

**The impact of privatization of fixed-line
telecommunications operators on network expansion, tariffs, and
efficiency - Empirical evidence on some worldwide differences***

Abstract

The aim of this paper is to empirically highlight some important worldwide differences in the impact of privatization of the fixed-line telecommunications operator on network expansion, tariffs, and efficiency during the 1985-2007 period for a large panel of countries. The countries considered are first re-grouped into OECD and non-OECD countries. Then, the non-OECD countries are classified into Latin American and The Caribbean countries and African countries. Finally, the African countries are disaggregated into resource rich, resource scarce coastal, and resource scarce landlocked countries. We find no perceptible effects on network expansion both in the OECD and the non-OECD groups. Privatization has a significant effect on labor efficiency in the OECD countries while in the non-OECD countries it is found to have a significant positive effect on tariffs. In Latin America and The Caribbean and in African resource rich and resource scarce coastal countries, privatization is associated with increases in tariffs that have not translated into network expansion. In Africa resource scarce landlocked countries, there is neither an impact on network deployment nor on prices. Moreover, while privatization has positively affected labor efficiency in Latin America and The Caribbean and African resource scarce coastal countries, the relationship is negative in African resource rich and resource scarce landlocked countries. As to the impact of privatization of the fixed-service on the mobile sector, in African resource rich and resource scarce coastal countries, privatization is strongly associated with higher output in cellular penetration. In contrast, in Latin America and The Caribbean and African resource scarce landlocked countries, privatization and cellular deployment have a negative relationship.

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1 Introduction

Since the 80s, the telecommunications sector has been largely shaped by a set of market reforms which have been applied worldwide. These reforms included the liberalization of the telecommunications sector, namely the opening to competition of fixed and cellular segments often coupled with the privatization of the fixed-line traditional incumbent. They were typically accompanied by the creation of independent regulatory agencies free from any political pressure in a sector where regulation and competition policy were playing an increasingly important role in the functioning of the market.

The current state of the privatization reform across different regions raises an important question: Should this reform apply equally to countries with different levels of development, in the telecommunications sector or even in the overall economy? Indeed, private investors face distinct incentives in OECD countries characterized by excess supply and in non-OECD countries where excess demand is rather the norm. In addition, African countries' fixed-line networks were largely underdeveloped lagging behind their Latin American and Caribbean counterparts and hence facing more difficulties to attract private investors.

Private investors decisions to enter the market are expected to be influenced by various factors that characterize the diversity of economies worldwide. Latin American and The Caribbean countries have a percentage of urban population similar to that of OECD countries.¹ African countries, in particular, African resource scarce landlocked countries have populations that are largely rural. Gross Domestic Product (GDP) per capita is also largely different across OECD, Latin American and The Caribbean and African countries. Again, African resource scarce landlocked are the most penalized on this dimension.

In this paper, we perform a systematic econometric investigation of the impact of privatization of fixed-line operators on network growth, tariffs, and efficiency with the purpose of highlighting any important differences when examining OECD and non-OECD countries, Latin American and The Caribbean countries, African resource rich countries, African resource scarce coastal countries, and African resource scarce landlocked countries. The

¹Economies of density are central to telecommunications operations and profitability.

main motivation for this work is to bring some new insights to the debate on the impact of privatization of fixed-line operators on the telecommunications sector. The empirical literature has produced divergent results and our work identifies some important differences indeed, which allows us to explain the divergence in the literature by the fact that a typical study in this literature uses very disaggregated data (on a specific region, say) or very aggregated data (worldwide data sets). In this paper, we use comparable data sets on a large enough number of groups of countries, which allows us to recover most of the results in the literature. The main policy implication is that the outcomes of a privatization reform are to a large extent sector-dependent and expected to be affected by the specific economic conditions of the country where it is applied.

The plan of the paper is as follows. The next section summarizes some of the empirical results recently put forward in the literature on the impact of the privatization of the fixed-line operators on telecommunications outcomes. This section is not meant to be exhaustive but rather to serve the purpose of arguing that there is a need to analyze the impact of privatization at a more “disaggregated” level according to wealth and geography. Section 3 describes the basic econometric ingredients that constitute the elements of the empirical methodology we use to analyze the data sets on 23 OECD countries and 85 non-OECD countries covering the period 1985-2007. In section 4, we discuss the results of a preliminary analysis of these data and of the fixed-effect and random-effect estimations of the impact of privatization. Section 5 summarizes our empirical findings and discusses some policy implications. A detailed description of the data used, their sources, data statistics and estimations are given in the appendix.

2 Impact of privatization - What do we know?

The availability of data accumulated over more than two decades on the telecommunications sector has enabled the emergence of a relatively large empirical literature that analyzes the impact of major market reforms on infrastructure deployment in this sector. We briefly review some representative studies in this stream of literature, with a special focus on the privatization

reform, and indicate the contribution of our paper.

Most of the studies done so far on the impact of sectoral reforms on infrastructure deployment in non-OECD countries acknowledge that, overall, there exists a robust relationship between some variables representing the reforms and some variables measuring telecommunications network expansion such as fixed-line penetration. In particular, the bulk of this literature has come to the conclusion that the introduction of competition has resulted in measurable network deployment and labor efficiency in the fixed-line segment (see McNary (2001), Fink et al (2002), Wallsten (2001), Gutierrez (2003), Ros (1999, 2003), and Li and Xu (2004).

There is no such a consensus on the impact of the privatization of the fixed-line incumbent on network expansion. Some empirical results indicate that this policy has a positive impact on fixed-line deployment. After controlling for tariff re-balancing, Banerjee and Ros (2000) find that privatization reduces unmet demand by approximately 28% in a data set on 23 Latin American countries for the period 1986-1995. Gutierrez (2003) reports a reduction of unmet demand of the order of 10 to 18% in data on 22 Latin American countries covering the period 1980-1997. Similar results are obtained by Fink et al. (2002), Ros (2003), and Li and Xu (2004) using large data sets.²

However, other empirical studies using worldwide data sets, in particular, Ros (1999) and McNary (2001), indicate that privatization has a null or even a negative impact on fixed-line deployment.³ Nevertheless, both authors insist on the role played by independent regulators in the privatization process, a feature that neither of them include in their investigations. The importance of this issue is highlighted by Wallsten (2001) and Gutierrez (2003) who find that privatization coupled with the existence of an independent regulator results in larger gains in terms of network expansion. Fink et al. (2002) and Ros (2003) also find that the impact of privatization and competition reforms is enhanced by the creation of a separate regulator. As to the impact

²Fink et al (2002) provide an analysis of the impact of competition on fixed-line deployment and labor efficiency in data on 86 developing countries across African, Asian, Middle Eastern, Latin American, and Caribbean countries for the period 1985-1999. Ros (2003) and Li and Xu (2004) use Latin American and worldwide data, respectively.

³For an analysis of privatization policies across the world see Bortolotti and Siniscalco (2004).

of privatization on efficiency, it is found that it is similarly affected by the presence of an independent regulator (Wallsten, 2001, Gutierrez, 2003).⁴

In this paper, we seek to contribute to the debate on the impact of the privatization of the fixed-line operator on telecommunications outcomes by performing an empirical analysis that seeks to explain the divergent results obtained in the empirical literature. Our empirical analysis takes as a conjecture (and test it) that the different results on the performance of privatization of fixed-line operators that have been produced in the empirical literature can be explained, to a large extent, by regional specificities.

Indeed, the privatization reform can be expected to yield different outcomes in OECD countries and non-OECD countries where the former are characterized by excess supply of telecommunications service and the latter are characterized by excess demand. Subsidized prices have been typically too low to allow public fixed-line operators to engage in large investments to expand the network. Hence, due to supply constraints, fixed-line networks in non-OECD countries are typically very small at the time of privatization.

