FINAL REPORT

ASSESSMENT OF THE ECONOMIC IMPACT OF TELECOMMUNICATIONS IN JORDAN

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Columbia Institute for Tele-Information

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Assessment of the Economic Impact of Telecommunications in Jordan[1]

EXECUTIVE SUMMARY

The Jordanian telecommunications sector generates a significant direct and indirect impact on the country's economy, representing 6.43% of the country's 2014 GDP.

From a direct effect standpoint, the telecommunications industry gross revenues comprise 4.26% of Jordan's economy in 2014 and 1% of the workforce

- Jordan's telecommunications companies have generated in 2014 US$ 1.523 billion in revenues, which amount to US$ 605 million in fixed services and $ 918 in mobile telecommunications; total industry revenues represent 4.26% of the country's Gross Domestic Product.
- On the other hand, the sector generates approximately 12,000 direct and indirect jobs (representing 1% of the workforce in 2013).

Beyond the direct effects, telecommunications have a significant spill-over impact on the rest of the economy, generating US$ 776 million in economic value (or 2.17 % of the 2014 GDP)

- Jordan's mobile telecommunications industry has indirectly contributed US$ 375 million on average per year to the whole economy between 2001 and 2014 (1.05% of the 2014 GDP).
- On the other hand, Jordan's fixed broadband sector has indirectly contributed US$ 401 million per annum on average between 2006 and 2014 (1.12% of the 2014 GDP).
- The contribution of telecommunications to GDP growth reached :
    - 18,21% between 2001 and 2014 in the case of overall mobile services (2G + 3G)
    - 17,28% between 2011 and 2014 in the case of broadband mobile
    - 15,50% between 2006 and 2014 in the case of fixed broadband.

Mobile telecommunications

- Jordanian mobile telecommunications have achieved a penetration of 127% in 2014, enabling the delivery of multiple voice and data services (over the 2G and 3G networks).
- Combining direct and indirect effects, mobile telecommunications (2G and 3G) have an impact of US$ 1,293 million, which represent 3.62% of the Jordanian GDP in 2014.
- Mobile broadband services alone have generated annual economic value of US$ 396 million on average between 2011 and 2014 (which represents 1.11% of the 2014 GDP)

Fixed broadband

- Fixed broadband subscriptions have reached a penetration of 27% of households in 2014, enabling the delivery of multiple voice, video and data services.
- By combining direct and indirect effects, fixed broadband has an annual impact of US$ 480 million, which represent 1.34% of the Jordanian GDP in 2014.

Implications

Given the economic importance of telecommunications, public policies and regulatory frameworks need to be defined in order to maximize investment in network deployment and modernization, particularly in mobile broadband.

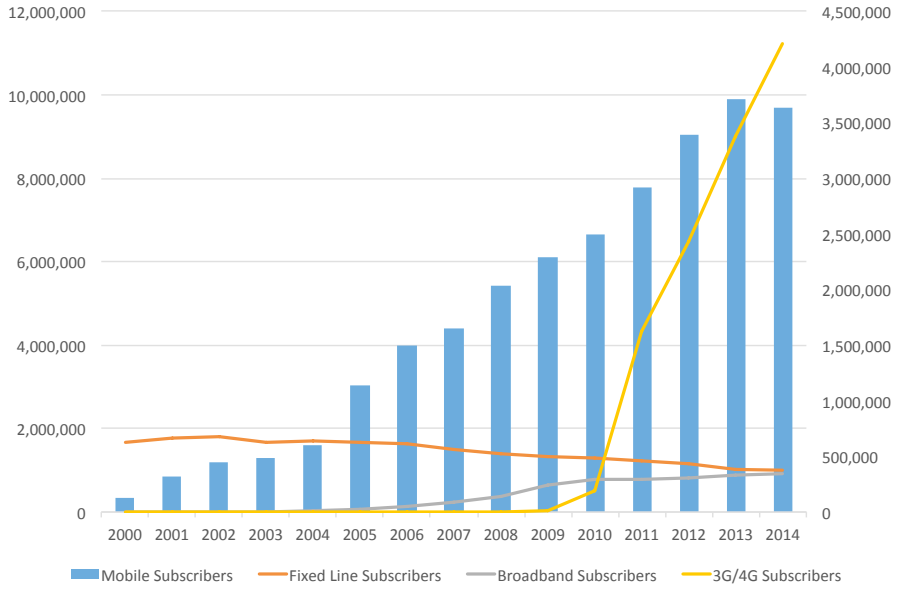
[1] Executive Summary of the study "Assessment of the Economic Impact of Telecommunications in Jordan" (April 2016),.

