of technological skill-bias can also account for such rising income inequality (Galor and Moav, 2000). Since technological advances favor skilled and educated workers, they also lead to greater wealth inequality in transition economies. This leads to the following hypothesis:

Hypothesis 2a (Wealth inequality): The investments of ICT will be negatively associated with wealth equality in transition economies.

ICT can be viewed as a medium by which relationships can be transformed and open interactions likely lead to more democratization. On the economic level, ICT plays a role in integrating TE into the global market and in spurring the rise of worldwide electronic business activities (Zembylas and Vrasidas, 2005). On the level of social organization, ICT is seen as a mediator for civil democratic processes of citizen participation and decision-making (Noveck, 2000). From this point of view, Shirazi (2008) investigated the impact of ICT expansion on social and political freedoms in ten countries of the Middle East. The results indicated that the use of ICT tools, such as the mobile cell phone and the Internet, enables citizens to share their opinions with others inside and outside their countries and therefore promotes democracy and freedom of expression in the region.

These findings lead to the expectation that the utilization of ICT positively influences social processes of freedom and democracy in TEs.

Hypothesis 2b (Democratization): The investments of ICT will be positively associated with improvement in democratic values in transition economies.

Consistent with the theory of endogenous growth for technological change innovation, economic and sociopolitical impacts from ICT can be influenced by policymakers or leaders in countries that encourage progressive economic and sociopolitical changes. Though transition economies seem to share the same goal of accelerating transition processes, they could weigh their importance differently according to their current transition status. While some TEs use ICT for establishing strong economic foundation and stabilizing overall economic conditions rather than resolving existing social or political problems others leverage it for improving civil rights and making gradual progress in educational coverage rather than drastic economic shifts. In other words, both economic and sociopolitical changes have been attempted by the ICTs. As a result, we expect that the investments in ICT, with different uses of reaping ICT benefits, lead to different outcomes. Consequently, we formulate the following hypothesis:

Hypothesis 3: The outcomes of using ICT for transition processes will differ across regional groups of transition economies.

Our hypotheses are empirically tested with data on three groups of TEs from the seven-year period of 2004 to 2010. Figure 2 presents the research framework of ICT impacts on transition economies.

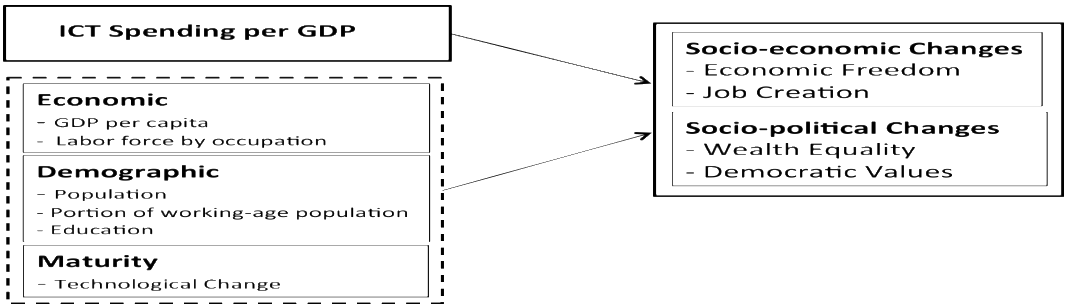

Figure 2. Research Framework

For Hypotheses 1 and 2, the outcomes from transition processes are determined by ICT spending and a set of control variables that could influence the transition processes at the aggregated level. To examine the variations of transition outcomes between groups (Hypothesis 3) and the different outcomes of ICT between TE groups and developed countries, we estimate these associations at each individual region level.

EMPRICAL APPROACH

Classification of Transition Economies

Sample data for our analysis was collected for the two transition economy groups, with a total of 10 countries according to IMF's classification for economies in transition (2000). The two regional groups of transition economies are presented in Table 2. Although IMF's classification does not include Latin countries, our study includes five countries in Latin America because in a broader sense, the definition of transition economies applies to a country or region with low absolute, but fast growing, and authorities committed to economic and political liberalizations (Amold and Quelch, 1998).