In addition, even non-OECD countries are largely heterogenous in the features of their telecommunications sector and in their economies as a whole. African networks were extremely small when privatization started, lagging behind countries in Latin America and The Caribbean. Attracting private investment is then likely to be more difficult for African countries.

Moreover, there are significant differences even among African countries. African resource rich countries typically engage to a lesser extent in market reforms than other countries in Africa, since they can rely extensively on natural resources. African resource scarce coastal countries function under economic models largely explained by international trade patterns. African resource scarce landlocked countries are those that are worse off in Africa because of their lack of internal natural resources, their geographical isolation from international trade flows, and their strong dependence on the construction of regional infrastructure networks. Clearly, these African countries provide different incentives for potential private investors.

⁴Some details of the private transactions are also found to play an important role in network deployment. See Wallsten (2000) and Li and Xu (2004) for the effects of exclusivity periods and Ros (2003) for the effects of the price cap regulatory regime.

3 Data and econometric specification

In this section, we first describe the data set on 108 countries that we constructed and the basic ingredients of the econometric methodology used to analyze them.

3.1 Data

We have constructed a time-series-cross-sectional (TSCS) data set containing time-varying information on 23 OECD countries and 85 non-OECD countries for the period 1985-2007.⁵ These data have been organized in variables regrouped in five categories, namely, “Telecommunications outcomes,” “Telecommunications reforms,” “Political and risk indices,” and “Other variables.” The list of the countries included in the data set, the designation of each of the variables, the data sources, and some standard summary statistics are given in the appendix.

We classify countries as follows: OECD, non-OECD (Latin America and The Caribbean, Africa, Middle East and Asia and The Pacific). We then explore Latin America and The Caribbean and African countries. Among African countries we further classify in resource rich, resource scarce coastal, and resource scarce landlocked (see Table A1 in the appendix).

Telecommunications outcomes are measured by the level of output (main-line penetration or cellular subscription), efficiency (mainlines per employee), or price (fixed residential, cellular). Telecommunications reforms are represented by variables that give the number of competitors in the analogue and digital cellular segments, whether a separate telecommunications regulator has been created and a variable that measures whether some percentage of the fixed-line incumbent’s assets have been sold to private investors. As to the fixed-line market, we do not include competition in the local segment.⁶

The political and risk indices indicate the degree of accountability in the government, as well as political, financial, and economic risk valuations

⁵Our panel includes countries that have reformed their telecommunications sector and countries that haven’t. Hence, selectivity bias should not be a concern in our data set.

⁶Even though this segment has historically constituted a bottleneck, Gasmi and Reucero Virto (2009) do not find a significant correlation between its opening to competition and the outcome variables considered here.

that are relevant to investment choices and ultimately to sector outcomes. Variables under the heading of “Other variables” are those that measure other demand and supply factors that are deemed relevant for our estimation of the determinants and the impact of the reforms such as the rural population and the Gross Domestic Product (GDP) per capita. Under this classification, we also include dummy variables that identify African countries according to their resources and geographical characteristics: resource rich, resource scarce coastal and resource scarce landlocked.

3.2 Econometric model

To investigate the impact of the privatization reform on telecommunications outcomes, we run a set of regressions with the dependent variable representing a measure of deployment, prices or efficiency. The explanatory variables have been chosen so as to allow us to test the impact of privatization, while controlling for other features that may have played a major role in the determination of the outcomes in the sector.

Given the type of our data which are time-series-cross-sectional (TSCS), we choose to apply fixed-effect and random-effect models. Fixed-effect models allow to control for fixed unobserved heterogeneity and hence are preferred to random models when estimating the relationship between privatization and telecommunications outcomes. Indeed, Wald tests confirm the presence of fixed-effects. Time dummies are included when the model’s goodness-of-fit improves with the presence of these variables.

We specify the following model:

$$y_{it} = \alpha_0 + \mathbf{x}'_{it}\beta + \epsilon_{it} \quad (1)$$

where $i = 1, 2, \dots, N$, $t = 1, 2, \dots, T$, y_{it} is a one-dimensional variable representing the continuous dependent variable (fixed-line deployment, cellular deployment, labor efficiency, price of fixed-line and price cellular), α_0 is a scalar parameter, \mathbf{x}_{it} is a vector of regressors including the variable privatization of the fixed-line operator, β is the associated vector of parameters, and ϵ_{it} is a disturbance term.

In order to account for dynamics in our data, we make use of the Differenced Generalized Method of Moments (DIF-GMM) developed by Arellano

and Bover (1995) for analyzing panel data and applied by Beck and Katz (2004) to TSCS data. However, fixed and random models outperform these models.⁷

To take care of endogeneity problems which seem likely to arise in the estimation of equation (1), we set a procedure to find appropriate instruments using the DIF-GMM (see Gasmi et al., 2009). Endogeneity can be indeed an issue in our context. For example, one may argue that efficiency might be raised prior to engaging in privatization so as to increase the attractiveness to investors. One can also argue that it is because the number of fixed-line is extremely low that the government decides to privatize. However, these models were again outperformed by fixed-effect and random-effect models.⁸

4 Impact of privatization

4.1 Preliminary analysis

In this section we explore some basic statistics of our data set. First, we compare the statistics from Tables A2-A8 in the appendix, the most relevant variables being summarized in Table 1 below. Then, we analyze the correlations between the privatization variable and those variables capturing telecommunications outcomes.

By taking a close look at Tables A2-A8 in the appendix, we can see that countries can be classified according to the extent of rural population and GDP per capita. Both OECD and Latin American and The Caribbean countries are characterized by a high percentage of the population in urban areas (between 25 and 40%). These two groups of countries have the highest GDP per capita (USD 23,253 for OECD and USD 3,488 for Latin America and The Caribbean).

Africa resource rich and resource scarce coastal countries share similar characteristics, a rural population of around 60% and a GDP per capita roughly above USD 1,000. Africa resource scarce landlocked countries differ substantially with a rural population that attains 80% and a GDP per capita that falls to USD 225. The creation of a regulatory agency attains 40% in

⁷Results are available from the authors upon request.

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the period under study for all country regions except in African resource rich countries where it falls to 28%.

These data are consistent with Bates et al. (2008) whereby Africa resource scarce landlocked countries are heavily penalized by their geographical isolation from coastal lines. Trade and infrastructure connections in these countries are historically largely dependent on their coastal neighbors. In terms of political accountability and risks, African resource scarce coastal countries outperform the other African countries, their trading patterns having shaped the ruling scene. African resource rich countries are those nations in Africa characterized by fewer political reforms supported by the flows of income from natural resources.

In Table 1 below, we can see the average over the period under study of the variables of interest to us, namely, privatization of the fixed-line incumbent and telecommunications outcomes. OECD countries are characterized by having 60% of their fixed-line operators at least partly privatized (twice as much as in non-OECD countries). The levels of telecommunications outcomes in terms of deployment and labor efficiency are largely above those of non-OECD countries. Prices of fixed-line and cellular are also above those of non-OECD countries.

In the case of non-OECD countries, Latin America and The Caribbean, African resource rich and African resource scarce landlocked have privatized between 30-40% of their fixed-line operators. This number falls to 10% in African resource scarce landlocked countries. In terms of outcomes, Latin America and the Caribbean countries are ahead of African countries in fixed-line and cellular deployment and in labor efficiency.

Africa resource scarce coastal countries are leading among African countries in terms of deployment and efficiency, which is consistent with international trading patterns and the relevance of infrastructure for this matter. African resource scarce landlocked countries are lagging behind the other countries in the continent as they have the lowest levels of deployment of fixed-line and cellular, the lowest labor efficiency, and the highest prices for fixed-line.

