Investigating the Impact of Investments in Telecoms on Microeconomic Outcomes: Conceptual Framework and Empirical Investigation in the Context of Transition Economies

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ABSTRACT

We propose and test a conceptual model allowing for investigating the microeconomic impact of investments in telecoms. While the impact of investments in telecoms on the macroeconomic outcomes has been previously investigated, there seems to be no published research that looked at the microeconomic impact of telecom investments. The proposed conceptual model links investments in telecoms with microeconomic constructs that are closely associated with such measure of macroeconomic bottom line as GDP; this allows us to outline a more detailed path traversed by the impact of investments. We use structural equation modeling to test the proposed model in the context of a sample of Transition Economies comprised of two groups differing in terms of the economic development. The results suggest the existence of the context-independent paths that are common to both groups; however, there is evidence that some of the impacts of investments in telecoms are dependent on the level of economic development. The results of the investigation offer valuable insights to decision and policy makers tasked with the responsibility of improving the micro- and macroeconomic impacts of investments in telecoms.

Keywords

Telecom investments, information technology for development, information technology in developing and transition economies, structural equation modeling, PLS.

INTRODUCTION

Investments in telecoms represent an important subset of overall investments in Information and Communication Technologies (ICT) of almost any economy of the world. Multiple investigations inquired into the contribution of investments in telecoms to the macroeconomic bottom line comprised of revenues from telecoms and the overall growth in productivity, as well as to the overall GDP (Khouja, 1995; Shao & Lin 2001; Chen & Zhu, 2004; DaBler *et al.*, 2002; Samoilenko & Osei-Bryson, 2008a,b). The general conclusion of the existing studies is that the more effective and efficient economies, with the higher levels of investments in telecoms and more productive full-time labor, have a greater macroeconomic impact of investments (Samoilenko & Osei-Bryson, 2007; Samoilenko &Osei-Bryson, 2008a, b). However, it is also important to inquire into the chain of microeconomic links that connects investments in telecoms and a measure of macroeconomic bottom line such as GDP.

According to a widely used framework of neoclassical growth accounting (Oliner & Sichel, 2000; Schreyer, 2000; Davery, 2000; Jorgenson & Stiroh, 2000; Whelan, 2000; Hernando & Nunez, 2002) a macroeconomic impact of investments in ICT is a function of three components: level of investments, labor, and total factor productivity (TFP) (Solow, 1957). Out of the three only first two are endogenous to the production function and could be used to explain the contribution to the macroeconomic bottom line, while TFP is exogenous and the nature of it remains unexplained (Samoilenko & Osei-Bryson, 2010). The implication is simple - a theoretically justified path of increasing the level of macroeconomic impact of investments is via increases in levels of investments and labor, and possibly, a complementarity of the two (Oliner & Sichel, 2000; Jorgenson 2001; Jorgenson & Stiroh, 2000; Council of Economic Advisors, 2001, Kraemer & Dedrick 2001; Pohjola 2002). Another route of growth consistent with the framework is via TFP; however, the implementation of this route via "spillover" effect is problematic due to the absence of the direct link between investments and TFP within the framework. While there is evidence that the level of human capital is an essential requirement for the spillover effect to take place (Xu, 2000), it is not clear whether investments in ICT could affect the level of human capital, thus reinforcing its own impact, or whether the level of human capital plays the role of an isolated environmental factor. The importance of obtaining a more detailed picture of the macroeconomic impact if investments in ICT is fairly obvious- the lower level of granularity shall allow decision makers to identify otherwise hidden sources of inefficiencies, as well as to identify

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complementarities and feedback mechanisms that magnify the impact of investments. Otherwise, in the absence of such details, a question "How to increase the macroeconomic impact of investments?" is answered by a valid, but not very useful response "Invest more and use a high quality labor." If that is the solution, then it only seems reasonable that poorly performing in this regard economies should resort to benchmarking of the best practices of the better performing economies of the similar level of economic development.

However, despite a theoretically justified link between investments in ICT and macroeconomic growth, the current research shows that the degree of the impact and the effectiveness of the link varies greatly even within the economies of the same type (e.g., developed, developing, transition, least developed) (Dewan & Kraemer, 2000; Pohjola, 2001; Piatkowski, 2003; OECD, 2005a; Oliner & Sichel, 2002; Jalava & Pohjola, 2002). Given this disparity, it is expected that policy and decision makers of the countries with the less pronounced macroeconomic benefits of investments in ICT are tasked to react appropriately and to improve the performance of investments; the current global economic situation will only emphasize the necessity of such actions. Consequently, in the absence of the continuous increase in the level of annual investments, the underperforming in this regard economies will have to achieve more with less.

An improvement of the macroeconomic outcomes of investments in ICT is not a trivial goal to accomplish for a decision maker, because a rationally planned intervention must be substantiated by the empirical evidence regarding to where in the process of transformation of investments into GDP inefficiencies exist, and what might cause them. In order to obtain some actionable information it is useful to inquire into the links between investments in ICT and microeconomic precursors and targets that are indicative of such macroeconomic outcomes as GDP. It is generally agreed that a higher level of GDP of an economy is associated with not only a higher level of personal wealth of its citizens, but also with a greater level of engagement in the international trade (van Ark, Inclaar, & McGuckin, 2003), and a better educated workforce (van Ark et al., 2004). However, it is not known whether economies that derive greater macroeconomic benefits from investments in ICT also derive greater microeconomic benefits, for a relationship between macroeconomic and microeconomic outcomes of investments has not been investigated. Currently, the mechanism of the microeconomic impact of investments still remains an under-researched "black box" in the sense that it is not clear how, or whether, the investments in telecoms could impact trade, affect the level of disposable income of the population, and elicit changes in the structure and quality of the labor force.

The overall objective of this study is to present and test a conceptual model of a "white box" path between investments in telecoms and impacts of the investments delivered by means of telecom products and services (henceforth, *telecom products*). The aim of the proposed conceptual model is to serve as a precursory first step in constructing the framework of the microeconomic impact of investments in ICT, of which telecoms is an important component. While the macroeconomic impact of investments in ICT and specifically investments in telecoms has been previously investigated, there seems to be no published research that looked at the linkage between telecom investments and microeconomic outcomes as reflected in the private wealth of citizens, quality of the labor force, and trade.

We conducted our investigation in the context of *Transition economies* (TE), as it was noted that from a research perspective TEs are advantageous (Samoilenko, 2008), for this group is comprised of economies that share many characteristics with developed countries, and economies that share characteristics mainly with less developed regions (OECD, 2004). Consequently, findings in the context of TEs may be better generalized beyond the small group of highly developed countries. This is especially important for the purposes of framework building and validation, for it was previously noted that the insights reporting the overall positive effects of investments in ICT (OECD, 2005a,b,c; IMF, 2001; Samoilenko & Osei-Bryson, 2008a,b) in the context of the relatively homogenous developed countries (Lam & Lam, 2005; Madden & Savage, 1999; Dunne *et al.*, 2004; Siegel, 1997) might not be applicable to a more diverse environment of emerging, developing and transition economies (Roztocki & Weistroffer, 2008; Hoskisson et al., 2000).

