Pervasive Versus Productive: The Case of Mobile Phones in Developing Economies

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Abstract

With statistics pointing to nearly 100% adoption of mobile phones in developed countries and nearly 50% adoption worldwide, mobile phones have become a pervasive portion of our information and communications infrastructure. In many developing countries, mobiles are becoming an important platform for delivering information services. Yet in spite of its rapid adoption, does this mean that cell phones increase productivity? This paper is a country-level analysis of whether investments in mobile phones translate into increased productivity. We find that in the near term, mobiles actually decrease productivity. The long-term benefits differ between developed to developing countries. In developing countries, there is a positive long-term benefit to productivity. In developing countries, however, this study does not find any long-term productivity improvements.

Keywords: mobile phones, economic growth, productivity

INTRODUCTION

To borrow from Solow's classic quip, we see mobile phones everywhere except in the productivity statistics. In 2007, the worldwide number of mobile telephone subscriptions exceeded 3.3 billion, marking the point where over half of the world's population has a cell phone (Reuters, 2007). Granted, the number of people using cell phones is notoriously difficult to count, with many people having multiple phones, pre-paid phones cards, and shared phones. Nonetheless, mobile devices are quickly becoming one of the most pervasive forms of information and communication technology (ICT). Yet pervasive is not the same as productive.

As this study shows, the rapid adoption of mobile devices has not resulted in a corresponding increase in productivity across the globe.

This research is primarily motivated by the growing role of mobiles in developing economies. Considering that many developing economies lack other traditional types of ICT infrastructure—such as fixed-line phones, internet connectivity, etc.—many pundits are predicting that the information revolution will come to developing economies via the mobile phone (Economist, 2000). Given the statistics that show widespread global penetration of mobile devices, this is certainly a justifiable perspective. Furthermore, rapid mobile adoption presents an opportunity for developing economies to leapfrog ahead, potentially catching up on the track of economic development. As a result, mobiles are a promising technological innovation for economic growth.

Yet in spite of the numbers showing the pervasive adoption of mobiles, it is not well understood whether that translates into any improvements in productivity. A majority of what we currently know about the benefits of mobiles comes from case studies. Furthermore, large volumes of these case studies are derived from the practitioner literature and hence lack an academic degree of rigorous analysis. Hence, it is uncertain whether the current body of cases demonstrates a generalizable benefit from mobile devices. This study attempts to answer that question by looking at the productivity of mobiles at the country-level. The goal is to examine whether the successes of the case studies translate into global benefits.

Although the primary motivation behind this study is mobile technology for development, it also has some applications in developed countries. The data set used in this study (see Data section) indicates that by 2004, the average developed economy had more than 90 cell phones per 100 people. In some cases, there were more than 100 phones per 100 people. Although cell phones are now a pervasive part of our culture, does that mean that we use them in a way that enhances our productivity?

To foreshadow the results of this paper, this study shows that:

- In developed and developing countries, mobiles have a *negative* short-term effect on economic growth.
- In developed countries, this short-term investment translates into long-term productivity improvements.

- In developing countries, the benefits are more ambiguous, though there is evidence of learning.

This paper is organized as follows. The next section summarizes some of the prior case studies showing the value of mobiles and some prior literature indicating a possible productivity benefit. The following three sections outline the general framework for analyzing this problem, the county data used, and the results of the analysis. The last section is a review of the results, their implications, and possible future research directions.

LITERATURE REVIEW

This section reviews the prior work on the potential value of mobile devices. It looks at this problem from two angles. First, how do mobile phones in particular increase productivity? This is an analysis of some of the previous case studies showing how mobile phones have successfully changed business processes, especially in developing economies. The second part of the review examines the broader country-level trends in ICT and economic development. As is shown, ICT investments in general have a history of positively affecting economic growth.

Mobiles and Productivity

Mobile phones are becoming an increasingly important tool in providing information services in many economies. This section describes some of the ways that mobiles are increasing the productivity and improving the processes of businesses and individuals in developing economies. This section specifically looks at four commonly cited mechanisms: price discovery, banking, best practices, and entrepreneurship.