By taking a close look at Table A9, we can see the correlation coefficients between privatization of the fixed-line incumbent and the variables

Table 1
Privatization and outcomes

	<i>priva</i>	<i>ml</i>	<i>cel</i>	<i>eff</i>	<i>p-res</i>	<i>p-cel</i>
OECD	0.6	49.9	35.3	181.8	19.9	1.3
Non-OECD	0.3	6.1	7.6	66.7	8.2	0.8
Latin America & C.	0.4	11.4	11.0	102.7	8.4	1.1
Africa	0.3	2.5	4.8	40.6	8.3	0.8
-Res. rich	0.3	2.2	5.5	40.1	6.5	0.8
-Res. scarce coastal	0.3	4.3	6.9	51.1	7.9	0.7
-Res. scarce land.	0.1	0.51	1.2	25.9	10.4	0.9

capturing telecommunications outcomes. This correlation is the strongest between privatization and cellular deployment, which suggests a close relationship between fixed-line and cellular sectors, possibly the two segments having benefited from each other. The correlation is also very strong and positive between privatization and labor efficiency in the fixed-line.

The relationship between privatization and fixed-line prices and fixed-line deployment is not very intense. In particular, there exists a positive correlation between privatization and fixed-line prices for Latin American and The Caribbean and African resource rich countries, and between privatization and fixed-line deployment for African resource rich countries. The correlation is the least intense between privatization and cellular prices, though it is consistently negative for all regions. This correlation is only significant for OECD countries.

4.2 Regression results

The preliminary analysis of the data performed so far sets the ground for a scrutiny of the relationship between the privatization reform and telecommunications outcomes in the data on OECD and non-OECD countries. Let us briefly recall the different steps and outcomes of this analysis. We have started with a quick inspection of simple statistics in each of the regions identified for our analysis: OECD, non-OECD, Latin America and The Caribbean, Africa, Africa resource rich, Africa resource scarce coastal and Africa resource scarce landlocked. This light-handed checkup of the data has led us to conclude that there are reasons to identify these different regions.

The next step then has been to search in the data for evidence of a relationship between the privatization reform and telecommunications outcomes. We have tackled this task by means of correlation tests. These tests have also shown that such a relationship might exist, and that it is stronger for cellular deployment and labor efficiency in the fixed-line. We also find that the correlation between privatization and outcomes is particularly strong for African resource rich countries.

We now address the issue of the existence of relationships between the variable of the privatization of the fixed-line and the telecommunications outcomes by running a set of regressions. Tables A10-A19 given in the appendix show the fixed-effect and random-effect estimation results on which we build our testing procedure asking whether the variable of privatization, (*priva*), has a significant impact on the variables of telecommunications outcomes, namely, mainline penetration (*ml*), cellular subscription (*cel*), mainlines per employee (*eff*), monthly subscription to fixed (*p_res*), and price of cellular (*p_cel*).

We also include in our estimations some additional control variables as needed. Those include telecommunications reforms, namely, cellular competition *comp_cel* and the creation of a separate regulator *reg*, political and risk indices, namely, democratic accountability *demo*, political risk *p_risk*, financial risk *f_risk* and economic risk *e_risk*, other variables, namely, rural population *rural* and GDP per capita *gdp*, and a constant *const*. The estimates shown in these tables are those of the parameters of equation (1).

In addition to showing the estimated values of the parameters associated

with the explanatory variables listed at the left, Tables A10-A19 include three additional items. Firstly, we show whether time dummies are included or not in the regression under Time.⁹ Secondly, we provide an F-statistic F (for fixed-effect) or Wald statistic $Wald$ (for random-effect) for testing the joint significance of the explanatory variables. Thirdly, the number of observations included in each regression, Obs.

In Tables 2 and 3 below, we can see the results summarized for the relationships of interest. By comparing these two tables, we see that these results are fairly similar for the fixed and random-effects models. The least one can say about the results obtained with the data on OECD-countries is that they do not convey the same messages as non-OECD countries. The impact of privatization of the fixed-line operator is only felt in OECD countries through an increase in labor efficiency in the fixed-line. The result that privatization does not have a significant impact on fixed-line deployment is consistent with the fact that when privatization was introduced, OECD countries had already well supplied markets.

In non-OECD countries, the impact of privatization is strongly felt through an increase on price of fixed-line. This is consistent with the fact that when privatization started in these countries, most had not implemented tariff rebalancing and were still working under cross-subsidization among services. As a result, prices of fixed-line were traditionally kept below cost for local communications which were subsidized by long distance and international calls.

In non-OECD countries, privatization is also associated positively with cellular deployment, though to a lesser extent. This suggests some degree of complementarity between privatization of the fixed-line and the number of cellular subscribers. From Tables 1 and 2, however, we can see that privatization of the fixed-line has not translated into a significant increase in fixed-line deployment nor in fixed-line efficiency. Hence, the increase in prices of fixed-line have not resulted into larger penetration or efficiency in the fixed-line.

⁹The inclusion of time dummies is done consistently with the value of a Wald statistic for testing the joint significance of time-specific effects. Testing for the presence of time-specific effects seems particularly relevant in our context since some important events have occurred during the period under study. These events include, among others, the 1995 “Tequila” crisis, the 1997 South-asian crisis, the 1998-1999 financial breakdown, and some events related to technological progress such as the introduction of digital systems.

Table 2
Impact of privatization on outcomes: Fixed-effect

Privatization	<i>ml</i>	<i>cel</i>	<i>eff</i>	<i>p_res</i>	<i>p_cel</i>
OECD	NS	NS	+ (*)	NS	NS
Non-OECD	NS	NS	NS	+ (***)	NS
Latin America and the Caribbean	NS	NS	NS	NS	NS
Africa	- (***)	+ (***)	- (**)	+ (***)	NS
Africa resource rich	- (***)	+ (***)	- (***)	+ (*)	NS
Africa resource scarce coastal	NS	+ (***)	+ (***)	+ (***)	NS
Africa resource scarce landlocked	NS	- (***)	- (**)	NS	NS

Note: NS stands for non-significant. + and - reflects that the impact is significant and the sign. */**/** stands for significance at the 10%/5%/1%.

Nevertheless, non-OECD are strongly heterogenous once analyzed in more detail. The impact of privatization in Latin American and The Caribbean countries is weaker than in Africa. Indeed, non of the explanatory variables are significant in the fixed-effect estimations in Table 1. From a joint look at the fixed and random-effect estimation results, the following conclusions can be derived from Latin American and The Caribbean and African regions. Both regions behave like the non-OECD sample in having a positive relationship between privatization and fixed-line prices, which is particularly strong in Africa.

Similarly to the non-OECD sample of data, privatization has not resulted in growth of fixed-line penetration rates in Latin American and The Caribbean nor in African countries. In particular, privatization of the fixed-line is strongly and negatively associated with fixed-line penetration in Africa. Since increases in prices of fixed-line are often justified by the need to increase

Table 3
Impact of privatization on outcomes: Random-effect

Privatization	<i>ml</i>	<i>cel</i>	<i>eff</i>	<i>p-res</i>	<i>p-cel</i>
OECD	NS	NS	+ (***)	NS	NS
Non-OECD	NS	+ (*)	NS	+ (***)	NS
Latin America and the Caribbean	NS	- (*)	+ (**)	+ (**)	NS
Africa	- (***)	+ (***)	- (***)	+ (***)	NS
Africa resource rich	- (***)	+ (***)	- (***)	+ (**)	NS
Africa resource scarce coastal	NS	+ (***)	+ (***)	+ (***)	NS
Africa resource scarce landlocked	NS	- (***)	- (***)	NS	NS

Note: NS stands for non-significant. + and - reflects that the impact is significant and the sign. */**/** stands for significance at the 10%/5%/1%.

profits of operator such that it can raise investment, the lack of translation of the increases on prices on penetration raises serious questions about the economic model applied in these countries.

The rest of the results in Tables 1 and 2 for Latin America and The Caribbean and African countries differ. In Africa, privatization of the fixed-line is strongly and negatively associated with fixed-line labor efficiency while in Latin America the relationship is weak and positive. These results suggest that the impact of privatization of the fixed-line on outcomes in the fixed-line sector were negative across the measures of outcomes in our data set for African countries.