Group	Country (Transitional Year)	Transitional Event
CEE	Czech Republic (1990) Hungary (1990) Poland (1990) Slovakia (1990) Slovenia (1990)	- The end of communism in Eastern Europe - The disintegration of USSR
Latin	Argentina (2001)	- Delinking Peso from the US dollar
	Brazil (2002)	- The IMF rescue package
	Chile (1990)	- The end of military dictatorship of Gen. Pinochet
	Columbia (1991)	- The Columbian Constitution was drafted and ratified
	Peru (1990)	- Break away from Hyper-inflation

Table 2. Classification of Transition Economies

Even though each country is grouped based on its geographical location, the two groups have different uses of ICT. As we discussed, most studies on transition economies have aimed at examining ICT-driven economic and political changes in the initial stages of transition process, so they do not present rich insights on the transformative role of ICT in TEs. This study aims to identify salient ICT implications based on each region's transition status and intention of ICT uses during the past seven years when ICT has become more essential and universal for transition processes.

CEE: Countries in CEE included for this study were the part of Soviet sphere of influence. They have the same transitional year of 1990, the year for the collapse of the USSR and the subsequent dismantling of communism in Eastern Europe. The five-exemplar countries included in this study joined the European Union in 2004. While their overall economic and societal indicators had stabilized, their economic markers remained below the European and OECD average (The World Bank, 2011). Important economic indicators such as GDP per capita and employment ratio were much lower than other OECD countries. In this regard, these countries hoped to catch up with living standards in developed countries and use ICT to stimulate overall societal improvements. Higher ICT spending would reflect such efforts (around 13.2% of GDP, which is approximately twice as high as the average spending of other OECD countries). So we examine whether investments in ICT are effective for socio-economic transition processes for these advanced transition economies.

Latin America: The selected countries in Latin America have experienced significant economic and political restructurings after initial transitional years. Their transitional years were mainly triggered by political liberalization. They have relatively healthier economic indicators as compared to other countries in the region, but they are still undergoing liberalization of economies and societal changes. While GDP per capita across the countries has continuously increased over the past decade, the gap in income distribution is still higher than those of other transition economy groups. Moreover, ICT-related social issues such as limited public access to digital services and education, lack of legal framework that encourages ICT investment, and affordability of ICT services and goods are still unsettled. However, in the last decade, there has been an increasing interest in all these countries to promote the use of ICT with attempts to develop and support e-government, e-health and e-commerce (Santos, 2009).

Data Description and Measurement

Our analysis was conducted on the two transition economy groups using publicly available data sources from 2004 to 2010. Moreover, the high-income OECD countries were included for the comparison purpose with the TE groups. Variables extracted for our dataset and their descriptive statistics are presented in Table 3.