1. The development of telecommunications in Jordan and its economic importance

In 2014, the telecommunications industry revenues comprised **4.26% of the country's GDP**[2]. With more than 10.5 million connections, mobile penetration has reached 127%[3]. Jordan mobile penetration rate is well above the regional average of 119%[4]. Additionally, fixed broadband penetration has reached 27% of Jordanian households.

The importance of the telecommunications sector can also be validated when looking at the number of jobs it generates. In 2013, the sector comprised 4,214 direct jobs[5]. In addition, the sector triggered the creation of 7,710 indirect jobs[6]: for each direct job, telecommunications operators create 1.83 among suppliers of goods and services to the operators.

Figure 1
Jordan: Penetration of telecommunications services (2000-2014)



Sources: ITU World Telecommunication/ICT Indicators 2015; GSMA Intelligence (2015)

2. Direct and indirect effects of mobile telecommunications on the Jordanian economy

The economic effects of mobile telecommunications are proportional to the development of the wireless market with its corresponding maturity level[7]. The contribution of mobile services (2G and

[2] Sources : International Telecommunications Union.
[3] Source : GSMA Intelligence. 142% according the TRC; the authors decided to rely on the percentage provided by the ITU to rely on a uniform data source for all countries.
[4] Source : GSMA Intelligence.
[5] Source: UIT.
[6] Source: estimation by Telecom Advisory Services LLC based on the research-based assumptions contained in the digitization model in Katz, R., Koutroumpis, P. and Callorda, F. (2014). Using a digitization index to measure economic and social impact of digital agendas, *Info*, January. We believe this to be a low estimate given that Jordan counts 3600 points of sale of SIM card and 25000 points where refill cards.
[7] Gruber, H., & Koutroumpis, P. (2011). Mobile Telecommunications and the impact on Economic Development. *Telecommunications Policy*, *67*, 278-286. Kathuria, R., Uppal, M., Mamta (2009). *An Econometric Analysis of the Impact of Mobile*, The Vodafone Policy Paper Series (9), pp. 5-20. Shiu, A., & Lam, P. (2008, June 25). Relationships between Economic Growth, Telecommunications Development and Productivity Growth: Evidence around the World. In

mobile broadband on 3G and 4G) to economic growth is driven by the sector internal dynamics (such as the investments linked to the deployment of networks and services[8]) and the positive externalities derived from private and enterprise use of services (*spill-over effects*). By allowing a more efficient functioning of the economy, telecommunications networks and services contribute to overall value creation.

The analysis of spill-over effects (also called indirect) of mobile telecommunications on the economy are based on a structural econometric model, composed of an aggregated production function, a demand function, a supply function, and an infrastructure function (see appendices 1 through 3).

2.1 Contribution of mobile telecommunications (2G + 3G) to Jordanian economic growth between 2001 and 2014:

- According to an econometric model developed in this study with Jordanian time series (see appendix 1), 10% increase in mobile telecommunications lines yields 1.24 % of GDP growth;
- Based on this coefficient, mobile telecommunications have contributed annually an average of US$ 375 million to Jordan's economic growth per year between 2001 and 2014.

Table 1

Estimation of mobile telecommunications contribution to Jordanian economic growth between 2001 and 2014[9]