The first potential benefit of mobile phones in development is a classic application of electronic commerce in business-to-business interactions. Mobile phones can help individuals and businesses identify the customers willing to pay the greatest value for their goods. For example, Indian fishermen can use their mobile phones (Jensen, 2007; Abraham, 2007), via a system using a Short Message Service (SMS) text message, to discover the market prices of fish at nearby ports. This information helps them maximize their value of their catch. Note that although extensive studies have shown that similar applications can apply to other agriculture sectors, most of these applications use more traditional ICT infrastructure. Nonetheless, some studies have also begun to look at mobiles in agriculture (e.g., Aker, 2008) and have shown similar benefits.

Another promising sector where mobiles can improve business is mobile banking (Andoh-Baidoo et al., 2007). These are technologies that bring banking services to people who previously were not able to use traditional banking services. The actual implementations have varied greatly. In some cases, the mobile phone serves as a de-facto credit card, such as with Wizzit in South Africa (Ivatury and Pickens, 2006) or Smart Money in the Philippines (Smith, 2004). Resourceful entrepreneurs have even learned how to use mobile phones to support banking when manufacturers and service providers do not provide formalized banking services. For example, when community members emigrate to work and support their families, they can use mobile phones to call their family members, informing them of when money has been wired back home (Tall, 2004). This saves the villagers the time and expense of taking the bus into the village to check for money when it may not yet have arrive, or from not having the money when it is technically available to them.

Beyond direct mechanisms for the exchange of money, mobile phones can also be used to share best practice information among individuals and business owners. Consider, for example, the West Africa Market Information Project (Michigan State University, 2008). Although it was initially conceived as a tool to share crop price and transportation cost information with farmers, it has since grown to serve as a tool to share general information with rural farmers. The project now provides information to help farmers understand government policies, trade barriers, trade practices, etc. Although transmitting such information via SMS is certainly a challenge, the ability to train rural farmers in modern best practices should help improve the overall productivity of the agricultural sector.

In addition to serving as the platform for delivering information services, some entrepreneurs use mobile phones to resell telecommunications services to their local community. This has a the productivity enhancing effect of moving part of the population from (often) low productivity farming to (potentially) high value-added telecommunication services providers. The flagship of this business model is Grameen Phone (Cohen, 2001). Under this model, a local entrepreneur purchases mobile phone service through Grameen Telecom, often using a micro-loan provided by Grameen Bank, and then reselling this service with the community. Although the cost of phone service may be too great for any single member of the community, this shared access amortizes the costs over many people, making it economically feasible. This business model has been replicated in many other countries (e.g., Reck and Wood, 2003).

The above review is only a brief survey of the many emerging applications of mobile devices in developing economies, yet it shows that mobiles have begun penetrating many aspects of the economy. Applications are emerging to help with agricultural supply chains and pricing discovery, to provide banking services to those ignored by traditional banking systems, and the sharing of best practices. The selling of ICT services has even become a business opportunity in and of itself. The goal of this study is to examine whether these individual cases have yet made a noticeable impact on the economies as a whole.

As a final note, mobile phones also have a major advantage vis-à-vis many other information delivery platforms, which may result in higher productivity compared to other ICT tools. The simplified user interfaces are often easier to use than the text-heavy and often more complex interfaces common in PC-based tools. In consequence, illiterate or semi-literate populations can much more easily use the technology (Arora and Athreye, 2002). This may give mobile phones a productivity enhancing edge compared to other forms of information technology when implemented in developing countries.

Telecommunications and Economic Development

The prior art on telecommunications provides some insight into whether mobile phones should be associated with economic growth. This work has shown that a well-developed telecom infrastructure is important for the growth of many developing economies. This link between telecommunications and economic growth was initially established approximately 20 years ago (Aschauer, 1989; De Long and Summers, 1991). Not only is telecom correlated with economic development, but the previous research has also shown that there is a causal link between investment in telecom and overall economic growth (Cronin et al., 1991). Furthermore, it has established a link between telecommunications investment and other capital investments. It shows that even if there is a high degree of investment in other sectors, without the telecommunications infrastructure necessary to coordinate among the different actors, that investment will not yield economic growth (Madden and Savage, 1998). This is of particular importance when studying the growth of emerging markets. Without the core infrastructure, other forms of investment will be ineffective, which will have substantial consequences for businesses interested in expanding their operations in developing economies.