Variables	Description of Variables / Data Source	Mean (S.D.)			
		Overall (CEE+LATIN) (N=70)	CEE (N=35)	LATIN (N=35)	OECD (N=35)
Econ_free	Overall economic freedom (0 ~100) - Source: Heritage Foundation	63.62 (6.60)	64.25 (3.96)	62.99 (8.48)	72.49 (6.82)
Unemployment	Unemployment rate (%) -Source: The World Bank	9.41 (3.04)	9.89 (3.88)	8.92 (1.81)	6.85 (2.19)
Gini	Gini coefficient (0~100) - Source: The World Bank	40.98 (12.52)	29.11 (3.55)	52.85 (4.12)	34.74 (6.32)
Press_oppression	Press freedom (0 ~115) - Source: Reporters Without Borders	15.01 (12.95)	6.06 (4.44)	23.96 (13.45)	5.01 (2.44)
ICT_spending	ICT related spending per GDP (%) - Source: Digital Planet; ITU	9.52 (5.71)	13.17 (5.77)	5.87 (2.37)	6.33 (.70)
GDP_growth	GDP growth (%) - Source: The World Bank	4.44 (3.65)	3.40 (4.07)	5.48 (2.37)	1.13 (2.65)
Second_edu	Secondary school enrolment (%) - Source: The World Bank	93.05 (6.76)	95.66 (4.37)	90.45 (7.37)	99.08 (2.13)
Pop_growth	Population Growth (%) - Source: CIA the World Factbook	.62 (.53)	.16 (.30)	1.09 (.22)	.39 (.42)
Working_age	Portion of working-age population (%) - Source: CIA the World Factbook	68.09 (2.86)	70.60 (.84)	65.58 (1.72)	66.15 (.89)
Industry	Labor force by occupation-Industry (%) - Source: CIA the World Factbook	26.06 (8.58)	33.19 (4.81)	18.93 (4.67)	24.48 (5.05)
Service	Labor force by occupation-Service (%) - Source: CIA the World Factbook	63.71 (6.56)	58.79 (4.69)	68.64 (3.90)	72.47 (5.57)

Table 3. Summary Statistics of the Dataset

Two datasets were leveraged for testing the proposed hypotheses: the aggregated dataset combining two TE groups for testing Hypotheses 1 and 2; and the individual grouped data sets for testing Hypothesis 3. In order to control for regional differences in the research variables, we normalized the variables to comparable scales.

Definition of Measures

To examine the impacts of the investments in ICT on socioeconomic and sociopolitical changes, we utilized four dependent variables of transition processes, an explanatory variable of ICT investments, and six control variables.

Econ_free: This variable is a measurement of overall economic freedom. The Heritage Foundation measures the overall economic freedom major components[1] of economic freedom for macroeconomic stabilization on a scale of 0 (not free) to 100 (free).

Unemployment: A dependent variable indicating the proportion of the transition economy's working-age population that was unemployed. We examine how ICT spending influences job creation of a transition economy.

Gini: A dependent variable indicating the level of wealth inequality of a country. A lower Gini coefficient indicates a more even income distribution.

Press_oppression: A dependent variable indicating the level of press freedom. Reporters Without Borders annually assesses the overall press freedom based on surveys on direct attacks on journalists and the media as well as indirect sources of pressure against the free press. Note the score ranges from 0 (free) to 115 (not free).

ICT_spending: Domestic spending on computer hardware and software, communication services, and communication equipment as a percentage of GDP.

Time: The number of years elapsed from 2004. This variable controls for the unobserved technological change and endogenous time effects on a country's transition process outcomes.

GDP_Growth: It indicates the percent increase rate in real gross domestic product.

Second_edu*:* Net enrollment ratio is the ratio of children of official school age based on the International Standard Classification of Education who are enrolled in secondary school compared with the population of the corresponding official school age.

Pop_growth: Growth in population of individual countries. Due to large variations in population among countries, we used the change in number of individuals in the population per unit time.

Working_age: Proportion of the working-age population (ages 15-60). It indicates an estimate of the total number of potential workers within a country.

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[1] Ten components of economic freedom: property rights, freedom from corruption, fiscal freedom, government spending, business freedom, labor freedom, monetary freedom, trade freedom, investment freedom, and financial freedom

Industry and ***Service***: the percentage distribution of the labor force by occupation (industry and service).