Item	Factor	Value	Source and / or estimation formula
1	Annual contribution of mobile telecommunications to GDP growth (for a 10% increase in additional penetration)	1.24 %	Coefficient resulting from structural model
2	Mobile telecommunications penetration 4Q2014	127.49 %	GSMA Intelligence
3	Mobile penetration 4Q2001	17.67 %	GSMA Intelligence
4	Compound Annual Growth Rate (CAGR) of mobile telecommunications penetration	16.42 %	(Mobile telecommunications penetration 4Q2014/4Q2001)^(1/13 years)-1
5	Annual impact of mobile telecommunications on GDP	2.04 %	(Annual impact)/10 * (CAGR Mobile telecommunications penetration)
6	CAGR GDP (2001-2014)	11.22 %	(GDP 4Q2014/GDP 4Q2001) ^ (1/13 years)-1
7	Percent contribution of mobile voice telecommunications to GDP growth	18.21 %	Annual impact of mobile telecommunications on GDP / CAGR GDP (2001-2014)
8	Incremental GDP growth (4Q2014/4Q2001)	US$ 26,790 M	GDP 4Q2014 - GDP 4Q2001
9	Total impact of mobile telecommunications on incremental GDP growth	US$ 4,879 M	Incremental GDP (4Q2014/4Q2001) * % contribution of mobile telecommunications to GDP growth

Africa-Asia-Australasia Regional Conference of the International Telecommunications Society. Retrieved from http://www.apeaweb.org/confer/hk10/papers/shiu_alice.pdf. Waverman, L., Meschi, M., Fuss, M. (2005). "The impact of telecoms on economic growth in developing countries", The Vodafone Policy paper Series (2), pp. 10-23.

[8] Between 2011-2014, the investments continued to increase even if the income of the sector decreased. Appendix 6.

[9] This value includes also the contribution of mobile broadband.

10	Annual impact of mobile telecommunications on GDP	US$ 375 M	Total impact /13 years

Source: Telecom Advisory Services analysis

2.2 Contribution of Mobile Broadband to Jordan's economic growth between 2011 and 2014

- According to an econometric model developed in this study with Jordanian time series (see appendix 2), 10% increase in mobile broadband lines yields 0.39 % of GDP growth;
- Based on this coefficient, mobile broadband have contributed annually an average of US$ 396 million to Jordan's economic growth between 2011 and 2014.

Table 2

Estimation of mobile broadband contribution to Jordanian economic growth between 2011 and 2014

Item	Factor	Value	Source and / or estimation formula
1	Annual contribution of mobile broadband to GDP growth (for a 10% increase in additional penetration)	0.39 %	Coefficient resulting from structural model
2	Mobile broadband penetration 4Q2014	55.34 %	GSMA Intelligence
3	Mobile broadband penetration 4Q2011	23.58 %	GSMA Intelligence
4	Compound Annual Growth Rate (CAGR) of mobile broadband penetration	32.89 %	(Mobile broadband penetration 4Q2014/4Q2011) ^(1/3 years)-1
5	Annual impact of mobile broadband on GDP	1.28 %	(Annual impact)/10 * (CAGR Mobile broadband penetration)
6	CAGR GDP (2011-2014)	7.39 %	(GDP 4Q2014/ GDP 4Q2011)^(1/3 years)-1
7	Percent contribution of mobile broadband to GDP growth	17.28 %	Annual impact of mobile broadband on GDP / CAGR GDP (2011-2014)
8	Incremental GDP growth (2011-2014)	US$ 6,884 M	GDP 4Q2014- GDP 4Q2011
9	Total impact of mobile broadband on incremental GDP growth	US$ 1,189 M	Incremental GDP (4Q2014/4Q2011) * % contribution of mobile broadband to GDP growth
10	Annual impact of mobile broadband on GDP	US$ 396 M	Total impact / 3 years

Source: Telecom Advisory Services analysis

It should be mentioned that mobile broadband impact is also included in the contribution of mobile telecommunications.

2.3 Contribution of mobile telecommunications to Jordan's 2014 GDP

In total, mobile telecommunications represent 3.62% of Jordan's 2014 GDP, broken down as follows:

- 2.57% represents the industry gross revenues (US$ 918 million) as a percentage of the country's GDP (US$ 35,765 million)
- 1.05% is the indirect contribution of mobile telecommunications (US$ 375 million) as a percentage of 2014 GDP

Table 3.

Direct and indirect contribution of mobile telecommunications to Jordan's economic growth

	Million US$ 2014	As % of GDP
Gross revenues of mobile telecommunications operators (2014)	**918**	**2.57%**
Indirect contribution (spill-over) of mobile telecommunications	**375**	**1.05%**
Total impact of mobile telecommunications on Jordan's 2014 GDP	**1,293**	**3.62%**

Source: Telecom Advisory Services analysis

3. **Direct and indirect effects of fixed broadband on the Jordanian economy**

3.1. **Contribution of fixed broadband to Jordan's economic growth between 2006 and 2004:**

- According to an econometric model developed in this study with Jordanian time series (see appendix 3), 10% increase in fixed broadband lines yields 0.73 % of GDP growth;
- Based on this coefficient, fixed broadband has contributed annually an average of US$ 401 million to Jordan's economic growth between 2006 and 2014.