In Africa, we can observe that the privatization of the fixed-line and cellular deployment are strongly and positively associated, while Latin American and The Caribbean countries show some negative weak association. Hence, in Africa, privatization and cellular penetration are strongly complementary, while in Latin America and The Caribbean these variables are weak

substitutes. Neither in Latin American and The Caribbean nor in African countries, privatization is associated with prices in the cellular sector.

In Tables 1 and 2 we can also observe significant differences between Africa countries when analyzed according to their resources and geographical characteristics. The strongest impact of privatization of the fixed-line on outcomes is experienced by African resource rich countries among the total sample of OECD and non-OECD countries. This impact is strongly negative in the fixed-line sector with increases in prices of fixed-line, together with decreases in fixed-line penetration and fixed-line labor efficiency. The impact on the cellular sector shows a strong complementarity between privatization of the fixed-line and cellular deployment and no significant impact on prices of cellular.

The impact of privatization of the fixed-line on telecommunications outcomes is also stronger in African resource scarce coastal countries than in Latin American and The Caribbean or OECD countries. In this sample of data, privatization has translated into increases in price of fixed-line, and has no significant impact on fixed-line deployment. In terms of the cellular sector, privatization and cellular penetration are strongly complementary, and there is no significant impact on prices of cellular. In contrast with African resource rich countries, in the sample of African resource scarce coastal countries, privatization is strongly positively associated with labor efficiency in the fixed-line.

The weakest impact of the privatization of the fixed-line on outcomes among African countries is observed in African resource scarce landlocked countries. The only impacts come through a strongly negative association between privatization and labor efficiency in the fixed-line and between privatization and cellular deployment. These results hence are fairly divergent from those of African resource rich and African resource scarce coastal countries.

To summarize, our analysis suggest a strong relationship between privatization of the fixed-line and prices in the fixed-line, labor efficiency in the fixed-line and cellular deployment. While the impact of privatization on price of fixed-line is consistently positive across all the sample of countries, the sign of the impact of this variables on labor efficiency and cellular deployment is

contingent on the region under analysis. The impact of privatization of the fixed-line is non significant when measured on variables of fixed-line deployment and price of cellular. When comparing across samples of countries, we can see that the impact of privatization on outcomes is the strongest on African resource rich countries and the weakest in Latin American and The Caribbean countries.

5 Conclusion

This paper has sought to contribute to the debate on the impact of the privatization of the fixed-line operator on telecommunications outcomes. Our work confirms the hypothesis that the results on the performance of the privatization reform, which are divergent in the empirical literature, can be explained by the heterogeneity of the countries and the data sets typically analyzed. In particular, our results are sensibly different when considering OECD, Latin America and the Caribbean, African resource rich, African resource scarce coastal, and African resource scarce landlocked countries.

The impact of privatization in OECD countries shows mainly in the improvement of labor efficiency in the fixed-line sector. In contrast, privatization in non-OECD countries is strongly correlated with price increases in fixed-line.¹⁰ We find no perceptible effects on fixed-line network expansion in OECD countries reflecting the extent to which there was excess supply at the time of privatization. Privatization in non-OECD countries, where fixed-line networks were scarcely developed, has however not led to substantial fixed-line network expansion.

Once the non-OECD countries sample is disaggregated, we obtain further regional differences. In Latin America and The Caribbean and in African resource rich and resource scarce coastal countries, privatization of the fixed-line is associated with increases in fixed-line tariffs which have not translated into fixed-line network expansion. In Africa resource scarce landlocked countries, there is neither an impact on fixed-line network deployment nor in fixed-line prices.

While privatization is positively associated with labor efficiency in the fixed-line in Latin America and The Caribbean and African resource scarce

¹⁰Note that this follows the end of the cross-subsidies era.

coastal countries, the relationship is negative in African resource rich and resource scarce landlocked countries. In terms of the mobile sector, in African resource rich and resource scarce coastal countries, privatization of the fixed-line is strongly associated with higher output in cellular penetration. In contrast, in Latin America and The Caribbean and African resource scarce landlocked countries, privatization of the fixed-line and cellular deployment seem to behave as “substitutes.”

The results presented in this paper for the case of telecommunications challenge the idea that there exists a model of reform of the infrastructure sectors that is equally applicable across countries or even regions. Privatization entails giving incentives to private actors to commit to long-term investment. The exploratory empirical results obtained in this paper suggest that the levels of network and economic development of a country have been key factors in attracting capital during the period studied, and that these factors in turn are important determinant of the success of the privatization programmes.

Appendix

- **Data**

The data set constructed for this study contains observations for the period 1985-2007 on the following list of countries:

- OECD countries (23): Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.
- Latin America and the Caribbean (25): Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay and Venezuela.
- Africa (43): Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Democratic Republic of Congo, Egypt, Republic of Congo, Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.
- Middle East (6): Jordan, Lebanon, Oman, Saudi Arabia, Syria and United Arab Emirates.
- Asia and Pacific (11): Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

We have collected data on variables regrouped in five categories: Telecommunications outcomes, Telecommunications reforms, Political and risk indices, and Other variables. The definition of these variables and the data sources are given below.

Telecommunications reforms

Telecommunications outcomes

Variable	Source(s)
OUTPUT	
• Mainline penetration	-ITU
• Cellular subscription	-ITU
EFFICIENCY	
• Mainlines per employee	-ITU
PRICE	
• Monthly subscription to fixed	-ITU
• Price of cellular	-ITU

Variable	Source(s)
• Privatization	-Various authors (Ros, 1999, 2003, Bortolotti et al., 2001, McNary, 2001, Li and Xu, 2004, Fink et al., 2002). -ITU World Telecommunications Regulatory database. -Operators and regulators websites. -Clark et al. (2004). -Private Participation in Infrastructure (PPI) Project World Bank database. -IPANeT Privatization Transactions database (World Bank).
• Competition in cellular	-Various authors (Ros, 1999, 2003, Bortolotti et al., 2001, McNary, 2001, Li and Xu, 2004, Fink et al., 2002). -Trends in Telecommunication Reform 1999: Convergence and Regulation. ITU. -ITU World Telecommunications Regulatory database. -Operators and regulatory authorities websites. -Clark et al. (2004). -http://www.gsmworld.com.
• Creation of a regulatory agency	-Trends in Telecommunication Reform 1999: Convergence and Regulation. ITU. -ITU World Telecommunications Regulatory database.

Telecommunications outcomes

- Output

- . Mainline penetration: Number of telephone lines per 100 inhabitants that connect the subscribers' terminal equipment

Political and risk indices

Variable	Source(s)
• Democratic accountability	-International Country Risk Guide (ICRG) risk ratings
• Political risk	-Idem
• Financial risk	-Idem
• Economic risk	-Idem

Other variables

Variable	Source(s)
• Rural population	-World Bank Indicators
• GDP per capita	-World Bank Indicators
• Africa resource rich	-Bates et al. (2008)
• Africa resource scarce coastal	-Idem
• Africa resource scarce landlocked	-Idem

to the Public Switched Telephone Network (PSTN).

- . Cellular subscription: Number of users of portable telephones subscribing to a mobile telephone service with access to the PSTN.
- Efficiency
 - . Mainlines per employee: Number of mainlines per employee in the fixed service activity.
- Price
 - . Monthly subscription to fixed: Recurring fixed charge (in 2000 US dollars) paid by residential subscribers to the PSTN. This charge covers only the rental of the line, not that of the terminal.
 - . Price of cellular: Price (in 2000 US dollars) paid for a 3-minute call during peak hours from a cellular telephone. For reasons of inter-country comparability, this price corresponds to that of a call placed with a pre-paid card.