Empirical Model

Using the country-level data, we tested the proposed research hypotheses. The research framework presented in Figure 2 leads to the empirical model.

$$\begin{aligned} Transition\_Process_{it} = {} & b_0 + b_1(ICT\_Spending)_{it-1} + b_2(Time)_{it} + b_3(GDP\_growth)_{it} \\ & + b_4(Second\_edu)_{it} + b_5(Pop\_growth)_{it} + b_6(Working\_age)_{it} \\ & + b_7(Industry)_{it} + b_8(Service)_{it} + e_{it} \end{aligned}$$

,where for country i in year t :

$$Transition\_Process_{it} = \begin{bmatrix} Econ\_free_{it} \\ Unemployment_{it} \\ Gini_{it} \\ Press\_oppression_{it} \end{bmatrix},$$

In order to test the hypotheses, we analyzed the dataset with multiple regression models. Each model includes a socioeconomic or sociological value (i.e., *Econ_free*, *Unemployment*, *Gini*, or *Press_oppression* in a transition economy over seven years) as a dependent variable and an explanatory variable (*ICT_spending*), as well as other control variables for economic (*GDP_capita*, *Industry*, and *Service*), demographic (*Second_edu*, *Pop_growth*, *Working_age*), and maturity (*Time*) factors in each country.

It is also desirable to construct a time-lagged dataset through which the impact of ICT spending on subsequent transition processes could be longitudinally assessed. ICT spending values per GDP (i.e., *ICT_spending*) from 2003 through 2009 were used to predict transition processes from 2004 through 2010.

RESULTS AND DISCUSSION

We report two sets of results from regressions. The first set of results includes the estimates from a pooled sample across the two regional groups of TEs, and the second set of results presents the estimates from each regional dataset and those from OECD countries. While we have not reported the correlation matrix, we did not find strong correlations between the explanatory variables; the highest correlation (ρ=-.61) among the explanatory variables was between *Industry* and *Service*. Instead of using a country's age of transition, we used *Time* to control for unobservable technological change effects on a country's transition process

outcomes, but we did not find significant differences in results and these two variables were highly correlated (ρ=-.83). Further, we tested for the presence of multicollinearity using Variance Influence Factors (VIF) of each explanatory variable in each regression model. The largest VIF was below 8.0, which indicates that multicollinearity was not an issue in our models. We also compared the regression models of no lag effect with those of one-year lag effect. The models with a lag effect had higher explanatory power as compared with the models with no lag, and this demonstrates the need to consider the models with a lag effect of *ICT_spending*.

ICT Impact on Transition Processes for Transition Economics

From the pooled sample across the regional groups over seven years, we estimate the effects of ICT spending on transition processes in order to test Hypotheses 1 and 2. The results are presented in Table 4.

Variables	*Economic Freedom*	*Unemployment Rate*	*Wealth Inequality*	*Press Oppression*
Intercept	143.429(58.583)*	-44.469(26.383)	23.039(28.317)	-104.535(89.045)
ICT_spending	.480(.198)**	-.252(.089)**	.017(.009)	.407(.301)
Time	.337(.389)	-.125(.175)	-.359(.188)	-.497(.591)
GDP_growth	-.156(.232)	-.195(.105)	-.126(.112)	.128(.053)*
Second_edu	-.352(.126)**	-.226(.056)***	.126(.061)**	-.272(.192)
Pop_Growth	6.093(3.483)	-3.702(1.569)**	.710(1.684)	11.229(5.294)*
Working_age	-.551(.757)	1.249(.341)***	.692(.366)	1.685(1.151)
Industry	-.685(.167)***	-.215(.076)**	-.117(.081)	.119(.255)
Service	-.133(.233)	.042(.105)	-.345(.113)**	.363(.355)
R^2 (adj. R^2)	.385(.293)	.412(.324)	.760(.754)	.641(.575)
Sample size	70 (=$10_{Countries}$ * 7_{Years})	70 (=$10_{Countries}$ * 7_{Years})	70 (=$10_{Countries}$ * 7_{Years})	70 (=$10_{Countries}$ * 7_{Years})
* = p <.05 ** = p <.01 ***= p <.001				

Table 4. Analysis Results across Regions

Overall, the findings from the analysis of dataset mostly support the formulated hypotheses on socioeconomic changes in transition economies. The estimates of *ICT_spending* are positively associated with overall economic freedom and job creation; however,

sociopolitical outcomes have negative yet insignificant relationships with *ICT spending*. We examine the detailed socioeconomic and sociopolitical changes derived from ICT spending across the regions as follows.