Table 4.

Estimation of fixed broadband contribution to Jordanian economic growth between 2006 and 2014

Item	Factor	Value	Source and / or estimation formula
1	Annual contribution of fixed broadband to GDP growth (for a 10% increase in additional penetration)	0.73%	Coefficient resulting from structural model
2	Fixed broadband penetration 4Q2014	26.87%	UIT
3	Fixed broadband penetration 4Q2006	4.69%	UIT
4	Compound Annual Growth Rate (CAGR) of fixed broadband penetration	24.39 %	(Fixed broadband penetration 4Q2014/4Q2006) ^(1/8 years)-1
5	Annual impact of fixed broadband on GDP	1.77 %	(Annual impact)/10 * (CAGR fixed broadband penetration)
6	CAGR GDP (2006-2014)	11.42 %	(GDP 4Q2014/ GDP 4Q2006)^(1/8 years)-1
7	Percent contribution of fixed broadband to GDP growth	15.50 %	Annual impact of fixed broadband on GDP / CAGR GDP (2006-2014)
8	Incremental GDP growth (2014-2006)	US$ 20,708 M	GDP 4Q2014 - GDP 4Q2006
9	Total impact of fixed broadband on incremental GDP growth	US$ 3,211 M	Incremental GDP (4Q2014/4Q2006) * % contribution of fixed broadband to GDP growth
10	Annual impact of fixed broadband on GDP	US$ 401 M	Total impact / 8 years

Source: Telecom Advisory Services analysis

3.2 Contribution of fixed broadband to Jordan's 2014 GDP

In total, fixed broadband represent 1.34% of Jordan's 2014 GDP, broken down as follows:

- 0.22% represents Jordan's fixed broadband gross revenues (US$ 79 million) as a percentage of the country's 2014 GDP (US$ 35,765 million)

- 1.12% is the indirect contribution of fixed broadband (US$ 401 million) as a percentage of 2014 GDP

Table 5.

Direct and indirect contribution of fixed broadband to Jordan's economic growth

	Million US$ 2014	In % of GDP
Gross revenues of fixed broadband operators (2014)	**79**	**0.22%**
Indirect contribution (spill-over) of fixed broadband	**401**	**1.12%**
Total impact of fixed broadband on Jordan's 2014 GDP	**480**	**1.34%**

Source: Telecom Advisory Services analysis

4. Total impact of mobile telecommunications and fixed broadband on Jordan's 2014 GDP

In sum, when considering the aggregate industry revenues and the spill-over indirect effects on the rest of the Jordanian economy, mobile telecommunications and fixed broadband have an impact of 6.43% on Jordan's GDP.

Table 6.

Direct and indirect contribution of mobile telecommunications and fixed broadband to Jordan's economy

		Million US$ 2014	In % of GDP
Direct Contribution (industry gross revenues)	Fixed telephony	$ 526	1.47 %
	Fixed broadband	$ 79	0.22 %
	Mobile telecommunications	$ 918	2.57 %
	Total	$ 1,523	4.26 %
Indirect contribution	Mobile telecommunications	$ 375	1.05 %
	Fixed broadband	$ 401	1.12 %
	Subtotal	$ 776	2.17 %
Total		$ 2,299	6.43 %
Jordan GDP		$ 35,765	100 %

Source: Telecom Advisory Services analysis

5. Implications

The strong contribution of telecommunications to the Jordanian economy is a function of two factors:

1. The sector dynamism: the telecommunications sector is growing, generating in turn direct and indirect jobs. In fact, the operators trigger a significant number of local suppliers, distributions agents, and providers of various services, which enhance the local value added to the economy.
2. The positive externalities (« Spill-over effects »): telecommunications networks and services result in a more efficient functioning of the economy particularly in terms of:
   - Productivity gains in existing sectors (such as tourism, exports, manufacturing) as well as social services, such as education and public administration;
   - Innovation incentives, leading to the creation of new businesses in the digital economy (applications, software platforms, local content);
   - Integration of isolated regions, leading to further development of economic activities;
   - Better coordination among economic agents through improved knowledge of inputs market prices (agriculture), better coordination between economic agents resulting in low transaction

costs, enhanced ability to negotiate selling prices; inventory management and delivery tracking;

- Improvement and extension of domestic economic exchanges, as well as at the regional and global scale.