After the proposed framework is outlined, we test it in action by concentrating on two groups of TEs, the more advanced *Leaders*, and less developed *Followers* (Samoilenko & Osei-Bryson, 2007; Samoilenko &Osei-Bryson, 2008a, b), with the purpose of accomplishing two goals in the empirical part of the study. First, we aim to identify the common pathways of the microeconomic impact of investments in telecoms for two groups of TEs. Second, we seek to identify the pathways that differentiate the two groups. Knowing the nature of the differences between the *Leaders* and the *Followers*, (e.g., the level of economic development, overall level of GDP, level of annual investments in telecoms, etc.), the accomplishment of the first goal will allow us to possibly and tentatively identify the context-independent impacts of investments that are less affected by the levels of capital investments, revenues, efficiency and effectiveness of an economy. By accomplishing the second goal we will be able to identify the impacts of investments that are context-dependent and are associated with the differences in

the level of economic development of TEs. We describe the research model in the next section of the paper.

RESEARCH MODEL

The research model of our investigation is based on a set of core proposition provided in Table 1; we offer justifications for the propositions and outline the hypothesized links next.

Investments in telecoms, once allocated, are distributed along multiple routes addressing various objectives (e.g., for the purposes of maintenance of the existing infrastructure, developing new capacities, and R&D, among others) covering fixed and variable costs. Thus, not all invested dollars are put to work to bring returns. However, a part of investments must also be allocated for the purposes of obtaining a consumption-driven stream of revenues from telecoms; the source of that stream is sustained by the purchases of the telecom products by consumers. Undoubtedly, consumers comprise a heterogeneous group consisting of private, commercial, governmental, and non-governmental subgroups associated with domestic and external markets. However, it is a defensible assumption that at least some of the telecom products are targeted at private consumers within the domestic market; consequently, we put forward proposition *A1*.

While some of the consumer products are intended for utilization in a stand-alone fashion (e.g., home appliances, furniture, garments, etc.), telecom products are mostly intended to be utilized within a network of similar products. As a result, consumers of the telecom products face costs of, first, acquisition of a product (e.g., first time connection fees associated with an acquisition of a cell phone, land line phone, or Internet connection) and, second, participation in the network (e.g., on-going expense of subscribing to the service). Clearly, there exist a certain relative level of domestic market saturation, but until the level is reached, the stream of revenues provided by private consumers will be impacted by two cost-related factors. The first factor is the cost of the original purchase of the service, we call it *cost of entry*, and the second factor is the cost of the continuing access to a network of compatible products, we call it *cost of use*. It is reasonable to argue that up to the certain point of market saturation there is a relationship between the satisfied consumer demand for telecom products and the costs of the purchase and consequent access to the network. Thus, we put forward proposition *A2*.

Table 1 Six propositions supporting the research model of the study

Hypothesized Link	Resultant Proposition
Investments in telecoms-> Introduction of telecom products	A1: Some of the common outcomes of investments in telecoms for a given economy are telecom products targeting private consumers of the domestic market.
Cost of entry + Cost of use of telecom products -> Level of consumption of telecom products	A2: A level of consumption of telecom products for a given economy is associated with a price of one-time access fee (cost of entry) to, and a price of consequent continuing utilization (cost of use) of the network of the telecom products.
Cost of entry of telecom products -> Cost of use of telecom	A3: For a given economy, a decline in the price of access to the network of the telecom products is associated with a decline in the price of the utilization of the network.
Decreased cost of entry and use of telecom products-> Increased Access to telecom products	A4: A decline in prices of entry and use of telecom products allows for a greater access to telecom products by the general population.
Increased Access to telecom products-> Improved Personal Financial Well-being *Increased Access to telecom products -> Increased Participation in International Trade* *Increased Access to telecom products -> Improved Labor Market.*	A5: For a given economy, a greater access to the network of the telecom products is associated with a greater level of the private financial wellbeing of the consumers, a greater level of participation of an economy in the international trade, and greater opportunities of the labor force.
Improved Personal Financial Well-being-> Increased Participation in International Trade *Improved Personal Financial Well-being-> Improved Quality of the Labor Market*	A6: A level of the personal financial wellbeing of the population has a positive impact on the participation of an economy in the international trade, and on the labor force of an economy.

The first hurdle that consumers of telecom products face is a cost of entry- the cost associated with the purchase of the product, and this hurdle must be overcome for a cost of use to be incurred. It is only reasonable to assume that if the cost of entry is lowered, then more potential consumers will be attracted to telecom products. This will allow for development of economies of scale for telecom products, and this will also allow for a network effect to take place, lowering the individual costs of continuous utilization of telecom products. This allows us to put forward proposition *A3*.

The decrease in prices of telecom products, caused by a network effect of more customers joining in, will increase the accessibility of the network of telecom products for the population in general. This assumption supports proposition *A4*.

This increased general access to telecoms, driven by lower costs, brings about some important implications. First, additional information flowing through the new channels will positively impact (via transparency of prices, increased competition among sellers, etc.) personal finances of customers in market-driven economies. Second, the increased access will also positively impact the involvement of a market-driven economy in international trade, via the influx of new entrants from abroad attracted by the increased size, accessibility, and availability of the consumer market. Third, the increased access will positively impact the labor market of an economy, by streamlining the search process and better balancing supply and demand via information transparency. These three assumptions, consistent with the generally accepted view of the positive impact of ICT on personal finances and the quality of labor markets (Indjikian & Siegel, 2005), support proposition *A5*.

Improvement in the level of the personal financial well-being is important in itself, but it also carries an impact on the international trade and the state of the labor force. For example, as the level of disposable income of the population increases, so does the consumers' demand for additional products and services; this demand will positively affect trade. Similarly, improvements in the level of the financial well-being of the population offer opportunities to obtain valuable skills and knowledge by means of the costly secondary and tertiary education; this will increase the average quality of the labor force of the economy and will positively impact the quality of the labor market. These two implications serve as a foundation for proposition *A6*.

We summarize the stated above six propositions in the form of a comprehensive "chain of events" conceptual model in Figure 1. It should be noted that it is not the purpose of the proposed conceptual model to identify and introduce neither specific nor general constructs, factors, or variables, but rather the intent is to outline a chain of events along which some of the impacts of investments in telecoms propagate. Consequently, the proposed conceptual model should allow for developing of multiple testable research models. Keeping this in mind, we utilize this conceptual model of microeconomic impact of investments in telecoms to develop a research model comprised of six constructs presented in Figure 2. In order to translate the proposed conceptual model into a parsimonious testable research model, we have incorporated the link *Investments in telecoms->telecom products* into a single construct *Telecom Capitalization*.