Because of this link between telecommunications and economic growth, many scholars have more recently considered the relationship between telecom and the digital divide. The above research indicates the telecom infrastructure is important for economic growth, but it does not establish is the benefits of those investments are equally shared among all members of society. It is possible that the economic growth generated by telecom infrastructure has only benefited the wealthy elements of society. Yet a study by Forestier et al. examines this question (Forestier et al., 2002). According to this study, the effect of telecom has changed over time. They find that although telecom has historically benefited only the rich, more recently it has been used to benefit the poor. They also find that these benefits extend beyond income to include improvements in infant mortality and literacy. As a result, investment in telecommunications infrastructure should not only help the overall economy but should also help bridge the gap between the rich and poor components of society.

Beyond the direct linkages between businesses investing the telecom infrastructure and reaping the economic benefits, an interesting prior study has shown how businesses can play an indirect role in telecom adoption in rural regions of the United States. Historically, rural regions lag behind urban areas in the adoption of communication technologies. Yet the rate of adoption among individuals is closely linked to the adoption rate at their place of employment (Hollifield and Donnermeyer, 2003). Hence, one way to speed the adoption of communication technologies in the community at large is to encourage local businesses to adopt the technologies. The adoption and use by businesses will then serve as a key driver behind the adoption of technologies by individuals.

Although the general trend indicates that ICT infrastructure should be an important driver of economic growth, some studies have indicated that developing countries may not obtain the same level of benefits from their investments. Consider, for example, the studies by Dewan and Kraemer (1998, 2000) to test if IT investments had an affect on economic growth. In their study, they find that IT has a positive effect on productivity in developed economies, but their results for developing economies are not statistically significant. They speculate that IT did not have any detectable effect in developing regions because of the limited infrastructure. This particular view on the limitations of IT in developing economies has been shared in other research (Mansell, 2001; DeMaagd and Moore, 2007; DeMaagd, 2008).

Although ICT tends to provide more benefits in developed economies, that does not address the question of which countries would most likely receive the most benefits from future expansions of the infrastructure. A recent study by Thompson and Garbacz (2007) addresses this question. They find that because of a history of universal service and other factors, most developed economies will see limited increased productivity growth from additional investments in ICT. In contrast, developing economies have a much greater potential to gain from ICT investment.

Although Dewan and Kraemer primarily focused on infrastructure in the narrower sense (e.g., roads, electricity wires, telephone connections), a broader interpretation may also affect the value of ICT investments. For example, the rule of law is an important factor in understanding the value of ICT investments. Zhang identified several legal prerequisites for successful implementation of ICT projects (Zhang, 2001). These included the implementation safeguards to ensure a competitive environment, mandatory interconnection with competing service providers, universal service rules to ensure access in even rural regions, transparent licensing procedures, an independent regulatory body, and pro-competitive allocation of scare resources (e.g., frequencies for wireless communication). Granted, while Zhang identifies a set of pro-competitive reforms, it should be noted that there is still considerable debate as to whether free markets or central control are the most efficient mechanism for providing growth in developing regions (Rodrik, 2007).

Another general aspect of the infrastructure is the structure of the labor and capital markets. This constraint goes beyond the obvious problem of financing the infrastructure. Instead, the value of ICT investments is also dependent on the relative costs of investing in capital versus investing in labor. According to Cecchini and Scott, when the cost of capital is high, it will be economically rational for the rich to adopt more advanced ICT technologies, but it will not affect the poor (Cecchini, 2003). As a result, it may be necessary for some countries to subsidize their ICT markets to ensure widespread ICT adoption. Although such subsidies may improve ICT adoption, which could have a wide array of non-economic benefits, it is possible subsidizing ICT when it is not economically rational could affect the country’s economic growth.

The general theme of the prior literature indicates that ICT in general may have a positive effect, but there are many impediments to success. These impediments are particularly problematic in developing economies, which often lack the same level of infrastructure, regulatory stability and mature financial markets.