Telecommunications reforms

- Privatization: Dichotomous variable which takes on the value 1 if

the assets of the incumbent have been partly (or totally) sold to private investors, and 0 if the incumbent is State-owned.

- Competition in cellular: Dichotomous variable with value 1 if there is more than one operator in the cellular segment (analogue and digital), and 0 if this segment is a monopoly.
- Creation of a regulatory agency: Dichotomous variable which takes on the value 1 if a regulatory agency exists and is separated from and not directly controlled by a ministry or a utility, and 0 otherwise.

Political and risk indices

- Democratic accountability: This variable, in the range between 0-6, is a measure of how responsive government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one.
- Political risk: Composite variable that includes 12 weighted variables covering both political and social attributes. The values of this risk index are in the range 0-100. Higher values of this index reflect low risk.
- Financial risk: Composite variable that includes 5 variables that measure ratios of the national financial structure. The values of this risk index are in the range 0-50. Higher values of this index reflect low risk.
- Economic risk: Composite variable that includes 5 variables that measure ratios of the national economic structure. The values of this risk index are in the range 0-50. Higher values of this index reflect low risk.

Other variables

- Rural population: Variable that indicates the percentage of the total population that resides in rural areas.

- GDP per capita: Gross Domestic Product per capita measured in constant 2000 USD.
- Africa resource rich: Dichotomous variable which takes on the value 1 if the country is African resource rich, and 0 otherwise.
- Africa resource scarce coastal: Dichotomous variable which takes on the value 1 if the country is African resource scarce coastal, and 0 otherwise.
- Africa resource scarce landlocked: Dichotomous variable which takes on the value 1 if the country is African resource scarce landlocked, and 0 otherwise.

Table A1
Africa: Classification

Variable	Designation	Countries
<i>dummy_rr</i>	Africa resource rich	Angola, Botswana, Cameroon, Republic of Congo, Zambia, Gabon, Guinea, Equatorial Guinea, Liberia, Namibia, Nigeria, Sierra Leone, Swaziland, Algeria and Tunisia.
<i>dummy_rsc</i>	Africa resource scarce coastal	Côte d'Ivoire, Ghana, Kenya, Tanzania, South Africa, Morocco, Benin, Cape Verde, Gambia, Madagascar, Mozambique, Mauritius, Senegal, Seychelles, Togo and Egypt.
<i>dummy_rsl</i>	Africa resource scarce landlocked	Malawi, Uganda, Burundi, Burkina Faso, Central African Republic, Ethiopia, Lesotho, Mali, Malawi, Niger, Chad, Democratic Republic of Congo and Zimbabwe.

- Descriptive statistics

Table A2
Summary statistics: OECD countries

Variable	Designation	Obs.	Mean	Std. Dev.	Min.	Max.
<i>ml</i>	Mainline penetration	528	49.95	10.52	14.52	74.19
<i>cel</i>	Cellular subscription	526	35.35	39.87	0	135.14
<i>eff</i>	Mainlines per employee	486	181.82	67.66	43.48	526.20
<i>p_res</i>	Monthly subscription to fixed	414	14.91	4.58	5.55	26.47
<i>p_cel</i>	Price of cellular	293	1.31	0.76	0.11	5.64
<i>priva</i>	Privatization	552	0.57	0.49	0	1
<i>comp_cel</i>	Competition in cellular	552	0.59	0.49	0	1
<i>reg</i>	Creation of a regulatory agency	552	0.53	0.49	0	1
<i>demo</i>	Democratic accountability	547	5.71	0.56	3	6
<i>p_risk</i>	Political risk	522	66.09	14.15	29.16	94.41
<i>f_risk</i>	Financial risk	547	41.92	5.11	25.66	50
<i>e_risk</i>	Economic risk	547	39.76	3.50	25.83	48.41
<i>rural</i>	Rural population	552	25.20	11.07	2.64	54.70
<i>gdp</i>	GDP per capita	552	23,253.82	8,674.32	6,423.80	56,189.02

Table A3
Summary statistics: non-OECD countries

Variable	Designation	Obs.	Mean	Std. Dev.	Min.	Max.
<i>ml</i>	Mainline penetration	1993	6.08	8.13	0.03	50.14
<i>cel</i>	Cellular subscription	2009	7.64	17.26	0	173.37
<i>eff</i>	Mainlines per employee	1658	66.77	68.39	1.10	564.30
<i>p_res</i>	Monthly subscription to fixed	1322	8.17	11.07	0.23	135.59
<i>p_cel</i>	Price of cellular	843	0.85	1.24	0.12	23.65
<i>priva</i>	Privatization	2112	0.30	0.46	0	1
<i>comp_cel</i>	Competition in cellular	2136	0.46	0.49	0	1
<i>reg</i>	Creation of a regulatory agency	2136	0.39	0.48	0	1
<i>demo</i>	Democratic accountability	1771	3.23	1.35	0	6
<i>p_risk</i>	Political risk	1770	57.11	12.07	9.58	86.41
<i>f_risk</i>	Financial risk	1770	30.68	8.10	6.5	49
<i>e_risk</i>	Economic risk	1770	31.47	6.44	1.37	48.00
<i>rural</i>	Rural population	2127	55.45	21.34	6.68	94.80
<i>gdp</i>	GDP per capita	2076	2,135.67	3,344.51	62.23	29,268.68

Table A4
Summary statistics: Latin America and the Caribbean

Variable	Designation	Obs.	Mean	Std. Dev.	Min.	Max.
<i>ml</i>	Mainline penetration	588	11.43	9.77	0.52	50.14
<i>cel</i>	Cellular subscription	588	11.01	20.13	0	112.89
<i>eff</i>	Mainlines per employee	495	102.74	85.44	13.23	564.30
<i>p-res</i>	Monthly subscription to fixed	365	8.38	12.73	0.23	135.59
<i>p-cel</i>	Price of cellular	242	1.11	1.89	0.02	23.65
<i>priva</i>	Privatization	600	0.39	0.48	0	1
<i>comp-cel</i>	Competition in cellular	624	0.44	0.49	0	1
<i>reg</i>	Creation of a regulatory agency	624	0.45	0.49	0	1
<i>demo</i>	Democratic accountability	576	3.80	1.29	0	6
<i>p-risk</i>	Political risk	576	60.31	11.94	23.08	86.41
<i>f-risk</i>	Financial risk	576	31.55	7.92	6.5	45.67
<i>e-risk</i>	Economic risk	576	31.20	6.16	1.37	44.04
<i>rural</i>	Rural population	624	38.66	17.47	6.68	76.70
<i>gdp</i>	GDP per capita	594	3,488.00	3,262.03	402.01	17,353.78

Table A5
Summary statistics: Africa

Variable	Designation	Obs.	Mean	Std. Dev.	Min.	Max.
<i>ml</i>	Mainline penetration	995	2.51	4.61	0.41	28.71
<i>cel</i>	Cellular subscription	1071	4.82	12.69	0	89.22
<i>eff</i>	Mainlines per employee	808	40.62	35.37	3.81	218.71
<i>p-res</i>	Monthly subscription to fixed	679	8.30	11.13	0.25	85.49
<i>p-cel</i>	Price of cellular	395	0.82	0.74	0.04	6.08
<i>priva</i>	Privatization	1071	0.26	0.43	0	1
<i>comp-cel</i>	Competition in cellular	1071	0.43	0.49	0	1
<i>reg</i>	Creation of a regulatory agency	1071	0.38	0.48	0	1
<i>demo</i>	Democratic accountability	826	2.92	1.17	0	5.5
<i>p-risk</i>	Political risk	826	54.74	11.42	9.83	79.83
<i>f-risk</i>	Financial risk	826	28.79	7.57	9.83	79.83
<i>e-risk</i>	Economic risk	826	30.43	6.67	5.33	45.25
<i>rural</i>	Rural population	1071	65.09	15.30	14.96	94.80
<i>gdp</i>	GDP per capita	1065	978.27	1,414.66	62.23	8,692.03