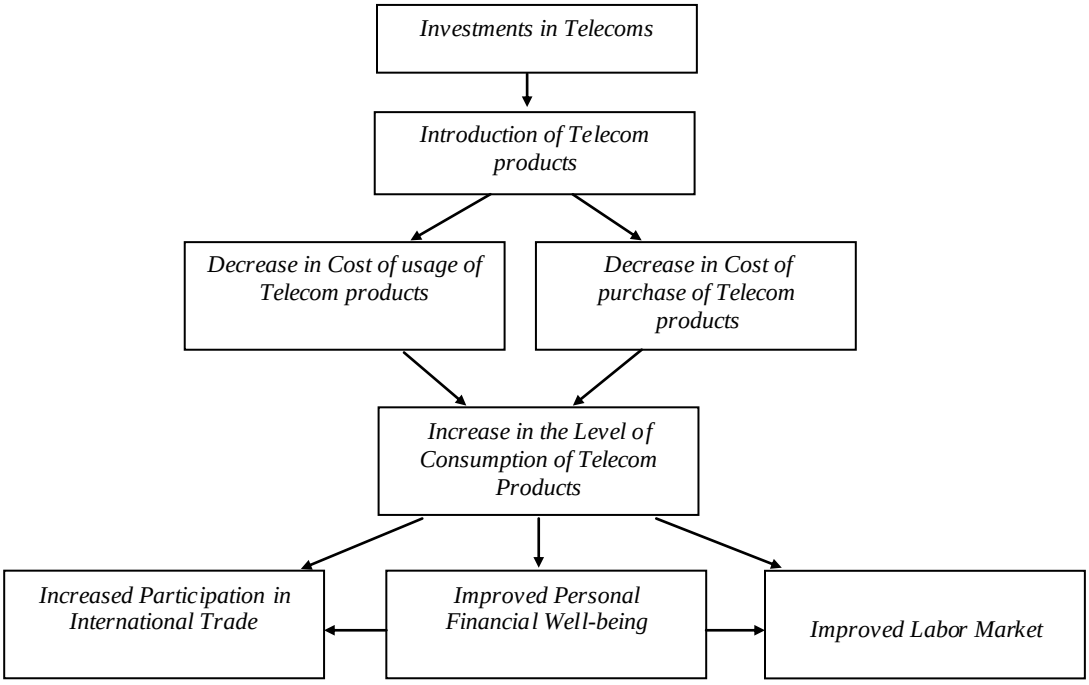

Figure 1 "Chain of events" conceptual model of the microeconomic impact of investments in telecoms

This abstraction is based on the assumption that, *ceteris paribus*, the economies with a higher level of the accumulated telecom capital, higher level of the annual investments in telecoms, and a more productive telecom labor will have greater capabilities providing telecom products to the general population.

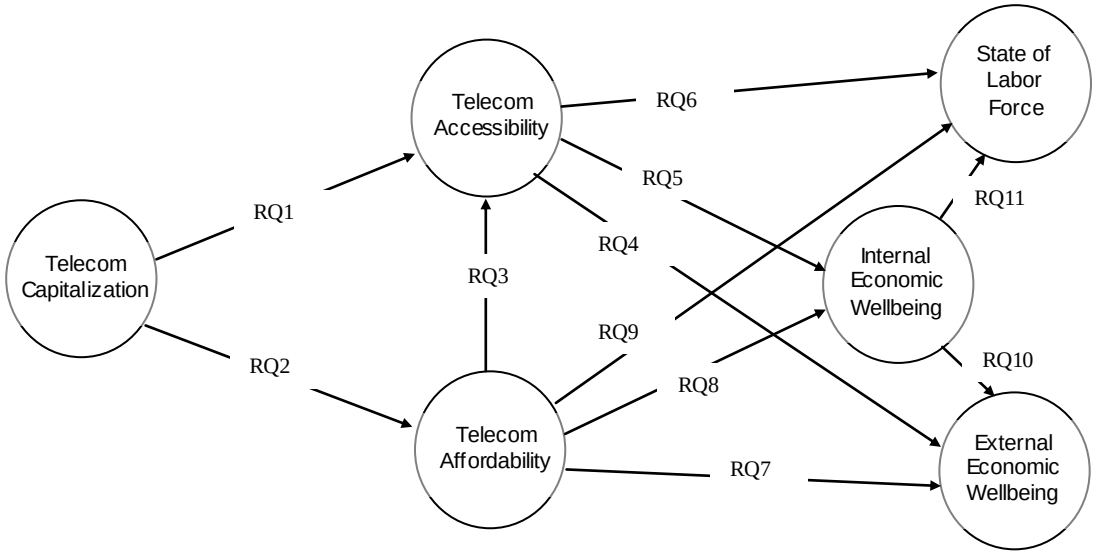

Figure 2 The research model of this study

We have also decided not to include in the research model a construct *Increase in the Level of Consumption of Telecom Products*, for while this link serves as an important step in our explanatory conceptual model, its presence in the research model is unnecessary. This is because if the assumption "lower cost leads to higher level of consumption" holds, then this construct is implicitly present via the inclusion in the research model of the constructs representing cost of usage and cost of purchase of telecom products.

We provide the operational definitions of the constructs in Table 2.

Table 2 Operational Definition of the Constructs of the Research Model

Construct	Operational Definition
Telecom Capitalization	A representation of the fiscal state of telecoms in a given economy, conceptualized using the overall level of accumulated telecom capital, telecom investments, and a full-time telecom workforce
Telecom Affordability	A representation of the cost of joining the network of telecom products
Telecom Accessibility	A representation of the cost of the continuing participation in the network of telecom products
Internal Economic Wellbeing	A representation of the level of disposable income of the population of an economy
External Economic Wellbeing	A representation of the level of participation of an economy in the international trade
State of Labor	A representation of the state of the workforce of an economy

Based on the proposed model we can formulate eleven research questions (see Table 3), which correspond to the paths between the constructs shown in the model.