FRAMEWORK

This section describes the approach to testing the value of mobile devices, when measured at the country-level. The general framework for analysis follows the same basic template that was used by Dewan and Kraemer (2000) in their classic work on the value of IT when analyzed at the country level. The general framework follows the Cobb-Douglas production function, where the country's GDP is a function of capital, labor, and mobile technology. The model is then:

For each Country *i* in Year *t*,

$$\log(GDP_{i,t}) = \beta_K \log(K_{i,t}) + \beta_L \log(L_{i,t}) + \beta_M \log(M_{i,t}) + \beta_T \log(T_{i,t}) + \lambda_t + \nu_i + \varepsilon_{i,t}$$

Where GDP is the Gross Domestic Product of country of country *i*, at time *t*, K is the capital stock of country *i*, at time *t*, L is the labor stock of country *i*, at time *t*. The three β's represent the corresponding elasticities, which are the primary focus of this study. In particular, if β_M is positive, then investments in mobile devices have a positive effect on the country's productivity. If the value is negative, then mobile phones actually have a negative effect on productivity. Finally, λ is the time effect, captured by year dummy variables, ν is the country specific variable, and ε is the random error term. Consistent with Dewan and Kraemer, we analyze this model using a random-effects regression. Finally, a large volume of the prior literature indicated that fixed-line telephone access is also strongly correlated with an increase in productivity, which leads to a slight modification of the above model:

A slight variation on this model is also informative. The previous models show the short-run effects of mobile technologies on productivity. A between-countries regression will describe the long-run effect (Berndt 1991) of mobile technologies. The model is similar, except the variables are expressed according to the country means:

$$\log(GDP_i) = \beta_K \log(K_i) + \beta_L \log(L_i) + \beta_M \log(M_i) + \beta_T \log(T_i) + \nu_i + \varepsilon_{i,t}$$

This model can then be analyzed using OLS regression. This approach is also consistent with the models used previously by Dewan and Kraemer.

As is discussed further in the data analysis, it is possible that over time countries will earn how to better integrate mobile phones into the production processes. Consequently, it is possible that a lack of an effect found at an early point in time will change and the positive effect will be found later. Hence the above model is analyzed both with a maximum year of 2004 and a maximum year or 2007.

Before delving into the analysis, the next section describes the data used.

DATA

This section describes the various variables used in the models described above. In particular, to estimate the regressions, the following variables are used: GDP, capital stock, labor stock, mobile technology investment, and fixed-line phone investment. In this case, the data is collected for the time frame from 1985 to 2007. This covers a majority of the time during which mobiles have been commonly available to consumers. It also covers a period both before and after the dot-com bubble burst.

The data set includes data from 84 countries. Based on United Nations (UN) membership, 192 countries current exist. Hence, the data set covers 44% of all countries. The remaining 108 countries were dropped due to missing and unavailable data. Although limited, the size of this data set compares favorably to other popular data sets, such as from the members of the Organization for Economic Cooperation and Development (OECD), which has only 30 member countries—as was used by Dewan and Kraemer (2000)—or data that only looks at certain geographic regions, such as Eastern Europe, as was used by Piatkowski (2005).

The most difficult variable to collect for country-level analysis is the capital stock. Although country-level capital stock data is difficult to obtain outside of developed economies, it is possible to compute a reasonable approximation. To do this, we begin with Gross Fixed Capital

Formation (GFCF) retrieved from the International Monetary Fund's (IMF) World Economic Outlook (WEO) database. This is a measure of the total investment in fixed assets, less disposals. Note that the "Gross" in this definition refers to the fact that it does not account for depreciation. By using the perpetual inventory method, we combine 10 years of GFCF data to compute estimate the capital stock. For this computation, we used a 7.5\% depreciation rate, comparable to the approach used by the oft-cited Penn World Tables. The following equation expresses the approach mathematically:

$$K_t = \sum_{i=0}^{15} (1 - 0.075)^i GFCF_{t-i}$$

The capital stock data is in units of local currency. To make the results, comparable, they are converted into purchase power parity units. Note that this approach assumes a homogenous discount rate across times and countries. This is admittedly a very strong assumption. For example, variations in monetary policy and in-country risk would introduce heterogeneity. Nonetheless, this is a commonly adopted assumption for computing capital stock. For example, the frequently used Penn World Tables (PWT) found in many country-level studies uses the same approach in computing their estimate of capital stock.