Table A6
Summary statistics: Africa resource rich

Variable	Designation	Obs.	Mean	Std. Dev.	Min.	Max.
<i>ml</i>	Mainline penetration	327	2.24	2.66	0.05	12.46
<i>cel</i>	Cellular subscription	336	5.57	13.72	0	87.85
<i>eff</i>	Mainlines per employee	246	40.06	31.04	3.81	149.10
<i>p-res</i>	Monthly subscription to fixed	209	6.47	8.51	0.25	60.54
<i>p-cel</i>	Price of cellular	117	0.81	0.71	0.04	4.36
<i>priva</i>	Privatization	360	0.33	0.47	0	1
<i>comp-cel</i>	Competition in cellular	360	0.37	0.48	0	1
<i>reg</i>	Creation of a regulatory agency	360	0.28	0.45	0	1
<i>demo</i>	Democratic accountability	307	2.84	1.10	0	5.5
<i>p-risk</i>	Political risk	307	54.33	13.10	9.83	79.83
<i>f-risk</i>	Financial risk	307	28.76	9.39	8.00	49.00
<i>e-risk</i>	Economic risk	307	32.01	7.31	7.37	45.25
<i>rural</i>	Rural population	360	56.92	14.39	14.96	78.20
<i>gdp</i>	GDP per capita	360	1,362.29	1,454.73	62.23	8,692.03

Table A7
Summary statistics: Africa resource scarce coastal

Variable	Designation	Obs.	Mean	Std. Dev.	Min.	Max.
<i>ml</i>	Mainline penetration	378	4.27	6.60	0.22	28.71
<i>cel</i>	Cellular subscription	382	6.94	15.50	0	89.22
<i>eff</i>	Mainlines per employee	331	51.14	42.30	6.41	218.71
<i>p-res</i>	Monthly subscription to fixed	247	7.96	11.31	0.27	85.45
<i>p-cel</i>	Price of cellular	145	0.74	0.63	0.08	3.89
<i>priva</i>	Privatization	408	0.29	0.45	0	1
<i>comp-cel</i>	Competition in cellular	408	0.52	0.50	0	1
<i>reg</i>	Creation of a regulatory agency	408	0.44	0.49	0	1
<i>demo</i>	Democratic accountability	312	3.23	1.16	1	5.5
<i>p-risk</i>	Political risk	311	58.45	8.27	36	74.50
<i>f-risk</i>	Financial risk	311	30.86	5.78	17.87	42.25
<i>e-risk</i>	Economic risk	311	30.50	5.99	5.33	39.54
<i>rural</i>	Rural population	399	60.76	11.21	39.26	83.30
<i>gdp</i>	GDP per capita	395	1,216.88	1,679.06	139.92	8,267.39

Table A8
Summary statistics: Africa resource scarce landlocked

Variable	Designation	Obs.	Mean	Std. Dev.	Min.	Max.
<i>ml</i>	Mainline penetration	290	0.51	0.55	0.04	2.96
<i>cel</i>	Cellular subscription	296	1.24	3.08	0	22.71
<i>eff</i>	Mainlines per employee	239	25.90	20.34	4.65	178.97
<i>p-res</i>	Monthly subscription to fixed	223	10.41	12.69	0.49	77.85
<i>p-cel</i>	Price of cellular	133	0.93	0.86	0.07	6.08
<i>priva</i>	Privatization	312	0.12	0.33	0	1
<i>comp-cel</i>	Competition in cellular	312	0.40	0.49	0	1
<i>reg</i>	Creation of a regulatory agency	312	0.41	0.49	0	1
<i>demo</i>	Democratic accountability	216	2.57	1.16	0.66	5
<i>p-risk</i>	Political risk	216	50.30	10.97	21.75	75.00
<i>f-risk</i>	Financial risk	216	25.93	5.66	11.08	40.50
<i>e-risk</i>	Economic risk	216	28.02	5.88	8.16	36.75
<i>rural</i>	Rural population	312	80.07	8.87	61.42	94.80
<i>gdp</i>	GDP per capita	309	225.08	128.60	81.00	680.45

Table A9
Correlation coefficients

Privatization	<i>ml</i>	<i>cel</i>	<i>eff</i>	<i>p-res</i>	<i>p-cel</i>
OECD	0.08	0.48	0.30	0.07	-0.21
Non-OECD	0.19	0.25	0.20	0.10	-0.03
Latin America and the Caribbean	0.08	0.19	0.18	0.22	-0.03
Africa	0.26	0.35	0.30	0.05	-0.12
Africa resource rich	0.48	0.35	0.45	0.42	-0.17
Africa resource scarce coastal	0.12	0.30	0.11	0.10	-0.04
Africa resource scarce landlocked	0.08	0.33	0.22	0.07	-0.13

- Regressions

Table A10
Fixed-effect: OECD countries

y_{it}	$\log(ml_{it})$	$\log(ce_{it})$	$\log(ef_{it})$
<i>priva_{it}</i>	0.007	-0.022	0.064*
<i>comp_cel_{it}</i>	0.024	0.180***	0.026
<i>reg_{it}</i>	0.042***	0.294***	0.066*
<i>demo_{it}</i>	0.086***	0.108***	0.034
<i>p_risk_{it}</i>	0.002***	0.000	0.011***
<i>f_risk_{it}</i>	0.002	0.013**	-0.002
<i>e_risk_{it}</i>	-0.008***	-0.032***	0.012**
<i>rural_{it}</i>	-0.001	-0.000	-0.046***
<i>gdp_{it}</i>	0.000***	0.000	-0.000**
<i>const</i>	3.081***	0.105	5.151***
Time	Yes	Yes	Yes
<i>F</i>	34.67***	541.60***	42.26***
Obs.	494	492	453
y_{it}	$\log(p_res_{it})$	$\log(p_cel_{it})$	
<i>priva_{it}</i>	-0.032	-0.029	
<i>comp_cel_{it}</i>	0.093***	-0.121	
<i>reg_{it}</i>	0.054*	0.004	
<i>demo_{it}</i>	-0.121***	-0.027	
<i>p_risk_{it}</i>	-0.000	-0.005	
<i>f_risk_{it}</i>	-0.009**	-0.005	
<i>e_risk_{it}</i>	0.005	0.008	
<i>rural_{it}</i>	0.023***	0.051	
<i>gdp_{it}</i>	0.000**	-0.000***	
<i>const</i>	2.415***	1.469	
Time	Yes	No	
<i>F</i>	8.86***	16.75***	
Obs.	391	276	

Table A11
Random-effect: OECD countries

y_{it}	$\log(ml_{it})$	$\log(cel_{it})$	$\log(ef_{it})$
<i>priva_{it}</i>	0.007	-0.028	0.095***
<i>comp_cel_{it}</i>	0.023	0.187***	0.043
<i>reg_{it}</i>	0.042***	0.293***	0.084**
<i>demo_{it}</i>	0.087***	0.124***	0.037
<i>p_risk_{it}</i>	0.002***	0.000	0.011***
<i>f_risk_{it}</i>	0.002	0.012**	-0.003
<i>e_risk_{it}</i>	-0.008***	-0.031***	0.006
<i>rural_{it}</i>	-0.003	-0.000	-0.010**
<i>gdp_{it}</i>	0.000***	0.000	0.000
<i>const</i>	3.110***	-0.182	4.224***
Time	Yes	Yes	No
<i>Wald</i>	111.97***	16670.20***	328.80***
Obs.	494	492	453
y_{it}	$\log(p_res_{it})$	$\log(p_cel_{it})$	
<i>priva_{it}</i>	-0.032	-0.135	
<i>comp_cel_{it}</i>	0.087***	-0.229**	
<i>reg_{it}</i>	0.052*	-0.122	
<i>demo_{it}</i>	-0.122***	-0.101	
<i>p_risk_{it}</i>	-0.000	-0.002	
<i>f_risk_{it}</i>	-0.008**	0.010	
<i>e_risk_{it}</i>	0.009*	0.005	
<i>rural_{it}</i>	0.010*	-0.003	
<i>gdp_{it}</i>	0.000**	-0.000***	
<i>const</i>	2.667***	1.743*	
Time	Yes	No	
<i>Wald</i>	275.98***	135.86***	
Obs.	391	276	