Table 3 The relationships between the constructs of the model and the corresponding research questions

RQ#	Path in the model	Formulation of the Research Question
RQ1	Telecom Capitalization -> Telecom Accessibility	*Do capital investments in telecoms result in greater accessibility of the telecom infrastructure, products, and services?*
RQ2	Telecom Capitalization -> Telecom Affordability	*Do investments in telecoms result in greater affordability of the telecom infrastructure, products, and services?*
RQ3	Telecom Affordability -> Telecom Accessibility	*Whether a greater affordability of the telecom infrastructure, products, and services is associated with the greater accessibility of the telecom infrastructure, products, and services?*
RQ4	Telecom Accessibility ->	*Whether a greater accessibility of the telecom infrastructure,*

	External Economic Wellbeing	*products, and services is associated with improvements in external economic wellbeing?*
RQ5	Telecom Accessibility -> Internal Economic Wellbeing	*Whether a greater accessibility of the telecom infrastructure, products, and services is associated with improvements in internal economic wellbeing?*
RQ6	Telecom Accessibility -> State of Labor Force	*Whether a greater accessibility of the telecom infrastructure, products, and services has a positive impact on the state of the labor force?*
RQ7	Telecom Affordability -> External Economic Wellbeing	*Whether a greater affordability of the telecom infrastructure, products, and services is associated with improvements in external economic wellbeing?*
RQ8	Telecom Affordability -> Internal Economic Wellbeing	*Whether a greater affordability of the telecom infrastructure, products, and services is associated with improvements in internal economic wellbeing?*
RQ9	Telecom Affordability -> State of Labor Force	*Whether a greater affordability of the telecom infrastructure, products, and services has a positive impact on the state of the labor force?*
RQ10	Internal Economic Wellbeing -> External Economic Wellbeing	*Do improvements in internal economic wellbeing of an economy result in improvement in its external economic wellbeing?*
RQ11	Internal Economic Wellbeing -> State of Labor Force	*Do improvements in internal economic wellbeing of an economy positively impact its state of the labor force?*

We use structural equation modeling (SEM) implemented with a partial least squares (PLS) approach to answer the research questions of the study.

OVERVIEW OF THE DATA ANALYTIC METHOD

Structural Equation Modeling (SEM) implemented with Partial Least Squares (PLS)

SEM is a methodology representing the second generation of multivariate analysis (Fornell, 1987). Unlike first generation statistical tools, exemplified by such techniques as cluster analysis, multiple regression, principal component analysis and others, SEM allows researchers to address a set of interrelated objectives within a single comprehensive analysis (Gefen *et al.*, 2000). Use of SEM allows researcher to posit a presence of the relationships between the unobserved variables, where every such variable is associated with one or many observed variables; unobserved variables are referred to as *latent* variables, and observed variables are referred to as *indicators* or *measures*.

SEM consists of two parts. The first part involves testing the *measurement* model and primarily deals with the validation of the latent constructs included the model. The second part involves the assessment of the *structural* model and involves testing of the hypothesized relationships between the latent constructs of the research model. The results of the assessment are based on the significance of the structural paths, which can be estimated by using such methods as general least squares (GLS), ordinary least squares (OLS), maximum likelihood estimation (MSL), partial least squares (PLS), and others. The basic structure of a SEM is depicted in Figure 3.

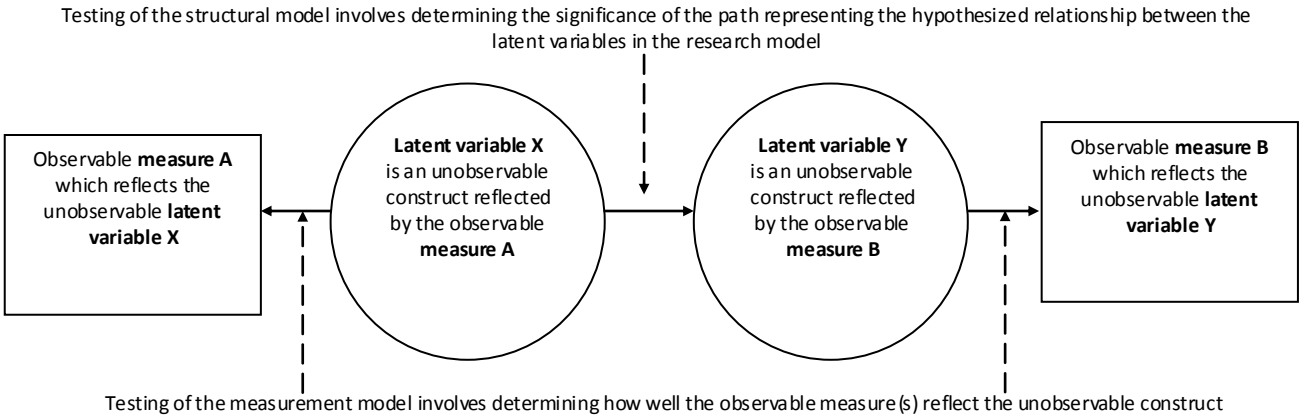

Figure 3 Structural Equation Modeling (SEM): Basic Structure and Components

There are two common approaches to SEM, covariance-based and variance-based. The covariance-based approach is based on the objective of minimizing the difference between the covariance matrix of the sample and the covariance matrix of the model. Thus, this approach is also commonly called factor-based, for the goal is to maximize the fit of the model by means of minimizing the unique variance; because of this goal of optimization of the fit the covariance-based approach is suitable for the investigations supported by a strong theory. In contrast, a variance-based approach attempts to optimize the predictive capability of the research model relative to the sample. The optimization of the prediction is achieved by estimating the parameters of the model by means of the minimization of the residual variances of the variables in the model (Chin, 1998); Because of the assumption that all the measured variance is useful variance to be explained, this method is commonly referred to as component-based. One of the least restrictive methods for estimating parameters in covariance-based SEM is partial least squares (PLS) (Wold, 1966).

Table 4 Null Hypotheses of the Study

RQ#	Corresponding Null Hypothesis
RQ1	$H0_1$: *There is no statistically significant relationship between the constructs Telecom Capitalization and Telecom Accessibility*
RQ2	$H0_2$: *There is no statistically significant relationship between the constructs Telecom Capitalization and telecom Affordability*
RQ3	$H0_3$: *There is no statistically significant relationship between the constructs Telecom Affordability and telecom Accessibility*
RQ4	$H0_4$: *There is no statistically significant relationship between the constructs Telecom Accessibility and External Economic Wellbeing*
RQ5	$H0_5$: *There is no statistically significant relationship between the constructs Telecom Accessibility and Internal Economic Wellbeing*
RQ6	$H0_6$: *There is no statistically significant relationship between the constructs Telecom Accessibility and State of Labor Force*
RQ7	$H0_7$: *There is no statistically significant relationship between the constructs Telecom Affordability and External Economic Wellbeing*
RQ8	$H0_8$: *There is no statistically significant relationship between the constructs Telecom Affordability and Internal Economic Wellbeing*
RQ9	$H0_9$: *There is no statistically significant relationship between the constructs Telecom Affordability and State of Labor Force*
RQ10	$H0_{10}$: *There is no statistically significant relationship between the constructs Internal Economic Wellbeing and External Economic Wellbeing*
RQ11	$H0_{11}$: *There is no statistically significant relationship between the constructs Internal Economic Wellbeing and State of Labor Force*

The popularity of PLS is due to its minimal demands on measurement scales, sample size, and residual distribution (Chin, 1998). While covariance-based methods are more appropriate when the research model is supported by strong theory and well-developed measures, PLS is recommended and often used for the purposes of theory development (Barclay *et al.*, 1995).