The remaining variables are much more straightforward. The labor stock is computed as the number of employed workers times the average hours per workweek. This data was taken from the IMF's WEO database.

The mobile and telephone variables are the number of phones per employed worker. Note that in this case, the phones per employed workers are used, instead of the more traditional phones per person metric commonly reported. This study is particularly focused on the productivity aspects, hence, phones are measured in terms of their relationship to the number of workers, not the population as a whole. This data is taken from the International Telecommunication Union's (ITU) World Telecommunications Indicators (WTI) database. Figure 1 shows the average rate of adoption of mobile phones per year from 2000 to 2007, the time period covered in this study. The top line shows mobile adoption in developed countries, the middle line the average penetration in all countries, and the bottom line the adoption in developing countries.

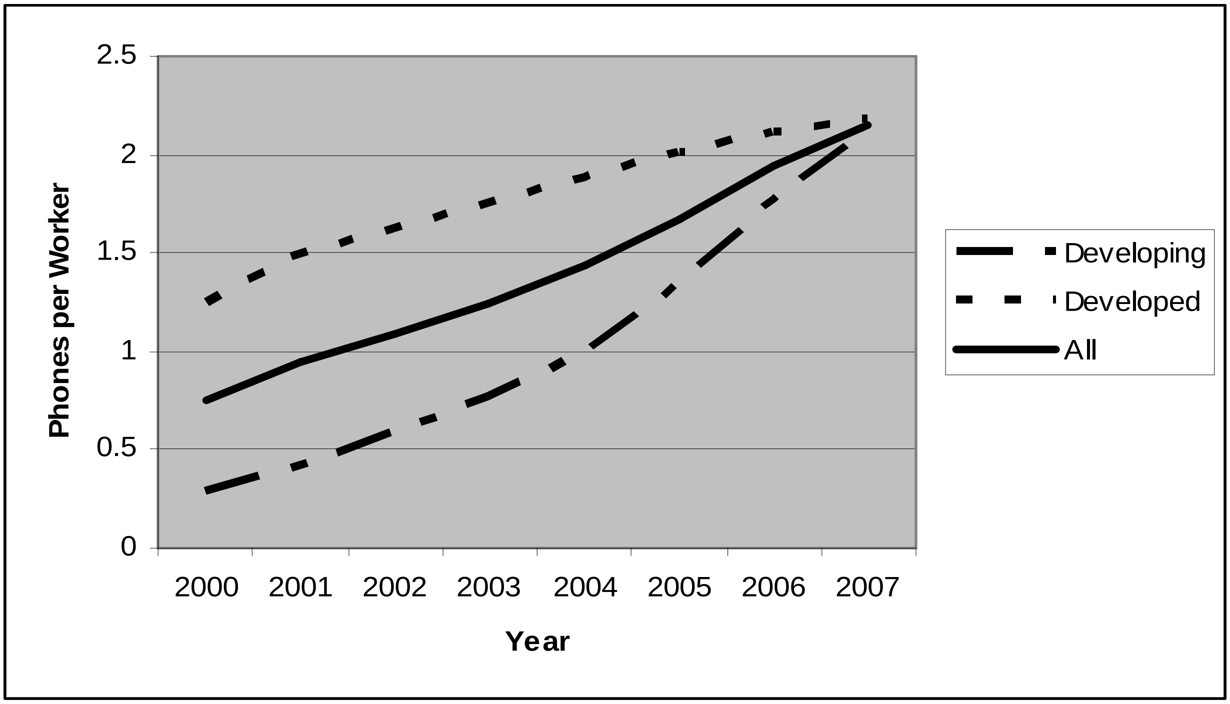

Figure 1: Average Cell Phones Per Employed Worker

Notice that the adoption rate in developing economies has been lower than that in developed economies. This, however, may actually be a misleadingly low estimate of the level of access to mobile phones. For example, recall from the literature review that some entrepreneurs are purchasing cell phones, building phone kiosks, and then selling access to these phones to others. As a result, measuring cell phone access based on the number of phones may result in an artificially low estimate of actual access to communications technologies.