Table A12
Fixed-effect: non-OECD countries

y_{it}	$\log(ml_{it})$	$\log(cel_{it})$	$\log(ef_{it})$
<i>priva_{it}</i>	0.007	0.054	-0.013
<i>comp_cel_{it}</i>	0.064*	0.060	0.148***
<i>reg_{it}</i>	-0.116***	0.096**	-0.093***
<i>demo_{it}</i>	-0.050***	-0.033**	-0.052***
<i>p_risk_{it}</i>	0.001***	0.001	-0.000
<i>f_risk_{it}</i>	0.010***	-0.002	0.006**
<i>e_risk_{it}</i>	-0.000***	-0.002	0.000
<i>rural_{it}</i>	-0.001	-0.023***	0.013***
<i>gdp_{it}</i>	0.000***	0.001***	0.000***
<i>const</i>	-0.263	0.681**	1.880***
Time	Yes	Yes	Yes
<i>F</i>	86.11***	392.73***	98.22***
Obs.	1601	1606	1342
y_{it}	$\log(p_res_{it})$	$\log(p_cel_{it})$	
<i>priva_{it}</i>	0.372***	-0.141	
<i>comp_cel_{it}</i>	0.089	-0.234**	
<i>reg_{it}</i>	0.180***	-0.264**	
<i>demo_{it}</i>	-0.073***	-0.046	
<i>p_risk_{it}</i>	0.003	0.002	
<i>f_risk_{it}</i>	-0.012**	-0.028***	
<i>e_risk_{it}</i>	0.010*	-0.000	
<i>rural_{it}</i>	0.019*	-0.097***	
<i>gdp_{it}</i>	0.000***	-0.000	
<i>const</i>	1.454	-4.442***	
Time	Yes	No	
<i>F</i>	26.20***	21.03***	
Obs.	1086	710	

Table A13
Random-effect: non-OECD countries

<i>y_{it}</i>	<i>log(ml_{it})</i>	<i>log(ce_{it})</i>	<i>log(ef_{it})</i>
<i>priva_{it}</i>	-0.001	0.068*	-0.023
<i>comp_cel_{it}</i>	0.062*	0.099**	0.156***
<i>reg_{it}</i>	-0.108***	0.094**	-0.077**
<i>demo_{it}</i>	-0.040***	-0.035**	-0.043***
<i>p_risk_{it}</i>	0.001	0.007**	-0.000
<i>f_risk_{it}</i>	0.011***	0.000	0.006**
<i>e_risk_{it}</i>	0.001	-0.002	0.002
<i>rural_{it}</i>	-0.018***	-0.010***	-0.010***
<i>gdp_{it}</i>	0.000***	0.000***	0.000***
<i>const</i>	0.633***	0.324**	3.286***
Time	Yes	Yes	Yes
<i>Wald</i>	2695.73***	10520.32***	2902.47***
Obs.	1601	1606	1342
<i>y_{it}</i>	<i>log(p_res_{it})</i>	<i>log(p_cel_{it})</i>	
<i>priva_{it}</i>	0.377***	-0.111	
<i>comp_cel_{it}</i>	0.045	-0.450***	
<i>reg_{it}</i>	0.202***	-0.372***	
<i>demo_{it}</i>	-0.078***	-0.032	
<i>p_risk_{it}</i>	0.009**	0.007	
<i>f_risk_{it}</i>	-0.018***	-0.039***	
<i>e_risk_{it}</i>	0.006	-0.001	
<i>rural_{it}</i>	0.011***	0.036	
<i>gdp_{it}</i>	0.000***	0.000	
<i>const</i>	2.592***	0.705	
Time	Yes	No	
<i>Wald</i>	751.12***	142.51***	
Obs.	1086	710	

Table A14
Fixed-effect:
Latin American and The Caribbean

<u>y_{it}</u>	<u>$\log(ml_{it})$</u>	<u>$\log(ce_{it})$</u>	<u>$\log(ef_{it})$</u>
<i>priva_{it}</i>	0.043	-0.016	0.001
<i>comp_cel_{it}</i>	0.136***	0.073	0.201***
<i>reg_{it}</i>	0.073**	0.125**	0.223***
<i>demo_{it}</i>	0.009	-0.0318	-0.035
<i>p_risk_{it}</i>	0.003	-0.006*	0.009
<i>f_risk_{it}</i>	0.004**	-0.009**	-0.000**
<i>e_risk_{it}</i>	-0.000	-0.001	0.009*
<i>rural_{it}</i>	0.032***	-0.015*	0.087***
<i>gdp_{it}</i>	-0.611**	0.000***	0.000
<i>const</i>	0.852***	-0.812**	1.024**
Time	Yes	Yes	Yes
<i>F</i>	108.34***	365.80***	48.94***
Obs.	498	497	423
<u>y_{it}</u>	<u>$\log(p_res_{it})$</u>	<u>$\log(p_cel_{it})$</u>	
<i>priva_{it}</i>	0.297	-0.327	
<i>comp_cel_{it}</i>	-0.286*	0.047	
<i>reg_{it}</i>	-0.081	0.170	
<i>demo_{it}</i>	-0.201***	-0.106	
<i>p_risk_{it}</i>	0.001	0.008	
<i>f_risk_{it}</i>	-0.033***	-0.012	
<i>e_risk_{it}</i>	-0.004	-0.001	
<i>rural_{it}</i>	0.023	-0.134***	
<i>gdp_{it}</i>	0.000***	0.000***	
<i>const</i>	1.705	1.667	
Time	No	Yes	
<i>F</i>	8.35***	12.73***	
Obs.	318	217	

Table A15
Random-effect:
Latin American and The Caribbean

<u><i>y_{it}</i></u>	<u><i>log(ml_{it})</i></u>	<u><i>log(ce_{it})</i></u>	<u><i>log(ef_{it})</i></u>
<i>priva_{it}</i>	0.014	-0.094*	0.130**
<i>comp_cel_{it}</i>	0.075**	0.086	0.328***
<i>reg_{it}</i>	0.083**	0.114*	0.124
<i>demo_{it}</i>	0.017	-0.039	0.089**
<i>p_risk_{it}</i>	0.004**	0.003	0.021***
<i>f_risk_{it}</i>	0.002	-0.015***	-0.016**
<i>e_risk_{it}</i>	0.005*	0.007*	0.022***
<i>rural_{it}</i>	-0.004	-0.006**	-0.020***
<i>gdp_{it}</i>	0.000***	0.000***	-0.000***
<i>const</i>	0.672	0.262	3.150***
Time	Yes	Yes	Yes
Wald	2590.59	10264.91***	753.72***
Obs.	498	497	423
<u><i>y_{it}</i></u>	<u><i>log(p-res_{it})</i></u>	<u><i>log(p-cel_{it})</i></u>	
<i>priva_{it}</i>	0.336**	-0.144	
<i>comp_cel_{it}</i>	-0.421***	-0.231	
<i>reg_{it}</i>	-0.019	-0.082	
<i>demo_{it}</i>	-0.165**	-0.191***	
<i>p_risk_{it}</i>	0.006	0.043***	
<i>f_risk_{it}</i>	-0.042***	-0.017	
<i>e_risk_{it}</i>	0.000	-0.001	
<i>rural_{it}</i>	-0.001	-0.009*	
<i>gdp_{it}</i>	0.000	0.000	
<i>const</i>	3.411***	-1.181	
Time		Yes	
Wald	72.79***	243.42***	
Obs.	318	217	