Because the research questions of the study express the hypothesized relationships between the SEM' model constructs, we can answer them by assessing the results of the structural model of SEM with PLS. The assessment will involve evaluating strength of the relationships between the constructs, where each path is represented by the null hypothesis; the research questions with the associated null hypotheses are summarized in Table 4.

DATA

The data for this study were obtained from the *World Development Indicators* database (web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS) and the *Yearbook of Statistics* (2009) of the *International Telecommunication Union (ITU)(* www.itu.int*).*

Table 5 Two subgroups of the sample of 18 TEs (Samoilenko & Osei-Bryson, 2010)

Subgroup	General Membership of the subgroup	Overall Sample
The *Leaders*	Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia, Slovakia	48
The *Followers*	Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Kazakhstan, Kyrgyz Republic, Moldova, Romania, Ukraine	60

TEs are commonly defined as economies that are in transition from centralized planning system to a free market economy (Roztocki & Weistroffer, 2008). To minimize the heterogeneity of our sample we use TEs that are classified as *Transition economies in Europe and the former Soviet Union* (IMF, 2001). Overall, we were able to construct the data set on 18 TEs covering the period from 2003 to 2008. The complete membership of the sample of 18 TEs is represented in terms of two clusters presented in Table 5: the more efficient in terms of the production of revenues and the utilization of investments *Leaders* and the less efficient *Followers* (Samoilenko & Osei-Bryson, 2010). In general, the *Leaders* also have higher levels of investments in telecoms, higher levels of revenues from telecoms, and more productive telecom workforce then the *Followers* (Samoilenko & Osei-Bryson, 2008 a, b). In order to account for the heterogeneity of the sample we will test two SEM models, one for the *Followers*, and one for the *Leaders*.

The representation of the latent variables of the research model is provided in Table 6 below. The representation of the construct *telecom Capitalization* was modeled after the construct *ICT Capitalization* of Samoilenko and Osei-Bryson (2008a, b), the representation of the rest of the constructs is unique to this study.

Table 6 Measures of the Current Research Model

Measure	Source variables	Representation	Latent Construct
TelCap1	*GDP per capita*(in current US$) *Annual telecom Investment per capita* (in current	Ratio of *GDP per capita* to *Annual telecom Investment per*	Telecom Capitalization

	US$)	*capita.*	
TelCap2	*Annual Total Revenue from telecoms*(% of GDP) *Annual Investments in telecoms*(% of GDP)	Ratio of *annual Total revenue from telecoms* to *Annual investments in telecoms*	
TelCap3	*Full-time telecom Staff* *Annual investment in telecoms(in current US$)*	*Ratio of Full-time telecom staff to the Annual investment in telecoms*	
Access1	*Business telephone connection charge, US$*	*Business telephone connection charge, US$*	Telecom Accessibility
Access2	*Residential telephone connection charge, US$*	*Residential telephone connection charge, US$*	
Afford1	*Price of a 3 minute fixed telephone local call, off peak rate, US$*	*Price of a 3 minute fixed telephone local call, off peak rate, US$*	Telecom Affordability
Afford2	*Business telephone monthly subscription, US$*	*Business telephone monthly subscription, US$*	
Afford3	*Residential telephone monthly subscription, US$*	*Residential telephone monthly subscription, US$*	
ExtW1	*Imports of goods and services (% of GDP)*	*Imports of goods and services (% of GDP)*	External Economic Wellbeing
ExtW2	*Exports of goods and services (% of GDP)*	*Exports of goods and services (% of GDP)*	
ExtW3	*Foreign direct investment, net inflows (% of GDP)*	*Foreign direct investment, net inflows (% of GDP)*	
IntW1	*Estimated Internet users per 100 inhabitants*	*Estimated Internet users per 100 inhabitants*	Internal Economic Wellbeing
IntW2	*Health expenditure, private (% of GDP)*	*Health expenditure, private (% of GDP)*	
IntW3	*International tourism, expenditures (current US$)* *GDP (current US$)*	*International tourism, expenditures(% of GDP)*	
EL1	*Employment to population ratio, ages 15-24, female (%)*	*Employment to population ratio, ages 15-24, female (%)*	State of Labor Force
EL2	*Employment to population ratio, ages 15-24, male (%)*	*Employment to population ratio, ages 15-24, male (%)*	
EL3	*Labor participation rate, female (% of female population ages 15+)*	*Labor participation rate, female (% of female population ages 15+)*	
EL4	*Labor participation rate, male (% of male population ages 15+)*	*Labor participation rate, male (% of male population ages 15+)*	

RESULTS OF THE DATA ANALYSIS

Preliminary Data Analysis: Principal Component Analysis (PCA)

We used PASW Statistics 18 (formerly SPSS) package to conduct an exploratory PCA in order to determine whether our latent constructs and measures demonstrate a specific pattern of loadings, align in the same direction and the measures associated with a given latent construct load together on the same principal component. The detailed results of the PCA are presented in Table 7 and Table 8. Overall, six components were extracted under the pre-specified condition of eigenvalue of a component being greater than one, and using the most common rotation option, *varimax*, in order to obtain an easy to interpret solution where each measure would be maximally associated with a single construct. The cumulative variance extracted by six components was 85.31%, which is sufficiently high. The value of Kaiser-Meyer-Olkin (KMO) test of sampling adequacy was above 0.5 and the value of Bartlett's test of sphericity was less than 0.05 (Bollen & Long, 1993). Thus we conclude that our data set is suitable for PCA.

Table 7 Principal Component Analysis: Descriptive Statistics

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.587
Bartlett's Test of Sphericity	Approx. Chi-Square	1670.948
	df	153
	Sig.	.000

The assessment of the results of PCA presented in Table 7 strongly suggests that our measures represent their respective latent constructs well; this allows us to continue our inquiry and perform PLS analysis. The three measures marked "(R)", namely, ExtW3, IntW1, and EL1, were later removed from the further analysis. Assessment of the research model involves two distinct steps. The first step, assessment of the *measurement model*, primarily deals with the evaluation of the characteristics of the latent variables and measurement items that represent them. The second step, assessment of the *structural model*, involves evaluation of the specified by the research model relationships between the latent variables.