Somewhat interestingly, the number of phones per worker in developed versus developing economies has begun to converge in recent years. It should be noted, however, that this is not the same as saying that the overall adoption rate has also converged. A difference in the relative portion of the population that is employed affects the computation of this variable. Hence, it is—at least at this point in time—not correct to state that developing countries have leapfrogged forward and caught up with developing countries in terms of telecommunications adoption.

The classification of developed versus developing is somewhat controversial. The metrics relying to varying degrees on the GDP per person, literacy rates, life expectancies, etc. For the purposes of this paper, are defined according to the International Monetary Fund's World Economic Outlook database, which primary defines the distinction on GDP. Table 1 shows which countries in our data set are classified as developed versus developing.

Table 1. Countries in Data Set

Developing Countries			
Algeria	Argentina	Armenia	Bahrain
Bangladesh	Belize	Benin	Bolivia
Botswana	Bulgaria	Burkina Faso	Burundi
Cambodia	Cameroon	Cape Verdi	Chile
China	Colombia	Congo	Costa Rica
Cote d'Ivore	Czech Republic	Dominica	Dominican Republic
Ecuador	Egypt	El Salvador	Estonia
Georgia	Guatemala	Haiti	Honduras
Hungary	India	Indonesia	Iran
Jamaica	Jordan	Kuwait	Lesotho
Libya	Madagascar	Malawi	Malaysia
Mali	Mauritania	Mauritius	Mexico
Morocco	Mozambique	Myanmar	Namibia
Nepal	Nigeria	Pakistan	Panama
Papua New Guinea	Paraguay	Philippines	Poland
Romania	Rwanda	Sao Tome	Saudi Arabia
Senegal	Sierra Leone	Slovak Republic	Solomon Islands
South Africa	Sri Lanka	St. Vincent	Swaziland

Syria	Tanzania	Thailand	Togo
Trinidad and Tobago	Tunisia	Turkey	Uganda
Uruguay	Venezuela	Vietnam	
Developed Countries			
Australia	Austria	Belgium	Canada
Cyprus	Denmark	Finland	France
Germany	Greece	Hong Kong (China)	Iceland
Ireland	Israel	Italy	Japan
Korea – Republic of	Luxembourg	Malta	Netherlands
New Zealand	Norway	Portugal	Singapore
Spain	Switzerland	Taiwan (China)	United Kingdom
United States			

ANALYSIS

This section analyzes the results from the models and data described above. The first model is examined using a time series regression with random effects. In addition to analyzing the full data set, the results are divided according based on developed or developing status. The random effects model is estimated using the maximum likelihood method. The results are shown in Table 2.

As should be expected, the capital and labor have a positive and significant effect on the GDP of the country. What is particularly interesting, however, is the negative coefficient for the mobile variable. Even more curious, this is true whether examining the total data set, the developed countries only, or the developing countries only. This stands in marked contrast to the case studies which imply that mobile phones can be used as a platform for profitably conducting business and it contrasts with the prior research that has shown that telecommunications infrastructure drives economic growth.

The only silver lining to this cloud is the relatively small effect. The coefficient for mobiles when looking at all countries is -0.0230, a small fraction of the magnitude of the capital and labor variables. Although the relative magnitude is slightly larger for the developed and developing subsets, the general story is still the same. Yet this model only looks at the short-term effects. With a smaller short-term cost, it may be easier to recover this "investment" and reap long-term gains.

Table 2. Production Function With Telecom

Variable	Coefficient	P-value
All Countries		
Capital	0.7046	< 0.001
Labor	0.3985	< 0.001
Mobile	-0.0230	< 0.001
Fixed-line	0.0327	< 0.001
Wald Chi^2	30386	< 0.001
N	1140	
Developed Countries		
Capital	0.7177	< 0.001
Labor	0.4014	< 0.001
Mobile	-0.0217	< 0.001
Fixed-line	0.0264	< 0.001
Wald Chi^2	14004	< 0.001
N	300	
Developing Countries		
Capital	0.6791	< 0.001
Labor	0.4517	< 0.001
Mobile	-0.0268	< 0.001

Fixed-line	0.0418	< 0.001
Wald Chi^2	23843	< 0.001
N	840	

One possible explanation for the above result is that in the near term, mobiles represent a diversion of resources away from other productive uses, but through learning and integration with business processes they eventually become productive investments. The final model considers the long-run value of these investments. In this model, the data set is collapsed taking the mean values of the variables for each country. (See the Framework section for more details.) The results should indicate whether the short-term production loss is offset by a long-term improvement in production.