ICT and Socioeconomic Changes: Regarding the relationship between ICT and changes in economic freedom, the estimate of *ICT_spending* is positive and significant. This indicates that a 1% increase in ICT spending per GDP is projected to improve the overall economic freedom index by .48 percentage points across the groups of TEs. Furthermore, we found that ICT spending per GDP significantly decreases unemployment rates. This implies that ICT has created more job opportunities in transition economies by creating new ICT-related jobs and by changing existing jobs toward such new industries. In addition, the negative and significant estimate of *Second_edu* implies that there exist high demands for skilled workers in transition economies.

In sum, we found that the ICT has played a significant transformative role in TEs' socioeconomic changes. Consequently, the findings support Hypotheses 1a and 1b.

***ICT and Sociopolitical Changes*:** In our analyses of the impact of ICT spending on changes in sociopolitical values, we did not find a significant association between ICT spending and sociopolitical indicators. The estimates of *ICT_spending* on *Gini* and *press_oppression* are both positive and insignificant. Therefore, Hypothesis 2a and 2b are not supported by the results.

These different findings in socioeconomic and sociological outcomes may be explained by the immaturity of ICT uses in transition economies. The liberalization and macroeconomic stabilization could be undertaken in a short period of time, as could the privatization of small-scale enterprises through ICT at the early stage of transaction process. In the meantime, the improvements in sociopolitical values would take a longer time since such changes are generally intensified by significant and large-scale legal and institutional reforms through better utilization of ICT. Therefore, the effects of ICT on transition processes may vary according to the different level of ICT uses and of transition progress (i.e., maturity of ICT utilization). It leads us to additional analyses accounting for each region's use of ICT and its impacts on transition processes. The following subsection presents the detailed results based the region groups.

ICT Impact on Transition Process within Groups

To investigate the regional differences in the transformative role of the ICT in transition economies (Hypothesis 3), we report the impacts of ICT spending on transition processes at the individual regional level. Tables 5 and 6 contain the results of region-level regressions. In order to compare the contributions of ICT in TEs with those in the developed countries, we included the top five high-income OECD countries (i.e., France, Germany, Japan, United Kingdom, and United States).

Variables	CEE	Latin	OECD
	Economic Freedom		
Intercept	53.588(59.199)	258.170(110.067)*	- 176.145(294.652)
ICT_spending	.318(.099)**	3.818(1.129)**	5.570(1.04)***
Time	-.217(.272)	-.339(.870)	.313(.282)
GDP_growth	.021(.131)	.157(.358)	.005(.220)
Second_edu	-.492(.118)***	-.834(.200)***	-.489(.967)
Pop_Growth	2.031(1.885)	10.880(6.573)*	-1.837(2.894)
Working_age	.629(.712)	-2.213(1.488)	.701(1.491)
Industry	-.009(.103)	-1.105(.346)**	2.041(1.458)
Service	.165(.113)	.177(.504)	2.28(1.402)
R^2 (adj. R^2)	.768(.682)	.751(.675)	.865(.824)
Sample Size	35 (=$5_{Countries}$ * 7_{Years})	35 (=$5_{Countries}$ * 7_{Years})	35 (=$5_{Countries}$ * 7_{Years})
	Unemployment Rate		
Intercept	-88.053(78.303)	37.352 (25.158)	-184.831(154.345)
ICT_spending	-.184(.031)***	-.222(.257)	1.652(0.546)**
Time	-.278(.360)	-.259(.199)	.327(.148)**
GDP_growth	-.350(.174)	-.248(.082)**	.001(.115)
Secondary_edu	.171(.155)	.012(.046)	.451(.507)
Pop_Growth	-3.047(2.493)	1.079(1.502)	4.124(1.516)**
Working_age	1.903(.941)	-.215(.340)	1.242(.781)
Industry	-.465(.136)**	.219(.079)**	1.108(.764)
Service	.006(.150)	-.252(.115)*	.627(.734)
R^2 (adj. R^2)	.555(.418)	.713(.625)	.642(.532)
Sample Size	*35 (=$5_{Countries}$ * 7_{Years})*	*35 (=$5_{Countries}$ * 7_{Years})*	*35 (=$5_{Countries}$ * 7_{Years})*
* = p <.05 ** = p <.01 ***= p <.001			