Table 8 Principal Component Analysis: Pattern of Loadings and Extracted Variance

	Component						Communalities
	1	2	3	4	5	6	Extraction
TelAccess1					0.919		0.933
TelAccess2					0.900		0.893
TelAfford1			0.768				0.707
TelAfford2			0.902				0.861
TelAfford3			0.876				0.909
TelCap1		0.959					0.976
TelCap2		0.955					0.932
TelCap3		0.869					0.842
ExtW1						0.777	0.881
ExtW2						0.765	0.838
ExtW3 (R)						0.590	0.498
IntW1 (R)			0.573	0.623			0.875
IntW2				0.937			0.913
IntW3				0.938			0.895
EL1 (R)	0.910						0.888
EL2	0.838						0.893
EL3	0.777						0.737
EL4	0.834						0.885

SEM with PLS: Measurement Model

The process of evaluating the adequacy of the measurement model involves assessing the reliability of the individual items and their constructs, the convergent validity of the measures representing each construct, and discriminant validity of the measures (Hulland, 1999). We offer a summary of the assessment of *the Leaders'* model in Table 9, and the assessment of *the Followers'* model in Table 10. Table 11 contains the results of the assessment of the convergent validity of both models.

A test of the reliability of the individual items involves assessment of the loadings of the measures on their latent construct and in turn the assessment of the reliability of the constructs is conducted by assessing the composite reliability of the constructs. All measures of the internal consistency were above 0.7 (Nunnaly, 1978) and the values of variance shared by each construct and its measures were greater than 0.5 (Rivard & Huff, 1988). The results of the assessment of reliability of the individual measures illustrate that the measures and the constructs share the significant amount of variance (individual

loadings of the all items are greater than 0.7); thus, our research model fares well in regard to the assessment of the reliability of the individual items.

Table 9 Assessment of the Measurement Model of *the Leaders*

Construct	AVE	Square Root of AVE	Composite Reliability	R Square	Cronbach's Alpha	Communality
Telecom Capitalization	0.9112	0.954568	0.9685	0	0.956	0.9112
Telecom Accessibility	0.9728	0.986306	0.9862	0.1725	0.9721	0.9728
Telecom Affordability	0.898	0.947629	0.9463	0.0347	0.8864	0.898
Internal Economic Wellbeing	0.9843	0.992119	0.9921	0.2717	0.984	0.9843
External Economic Wellbeing	0.7201	0.848587	0.8373	0.8382	0.6114	0.7201
State of Labor Force	0.9023	0.949895	0.9652	0.1435	0.946	0.9023

Table 10 Assessment of the Measurement Model of *the Followers*

Construct	AVE	Square Root of AVE	Composite Reliability	R Square	Cronbach's Alpha	Communality
Telecom Capitalization	0.7728	0.87909	0.9105	0	0.863	0.7728
Telecom Accessibility	0.9728	0.986306	0.9862	0.2048	0.9721	0.9728
Telecom Affordability	0.8968	0.946995	0.9456	0.0729	0.8864	0.8968
Internal Economic Wellbeing	0.9173	0.957758	0.9569	0.1217	0.91	0.9173
External Economic Wellbeing	0.953	0.976217	0.9759	0.1618	0.9516	0.953
State of Labor Force	0.7799	0.883119	0.9139	0.6015	0.8621	0.7799

The evaluation of the measure of internal consistency is commonly used for assessing convergent validity of the measures (Fornell & Larcker, 1981). The evaluation process involves assessment of the magnitude and significance of the t-values for the loadings of each of the individual items as well as the assessment of the loadings of the measures on their own constructs. It is expected that the t-values are significant and the measures representing their construct exhibit high loadings on that construct and low loadings on the other constructs in the model. The results (provided in Table 10) demonstrate that the research model passed the test of the convergent validity, for all t-values for all measures of the constructs are significant. Further assessment of convergent validity (Table 11) demonstrated that all measures in our research model share a lot of variance and loads highly only on their own constructs; this pattern is indicative of high convergent and discriminant validity of the model.

Table 11 Assessment of Convergent Validity

Constructs and Measures	**T-statistics, *the Followers***	**T-statistics, *the Leaders***
TelCap1 <- Telecom Capitalization	3.627	2.3271
TelCap2 <- Telecom Capitalization	2.3857	3.828
TelCap3 <- Telecom Capitalization	4.9152	3.2811
EL2 <- State of Labor Force	14.2762	6.2654
EL3 <- State of Labor Force	18.3242	7.5116
EL4 <- State of Labor Force	9.4139	9.6654
ExtW1 <- External Economic Wellbeing	9.921	20.1553
ExtW2 <- External Economic Wellbeing	12.809	16.5783
TelAccess1 <- Telecom Accessibility	28.4769	66.4215
TelAccess2 <- Telecom Accessibility	27.437	58.1425
TelAfford1 <- Telecom Affordability	17.2509	26.8014
TelAfford2 <- Telecom Affordability	19.4057	34.3235
IntW2 <- Internal Economic Wellbeing	42.2121	57.1787
IntW3 <- Internal Economic Wellbeing	41.4016	57.6581

The successful evaluation of the adequacy of our measurement model allows us proceed further with the assessment of the structural model.

SEM with PLS: Structural Model

The testing of the significance of the hypothesized relationships between the specified in the research model constructs requires assessing the paths of the structural model. Once the path coefficients between the constructs in the model have been calculated, we can evaluate the significance of the path coefficients and the significance level of the path. In SmartPLS t-values are obtained by running a bootstrapping procedure, while the significance level of the path is established by using 2-tailed t-distribution table. We present the results of the assessment of the structural model in Table 12.

Overall, out of eleven paths of the research model we can identify six that are common to both groups of TEs (see Figure 4), while the rest of the paths represented by two that are unique to the *Leaders*, and three that are unique to the *Followers* (see Figure 5). The common paths possibly indicate the routes by which investments in telecoms impact microeconomic outcomes of economies regardless of the level their economic development.

Table 12 Assessment of the Structural Model

Structural Path	*The Leaders*		*The Followers*	
	T Statistics	**Test of $H0_n$**	**T Statistics**	**Test of $H0_n$**
Telecom Capitalization -> Telecom Accessibility	0.1553	Not Rejected	2.4696	Rejected
Telecom Capitalization -> Telecom Affordability	2.0233	Rejected	3.8681	Rejected
Internal Econ. Wellbeing -> External Econ. Wellbeing	6.1307	Rejected	4.2627	Rejected
Internal Economic Wellbeing -> State of Labor Force	0.3615	Not Rejected	10.8886	Rejected
Telecom Accessibility -> External Economic Wellbeing	6.9537	Rejected	2.013	Rejected
Telecom Accessibility -> Internal Economic Wellbeing	4.5063	Rejected	0.2762	Not Rejected
Telecom Accessibility -> State of Labor Force	2.4555	Rejected	6.4332	Rejected
Telecom Affordability -> External Economic Wellbeing	11.6644	Rejected	5.0855	Rejected
Telecom Affordability -> Internal Economic Wellbeing	1.2904	Not Rejected	6.0657	Rejected
Telecom Affordability -> State of Labor Force	2.7258	Rejected	0.3609	Not Rejected
Telecom Affordability -> Telecom Accessibility	2.8256	Rejected	3.2728	Rejected

For example, it is reasonable to assume that overall cost of using telecom products and services decreases regardless of the context as capital investments in telecoms transformed into the telecoms infrastructure- this may explain the commonality between the *Leaders* and the *Followers* in regard to *Telecom Capitalization->Telecom Affordability* path.