Table A16
Fixed-effect: Africa

y_{it}	$\log(ml_{it})$	$\log(cel_{it})$	$\log(ef_{it})$
<i>priva_{it}</i>	-0.118***	0.198***	-0.121**
<i>comp_cel_{it}</i>	-0.027	0.143**	0.078*
<i>reg_{it}</i>	0.114***	0.152***	0.031
<i>demo_{it}</i>	0.017	-0.090***	-0.010
<i>p_risk_{it}</i>	-0.003	0.000	-0.006***
<i>f_risk_{it}</i>	0.003***	0.002	0.008**
<i>e_risk_{it}</i>	0.000	-0.001	-0.001
<i>rural_{it}</i>	-0.011**	-0.029***	0.002
<i>gdp_{it}</i>	0.000***	0.001***	0.000***
<i>const</i>	-0.265	1.865***	2.383***
Time	Yes	Yes	Yes
<i>F</i>	33.40***	173.77***	39.58***
Obs.	764	774	626
y_{it}	$\log(p-res_{it})$	$\log(p-cel_{it})$	
<i>priva_{it}</i>	0.413***	0.209	
<i>comp_cel_{it}</i>	0.095	-0.119	
<i>reg_{it}</i>	0.098	-0.447***	
<i>demo_{it}</i>	-0.067**	0.038	
<i>p_risk_{it}</i>	0.001	-0.007	
<i>f_risk_{it}</i>	-0.018**	-0.016	
<i>e_risk_{it}</i>	0.015**	0.002	
<i>rural_{it}</i>	0.028	0.102***	
<i>gdp_{it}</i>	0.000***	0.000	
<i>const</i>	0.838	-6.099**	
Time	Yes	No	
<i>F</i>	18.32***	9.82***	
Obs.	529	312	

Table A17
Random-effect: Africa

<i>y_{it}</i>	<i>log(ml_{it})</i>	<i>log(cel_{it})</i>	<i>log(ef_{it})</i>
<i>priva_{it}</i>	-0.119***	0.236***	-0.113**
<i>comp_cel_{it}</i>	-0.022	0.135**	0.083*
<i>reg_{it}</i>	0.113**	0.156***	0.0340
<i>demo_{it}</i>	0.020	-0.089***	-0.014
<i>p_risk_{it}</i>	-0.003	0.004*	-0.005**
<i>f_risk_{it}</i>	0.004	0.006	0.010***
<i>e_risk_{it}</i>	0.001	-0.004	-0.001
<i>rural_{it}</i>	-0.014***	-0.005***	0.000
<i>gdp_{it}</i>	0.000***	0.000***	0.000***
<i>const</i>	-0.265	0.254	2.501***
Time	Yes	Yes	Yes
<i>Wald</i>	1083.36***	5182.54***	1232.24***
Obs.	764	774	626
<i>y_{it}</i>	<i>log(p_res_{it})</i>	<i>log(p_cel_{it})</i>	
<i>priva_{it}</i>	0.430***	0.096	
<i>comp_cel_{it}</i>	0.070	-0.273**	
<i>reg_{it}</i>	0.131	-0.505***	
<i>demo_{it}</i>	-0.080**	0.016	
<i>p_risk_{it}</i>	0.004	-0.003	
<i>f_risk_{it}</i>	-0.018**	-0.025	
<i>e_risk_{it}</i>	0.014**	0.006	
<i>rural_{it}</i>	0.028***	0.014*	
<i>gdp_{it}</i>	0.000**	0.000	
<i>const</i>	0.747	-0.299	
Time	Yes	No	
<i>Wald</i>	532.27***	72.00***	
Obs.	529	312	

Table A18
Fixed-effect: Africa per region

y_{it}	$\log(ml_{it})$	$\log(ce_{it})$	$\log(ef_{it})$
$priva_{it} * dummy_{rr}$	-0.305***	0.321***	-0.279***
$priva_{it} * dummy_{rsc}$	0.027	0.364***	0.219***
$priva_{it} * dummy_{rsl}$	-0.066	-0.342***	-0.686**
$comp_{cel_{it}}$	-0.037	0.135**	0.051
reg_{it}	0.087**	0.188***	0.063
$demo_{it}$	0.015	-0.085***	0.000
$p_{risk_{it}}$	-0.004**	0.001	-0.008***
$f_{risk_{it}}$	0.006**	0.002	0.012***
$e_{risk_{it}}$	-0.000	-0.002	-0.002
$rural_{it}$	-0.014***	-0.020***	0.008
gdp_{it}	0.000***	0.000***	0.000***
$const$	0.062	1.177**	1.913***
Time	Yes	Yes	Yes
F	32.59***	171.69***	43.66***
Obs.	764	774	626
y_{it}	$\log(p-res_{it})$	$\log(p-ce_{it})$	
$priva_{it} * dummy_{rr}$	0.261*	0.339	
$priva_{it} * dummy_{rsc}$	0.790***	0.207	
$priva_{it} * dummy_{rsl}$	0.094	0.007	
$comp_{cel_{it}}$	0.104	-0.115	
reg_{it}	0.100	-0.416***	
$demo_{it}$	-0.067**	0.016	
$p_{risk_{it}}$	0.002	-0.007	
$f_{risk_{it}}$	-0.014*	-0.015	
$e_{risk_{it}}$	0.013**	0.002	
$rural_{it}$	0.037**	0.109***	
gdp_{it}	0.000***	0.000	
$const$	0.144	-6.595**	
Time	Yes	No	
F	17.98***	8.06***	
Obs.	529	312	

Table A19
Random-effect: Africa per region

<i>y_{it}</i>	<i>log(ml_{it})</i>	<i>log(ce_l_{it})</i>	<i>log(ef_f_{it})</i>
<i>priva_{it} * dummy_{rr}</i>	-0.308***	0.268***	-0.272***
<i>priva_{it} * dummy_{rsc}</i>	0.029	0.415***	0.219***
<i>priva_{it} * dummy_{rsl}</i>	-0.067	-0.352***	-0.686***
<i>comp_{cel}_{it}</i>	-0.033	0.127**	0.056
<i>reg_{it}</i>	0.086*	0.156***	0.069
<i>demo_{it}</i>	0.017	-0.078***	-0.003
<i>p_{risk}_{it}</i>	-0.004*	0.003	-0.007***
<i>f_{risk}_{it}</i>	0.007**	0.006*	0.013***
<i>e_{risk}_{it}</i>	0.000	-0.004	-0.002
<i>rural_{it}</i>	-0.016***	-0.001	0.006
<i>gdp_{it}</i>	0.000***	0.000***	0.000***
<i>const</i>	0.032	-0.078	2.077***
Time	Yes	Yes	Yes
Wald	1125.58***	5462.79***	1459.11***
Obs.	764	774	626
<i>y_{it}</i>	<i>log(p_{res}_{it})</i>	<i>log(p_{cel}_{it})</i>	
<i>priva_{it} * dummy_{rr}</i>	0.257**	0.162	
<i>priva_{it} * dummy_{rsc}</i>	0.796***	0.057	
<i>priva_{it} * dummy_{rsl}</i>	0.104	0.072	
<i>comp_{cel}_{it}</i>	0.080	-0.270**	
<i>reg_{it}</i>	0.119	-0.505***	
<i>demo_{it}</i>	-0.077**	0.017	
<i>p_{risk}_{it}</i>	0.004	-0.003	
<i>f_{risk}_{it}</i>	-0.014**	-0.026**	
<i>e_{risk}_{it}</i>	0.012*	0.006	
<i>rural_{it}</i>	0.033***	0.015*	
<i>gdp_{it}</i>	0.000***	0.000	
<i>const</i>	0.277	-0.334	
Time	Yes	No	
Wald	566.71***	72.65***	
Obs.	529	312	

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