Because the long-term model no longer is done as a time-series model, it is tested at two points in time. This will provide two snapshots in time to determine whether the long-term effects are changing as time progresses. The first point in time was chosen as the year 2004. As was discussed in the data section, this is a period after the developing economies began a rapid rate of adopting mobile phones, but it is still a fairly early point in their adoption. The results are shown in Table 3.

Table 3. Long-Term Results: 2004		
Variable	Coefficient	P-value
All Countries		
Capital	0.5629	< 0.001
Labor	0.6796	< 0.001
Mobile	-0.0047	< 0.001
Fixed-line	0.0105	0.384
F	15294	0.245
R^2	0.9981	

N	114	
Developed Countries		
Capital	0.5584	< 0.001
Labor	0.4498	< 0.001
Mobile	0.0321	0.001
Fixed-line	0.0493	< 0.001
F	21078	< 0.001
R^2	0.9996	
N	30	
Developing Countries		
Capital	0.5674	< 0.001
Labor	0.6796	< 0.001
Mobile	-0.0164	0.280
Fixed-line	0.0647	0.011
F	11154	< 0.001
R^2	.9981	
N	84	

The results including all countries in the data set had ambiguous results. Once again, the coefficient was negative (-0.0047), but it was not statistically significant. But when separately analyzing the model according to the developed/developing distinction, they two sets had different results. For the developed countries, the results indicated a positive and significant long-term benefit from mobile investments (0.0321). Although the developed countries are able to turn the short-term investment payments into a long-term benefit, this result does not appear to extend to the developing countries. As of 2004, it did not appear that developing countries had yet learned how to productively leverage their investments in mobile devices.

The next step is then to look at a more recent period in time. By 2007, the most recent time period in which the data is available, approximately half of the world's population had a mobile phone. Did the additional three years of learning time and increased adoption result in a productive use of the mobile phones? The results are shown in Table 4.

The results of the 2007 analysis imply that developing countries are now finally beginning to learn how to productively use mobile phones. Notice that the coefficient now positive, though the p-value is relatively weak, especially in comparison to the other variables. This implies that, although some countries are learning to use their mobiles more efficiently, the overall success is still inconsistent. Some countries are learning, but some are not. The weak significant implies some grounds for optimism regarding the future development potential to be derived from mobile phones, though obviously many developing countries still have substantial work to accomplish to that end. This issue, and particularly the focus on the role of learning, is discussed in more detail in the next section.

Table 4. Long-Term Results: 2007

Variable	Coefficient	P-value
All Countries		
Capital	0.7396	< 0.001
Labor	0.2428	< 0.001
Mobile	0.0291	< 0.001
Fixed-line	0.0498	< 0.001
F	42690	< 0.001
R^2	0.997	
N	114	
Developed Countries		
Capital	0.6033	< 0.001
Labor	0.3840	< 0.001
Mobile	0.0464	< 0.001

Fixed-line	0.0181	< 0.001
F	317300	< 0.001
R^2	0.9996	
N	30	
Developing Countries		
Capital	0.7866	< 0.001
Labor	0.1922	< 0.001
Mobile	0.0302	0.068
Fixed-line	0.0241	< 0.001
F	19300	< 0.001
R^2	.9981	
N	84	

CONCLUSION

These results contrast with part of the conventional wisdom behind mobile technology. Mobile technology had a positive effect on growth in developed economies in the long run, but the results painted a less optimistic picture for developing economies. Given the increasing number of case studies coming from developing economies that rely on mobiles as a business platform, why are the results of these case studies not fully generalized into the empirical analysis?

On possible explanation is that cell phones have not been widely used for a long enough period of time for people to determine how to most effectively derive the economic benefits. Notice that most of the positive examples in the Literature Review section are case studies. They represent limited examples of successful implementations. It may take longer still for more people to mimic the benefits and apply these specific case studies to their particular industry.