Table 5. Analysis Results of Individual Group's Socioeconomic Changes

Socioeconomic Changes: Overall, ICT spending is positively associated with improvements in the economic environment across two transition economy groups. Since both regions have utilized ICT to improve economic conditions during the transition process, they have experienced positive economic outcomes in economic freedom and job creation. For CEE, the estimates for *ICT_spending* are significant for both socio-economic factors. Meanwhile, Latin America countries have experienced a significant and positive impact of ICT only on economic freedom. Since Latin America countries are more likely to utilize ICT as a tool for enhancing societal liberalizations, they might not benefit from ICT in terms of mitigating

unemployment rate. However, the negative and significant estimate of *Service* implies that the countries can create job opportunities by investing ICT into the service sectors. Regarding the OECD countries, although they have enhanced the overall economic conditions, they have failed to reduce the number of unemployed workers. This result is consistent with prior findings for developed countries (Bresnahan et al., 2002; Brynjolffson and McAfee, 2011). This implies that not every country benefits from technological progress, at least not in the same way. For developed countries, many jobs have been replaced by ICT applications that increased the demand for skilled workers adaptable to such ICT dynamics but likely reduced the demand for low skilled workers. While Brynjolffson and McAfee (2011) found a negative association between technological progress and job creation only in the U.S. industries, our results suggest that such a negative association may be prevalent across developed countries.

After all, the findings suggest that ICT has contributed to solving each region's economic problems in their transition status and this contribution is more effective for TEs.

Variables	CEE	Latin	OECD
	Wealth Inequality		
Intercept	-.594(65.194)	70.574(18.708)***	-17.058 (361.183)
ICT_spending	-.144(.109)	.666(.192)***	7.097(1.277)***
Time	.280(.299)	-.662(.148)***	.346(.346)
GDP_growth	-.035(.145)	.071(.061)	-.012(.270)
Second_edu	.444(.129)***	.068(.034)	-.057(1.185)
Pop_Growth	-1.817(2.07)	7.287(1.117)***	10.734(3.547)**
Working_age	.073(.783)	-.055(.253)	-2.639(1.827)
Industry	-.171(.113)	.108(.059)*	2.206 (1.787)
Service	-.182(.124)	-.0474(.085)***	1.764(1.718)
R^2 (adj. R^2)	.632(.519)	.767(.757)	.765(.692)
Sample Size	35 (=$5_{Countries}$ * 7_{Years})	35 (=$5_{Countries}$ * 7_{Years})	35 (=$5_{Countries}$ * 7_{Years})
	Press Oppression		
Intercept	103.113(70.378)	-53.246(137.992)	57.3229 (257.853)
ICT_spending	.079(.118)	-2.404(1.215)	-.442(.911)
Time	1.023(3.23)**	-.693(1.091)	.102(.247)
GDP_growth	-.045(.156)	.939(.449)*	.196(.192)
Second_edu	.089(.139)	-.074(.251)	-.249(.846)
Pop_Growth	-1.252(2.241)	54.903(8.240)***	2.268(2.532)
Working_age	-1.868(.845)*	-1.052(1.865)	-.098(1.304)
Industry	-.041(.122)	.831(.434)	-.223(1.276)
Service	.443(.135)**	.873(.631)	-.198(1.227)
R^2 (adj. R^2)	.726(.641)	.820(.764)	.292 (.193)
Sample Size	35 (=$5_{Countries}$ * 7_{Years})	35 (=$5_{Countries}$ * 7_{Years})	35 (=$5_{Countries}$ * 7_{Years})