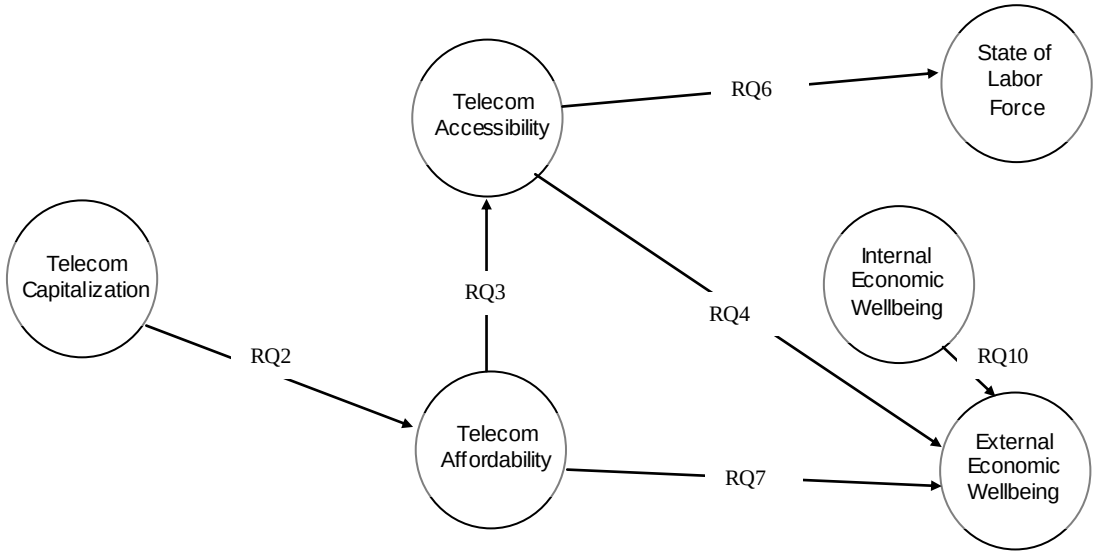

Figure 4 Common Paths in the Model

However, it also plausible that the construct *Telecom Accessibility* does not only depict the cost of access of the network of telecom-related products and services, but also reflects the "last mile problem", solution of which is dependent on the level of existing infrastructure.

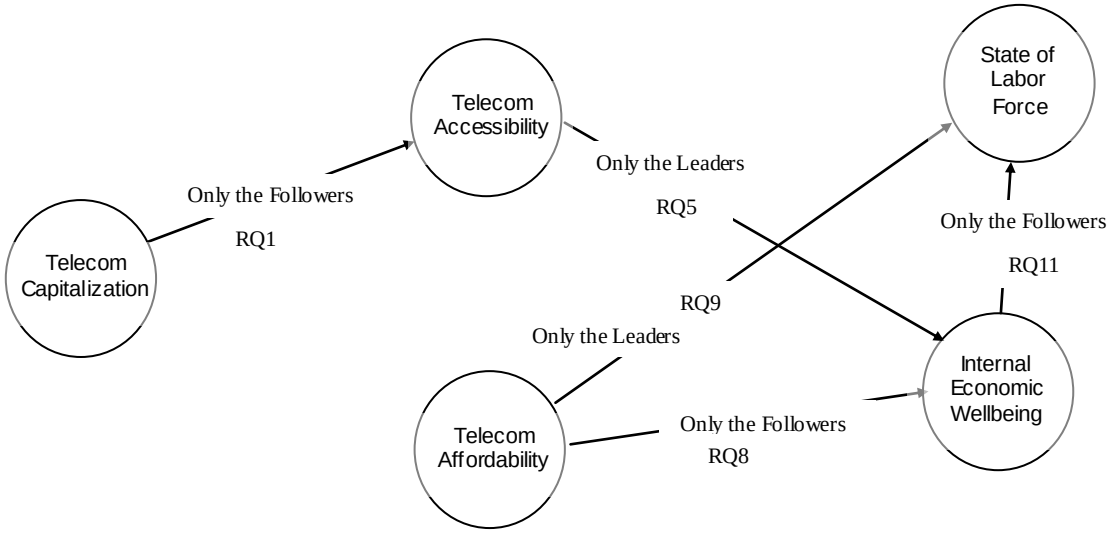

Figure 5 Paths in the Model differentiating *the Leaders* from *the Followers*

If this is so, then it is understandable why the construct *Telecom Capitalization* of only *the Followers*, but not *the Leaders*, is associated with *Telecom Accessibility*, for the level of the accumulated telecom capital of *the Leaders* is much higher than the capital of *the Followers* (Samoilenko, 2008). Meaning, *the Leaders* can make telecom-related products and services more affordable by making them cheaper, but *the Leaders* cannot make them more accessible, for they are already accessible enough to all who wants to access them, by virtue of the accumulated telecom capital and telecom infrastructure. *The Followers*, however, still lag in this regard (Samoilenko, 2008) and could increase the level of accessibility by making additional investments in telecoms.

DISCUSSION

We summarize the findings of the common paths, along with their interpretations in Table 13 below. Regardless whether the context is represented by developed, developing, or least developed economies there are two routes by which investments in telecoms may impact a macroeconomic bottom line. The first way is via the *spillover effect*, where the impact of investments is indirect and investments work by causing other economic factors or entities to be more productive. The second way is by providing a return on investments in the form of revenues that contribute directly to the overall GDP. Samoilenko and Osei-Bryson (2008 a, b) found that in the context of TEs those countries with higher levels of telecom investments also produced higher level of revenues. However, the findings also suggest that the lower level of investments is not the only culprit staying on the path to the high level of revenues, for the TEs with the lower levels of investments also exhibit a much greater levels of inefficiencies in the process of converting investments into revenues and display a lack of complementary effects of investments in telecoms and telecom labor (Samoilenko and Osei-Bryson, 2008 a, b).