This is consistent recent interest in technology spillovers as a tool for understanding technology adoption. Romer developed the initial theory (Romer, 1990), which was then adapted to the ICT for development context by Kauffman and Techatassanasoontorn (2005). This theory states that as firms adopt and learn from technologies, other businesses can observe those actions and also learn from them. This makes it more likely that geographically collocated businesses or trading partners will be more likely to adopt and benefit from the same technologies. In other words, the learning from one organization spills over to benefit other related businesses.

The results from this study imply a failure to achieve a technology spillover. If knowledge spillovers were happening as theorized, the successes of the individual case studies should spill over to other firms, resulting in a larger impact. This impact is not found. It appears that businesses have been unable to translate the success stories from other implementations into their own business contexts, thereby improving their own firms. This is a problem that must be corrected in order to realize the value of investments in mobile technology.

This view is also supported by the different effects found in the model analyzing data up to 2004 versus the model analyzing data up to 2007. The 2004 model found a negative effect, whereas the 2007 model found a weakly significant positive effect. This implies that over time the developing countries have been able to observe and learn from the mobile phone success stories.

From a policy and business perspective, this implies a different approach to mobile technologies. It is not enough to adopt government policies and business strategies that strive to put a mobile phone in the hand of every person. In fact, the results of this study imply that it will result in a short-term cost that my have ambiguous long-term benefits. Instead of striving towards basic development statistics, such as the number of mobile phones per 100 people, businesses and governments need to focus on replicating the existing success stories. Instead of investing in cell phone towers and handsets, it may be wiser to invest in business cooperatives and research to understand which specific applications work and how the existing success stories can be translated into new applications for new industries.

For example, it is non-trivial to translate the benefits of fishermen using mobile phone into a corresponding benefit for farmers. Although a fisherman may be able to choose from a variety of ports, a rural farmer may have only one monopolist marketplace through which to sell his goods. Hence, applications to aid in price discovery may not be as helpful to the farmer.

Although such problems seem to argue against the implementation of information systems in some contexts, this need not be the case. Although rural farmers in Africa may not profit from price data from the Chicago Mercantile Exchange, they could still profit from the sharing of best practices information. The higher output, even if the local monopolist purchaser offers a poor price, will leave the farmer better off. In general, the benefits of ICT do not require a complete correction of the underlying structural inefficiencies of the local economy (not that that would hurt). The systems merely need to ensure that the information provided to the farmer is actionable.

An alternative explanation for the lack of statistically significant results is that the effect is not detectable at the country-level of analysis. As was shown in Figure 1, the average mobile phone penetration in developing countries is only 30 per 100 people. As a result, even a positive benefit would be difficult to detect. The effects may simply be lost in the general noise of the model. It is possible that a study at the firm or industry level could find a positive effect when the country-level data shows nothing. Nonetheless, other telecommunications products have been shown to have a positive effect at the country level, which casts some doubt on this particular argument. If prior studies of telecommunications are any indication, it should be possible to find an effect from mobile phones at the country level. Furthermore, the analysis was able to successfully detect the negative short term effects in both developed and developing economies, it found a positive long term effect in developed economies, and it was able to detect the effects of fixed-line phones. Given that all of these other effects were detectable at the country level, it implies that the utility of mobiles in developing countries should also have been detectable.

Nonetheless, assume for a moment that the above conclusions are incorrect and that the productivity effect is not detectable at the country level in developing countries. This would not alter the resulting policy recommendations. The fundamental problem remains the same: the overall positive effects are little more than noise in the statistical model. Although it may be rational to pursue targeted activities to learn more about how to apply success stories in other context, any broad initiatives are unlikely to yield substantial improvements in economic growth. Hence, although explanations for the statistical phenomenon may vary, the underlying policy recommendations are the same.

Granting the above concerns for the business value of mobiles, this study does not mean that mobile devices are completely without value. This study examined only one metric: an increase in output as measured by GDP. Yet consumers may derive a host of other non-economic benefits. Commonly cited examples are educational access, communication with friends and family, access to government resources, and general empowerment. As a result, although our results did not find any economic benefit, this does not imply that the explosion in cell phone use is irrational.

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