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

Table 6. Analysis Results of Individual Region's Sociopolitical Changes

Sociopolitical Changes: Unlike the findings for economic changes, the findings for sociopolitical changes present a less consistent association with ICT spending between regions. Regarding wealth inequality, while Latin America has experienced a significant and positive impact of ICT spending, CEE had a negative but insignificant association with ICT. Moreover, in term of democratization (*Press_oppression*), ICT spending is not significantly associated with the vitalization of democracy in both regions.

For Latin America, ICT has been mostly used by small-scale enterprises rather than by large-scale enterprises or governments, and so they have improved overall economic freedom values, but failed to control existing high-income disparity and severe oppression of press freedom (see Table 3 where averaged value of press oppression is much higher than other groups) at the country level. Interestingly, for advanced transition economies in CEE, although they have created more jobs resulting from the increased ICT spending, they did not aggravate their income discrepancy between skilled and unskilled workers. Meanwhile, OECD countries, as we expected, faced worsening wage gaps between high-skill jobs and low-skill jobs because of growing demand for skilled workers.

Consequently, these diverse results suggest that the contributions of ICT to transition processes differ under each region's transition trajectory. A summary of the results is presented in Table 7.

	Overall	CEE	LATIN	OECD
Economic Freedom	+**	+**	+**	+***
Unemployment	-***	-***	-	+**
Wealth Inequality	+	-	+***	+***
Press Oppression	+	+	-	-

*"="p"<.05"'"**"="p"<.01"'"***="p"<.001

Table 7. Summary of Results

Consequently, our empirical evidence supports Hypothesis 3. With respect to socioeconomic outcomes, while CEE has seen improvements both in overall economic conditions and in better employment from ICTs, Latin America countries have achieved enhancement only in economic freedom. Regarding the effects of ICT on sociopolitical values, the increased ICT spending has aggravated wealth disparity in Latin America, but it did not lead to the same problem in CEE. Moreover, we confirm that the different roles of ICTs in TEs and developed countries.

CONCLUSION

This research has attempted to estimate the contribution of ICT investments to the transition processes of TEs between 2004 and 2010. The results substantiate that ICT has played an important transformative role in TEs. Overall, ICT spending has a positive association with economic freedom and job creation, but it is negatively or insignificantly associated with wealth equality and democratization of transition economies. Further, we found that these associations differ depending on the transition economy's different use of ICT. Our results also indicate that transition economies received more benefits from ICTs in terms of stimulating economic growth (for CEE) and enhancing sociopolitical status (for Latin America) than developed countries did.

From a practical perspective, our study helps guide policymakers in transition economies. The findings of the study will assist policymakers from transition economies in utilizing ICT to achieve economic success or increase their sociopolitical status.

This study also contributes to the extant literature on ICT dynamics, not only by providing new insights into the transformative role of ICT in transition economies over the past decade but also by identifying a diverse set of issues for future research. The growing demand for theories about the role of ICT in new economies will require researchers to conduct in-depth studies on specific aspects of the findings presented in this paper. For example, while this study concentrated on ICT spending and its impacts on the transition process, it might be interesting to examine the different characteristics and utilizations of ICT in a centrally planned system (e.g., ICT for reporting to central planners) and a market-driven system (e.g., ICT for facilitating communication between citizens and government), and to identify the specific ICT properties that further transition processes. Moreover, it would be worthwhile to examine how the actual usage and affordability of ICT applications can stimulate the TEs' transition processes.

This paper's findings await further refinement from future studies. These findings are based on only two groups of transition economies. Thus, the results might vary with other groups of transition economies or with different model settings. Researchers will need to more completely investigate the full relationship between ICT investments and the transition process of transition economies by including other country groups.

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