Table 13 Summary of the Findings of the Study

RQ#	Research Question	Answer Based on the Results of the Study
RQ1	*Do investments in telecoms result in greater accessibility of the telecom infrastructure, products, and services?*	Only in the context of economically less developed TEs investments are associated with accessibility of telecom products.
RQ2	*Do investments in telecoms result in greater affordability of the telecom infrastructure, products, and services?*	Regardless of the level of economic development of TEs investments in telecoms are associated with affordability of telecom products.
RQ3	*Whether a greater affordability of the telecom infrastructure, products, and services is associated*	Regardless of the level of economic development of TEs a level of affordability of telecom

	with the greater accessibility of the telecom infrastructure, products, and services?	products is associated with their level of accessibility.
RQ4	*Whether a greater accessibility of the telecom infrastructure, products, and services is associated with improvements in external economic wellbeing?*	Regardless of the level of economic development of TEs the higher level of accessibility of telecom products is associated with greater involvement of the economy in international trade.
RQ5	*Whether a greater accessibility of the telecom infrastructure, products, and services is associated with improvements in internal economic wellbeing?*	Only in the context of economically better developed TEs the level of accessibility of telecom products is associated with the greater levels of disposable income of the population.
RQ6	*Whether a greater accessibility of the telecom infrastructure, products, and services has a positive impact on the state of the labor force?*	Regardless of the level of economic development of TEs, the level of accessibility of telecom products is associated with the state of the labor force of the economy.
RQ7	*Whether a greater affordability of the telecom infrastructure, products, and services is associated with improvements in external economic wellbeing?*	Regardless of the level of economic development of TEs, the level of affordability of telecom products is associated with a greater level of involvement of the economy in international trade.
RQ8	*Whether a greater affordability of the telecom infrastructure, products, and services is associated with improvements in internal economic wellbeing?*	Only in the context of economically less developed TEs the level of affordability of telecom products is associated with the level of disposable income of the population.
RQ9	*Whether a greater affordability of the telecom infrastructure, products, and services has a positive impact on the state of the labor force?*	Only in the context of economically better developed TEs the level of affordability of telecom products is associated with a state of the labor force of the economy
RQ10	*Do improvements in internal economic wellbeing of an economy result in improvement in its external economic wellbeing?*	Regardless of the level of economic development of TEs a greater level of disposable income of the population is associated with the greater level of involvement of the economy in international trade.
RQ11	*Do improvements in internal economic wellbeing of an economy positively impact its state of the labor force?*	Only in the context of economically less developed TEs the greater levels of disposable income of the population are associated with a better state of the labor force of the economy

The current investigation offers additional insights into the mechanism by which *Investment-to-Revenues* route works, for the constructs *telecom Accessibility* and *telecom Affordability* are the integral components of the revenue-generating process by which investments in telecoms impact macroeconomic bottom-line.

CONCLUSION

In order to obtain a broader perspective on the relationship between investments in ICT and their economic outcomes researchers have been encouraged to conduct longitudinal studies (Palvia, 2006; Hoskisson et al., 2000). However, it was noted that investigators conducting research in this area face a challenge associated with the general scarcity of sound theory-driven approaches, methods, and methodologies allowing for identification of the relevant economy-specific antecedents and their business and IT strategies consequents (Palvia, 2006). In this study we outlined a conceptual model of the microeconomic impact of investments in ICT, and then translated the outlined model into the research model that was tested in the context of TEs. We believe that the proposed model could be further refined, extended and then used to construct a general framework of the impact of investments in ICT; the outline of such framework is presented in Figure 6.

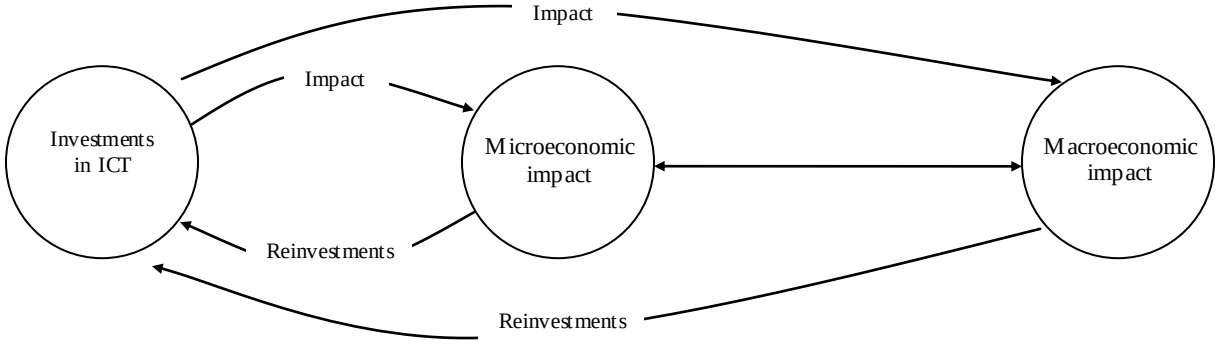

Figure 6 Closed-loop model depicting the overall impact of investments in ICT

Major contributions of this research are the new conceptual model of microeconomic impact of investments in ICT and the results that followed from its application to TEs.

We obtained evidence that investments in telecoms are associated with cheaper-to-purchase, and, eventually, cheaper-to-utilize telecom products. The importance of this finding is two-fold. First, it allows policy and decision makers not only to outline the short-term impact of investment in telecoms, but also to gauge the relative efficiency and effectiveness of investments in regard to the cost-related criteria. As a result, the short term impact of investments in telecoms could be partially assessed via the question "Do investments in telecoms result in cheaper-to-purchase and cheaper-to-utilize telecom products?" Second, the evidence suggest the importance of a strategic perspective in regard to investments, for once the domestic market of telecom products becomes saturated, policy and decision

makers will have to plan for a diminishing stream of revenue coming from the sales and services of telecom products. Eventually, the slim profit margins will not be able to sustain the stream of reinvestments and new sources of revenues will have to be identified, explored, and pursued.

Another important insight is provided by evidence of the impact of cheaper-to-utilize telecom products on trade and the state of the labor force. One of the possible implications is that a state of the labor force in a given economy is reflective of the local relative conditions, such as the level of the availability of the communication channels. Consequently, a scarcity of information channels mediated by telecom products could well be considered a contributing factor to a level of unemployment in a given economy. A similar implication is applicable to trade, which is not only influenced by the level of disposable income of the domestic consumers, but also seems to be associated with the availability of the communication channels of a given economy. It is plausible that investments in telecoms could provide a valuable, albeit indirect, contribution to the state of the labor force and trade in the context of TEs. Consequently, a long term impact of investments in telecoms could be evaluated by the question "Do investments in telecoms result in the increased density of communication channels available to the population?"

Overall, we were able to obtain evidence supporting the existence of the described by our conceptual model chain of events according to which investments in telecoms impact microeconomic outcomes in the context of TEs. By following (and modifying, where necessary) our model, decision and policy makers could monitor the performance of investments over time, as well as to improve the overall level of the impact of investments. Additional research is needed to identify performance guidelines, as well as to identify desirable milestones and benchmarks.

While our investigation outlined and tested some of the possible pathways of the impact of investments in Telecoms, it is not clear how the outcomes of investments could feedback and provide a continuous stream of reinvestments. Our future investigations will look into this issue.

In regard to the limitations, it should be noted that in this study we were often limited by the absence of data on all potentially relevant variables for all TES in the sample for the period covered by the sample; this affected how some of our constructs were defined.

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