As shown in the international comparisons (in appendix 5), Jordan is positioned among countries that have better levered telecommunications for its economic development. In this context, regulators and policy makers need to continue fostering the conditions necessary to stimulate the deployment and modernization of infrastructure, both in terms of fixed and mobile broadband. This should result in a growing adoption of broadband, both fixed and mobile, not only impacting economic activity but also delivery of social services.

Appendices

Appendix 1

Econometric model measuring the contribution of mobile telecommunications to Jordanian economic growth

Fonction de production agrégée :

$GDPit=a_1K_{it}+a_2L_{it}+a_3Mob\_Pen_{it}+a_4OilPrice_{it}+a_5Shock_{it}+e_{it}$

Fonction de demande :

$Mob\_Pen_{it}=b_1Rural_{it}+b_2Fixed_{it}+b_3Mob\_Price_{it}+b_4GDPC_{it}+b_5HHI_{it}+e_{it}$

Fonction d'offre :

$Mob\_Rev_{it}=c_1MobPr_{it}+c_2GDPC_{it}+c_3HHI_{it}+\square_{3it}$

Fonction d'infrastructure :

$$\Delta Mob\_Pen_{it} = d_1 Mob\_Rev_{it} + \varepsilon_{4it}$$

```
. reg3 (lgdp1 lfcapital_3 llabedu_1 lmobusers lnoil primavera2 yr_1-yr_15 )  (lmobusers lnrural lnfix
> ed   lgdpc1  lmobcost hhi_mobile) (lrevenuemobile lgdpc1 lmobcost hhi_mobile) (mobgrowth lrevenuemo
> bile)

Three-stage least-squares regression
------------------------------------------------------------------------------
Equation           Obs  Parms        RMSE    "R-sq"       chi2         P
------------------------------------------------------------------------------
lgdp1               56     18     .020342    0.9982   32047.10    0.0000
lmobusers           56      5    .0660929    0.9920    8188.34    0.0000
lrevenuemo~e        56      3    .1337734    0.8659     417.81    0.0000
mobgrowth           56      1     .619227    0.5476      51.87    0.0000
------------------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lgdp1        |
 lfcapital_3 |    .4572255    .079413     5.76   0.000      .301579    .6128721
   llabedu_1 |   -.1194211   .1761961    -0.68   0.498    -.4647592    .2259169
   lmobusers |    .1244647   .0418222     2.98   0.003     .0424948    .2064347
       lnoil |   -.0050288   .0194928    -0.26   0.796     -.043234    .0331764
  primavera2 |   -.0046642    .016606    -0.28   0.779    -.0372113    .0278828
        yr_1 |   (omitted)
        yr_2 |   -.3706046   .1006657    -3.68   0.000    -.5679057   -.1733035
        yr_3 |    -.369367   .0963915    -3.83   0.000    -.5582909   -.1804431
        yr_4 |   -.3605213   .0909407    -3.96   0.000    -.5387618   -.1822808
        yr_5 |    -.382221    .080602    -4.74   0.000     -.540198   -.2242441
        yr_6 |   -.4516534   .0628244    -7.19   0.000     -.574787   -.3285198
        yr_7 |   -.4179018   .0562343    -7.43   0.000    -.5281191   -.3076845
        yr_8 |   -.3386734   .0491304    -6.89   0.000    -.4349673   -.2423795
        yr_9 |   -.2426455   .0366411    -6.62   0.000    -.3144607   -.1708302
       yr_10 |   -.1497286   .0339035    -4.42   0.000    -.2161781    -.083279
       yr_11 |   -.0706626   .0310764    -2.27   0.023    -.1315713   -.0097539
       yr_12 |   -.0396814   .0288945    -1.37   0.170    -.0963135    .0169507
       yr_13 |   -.0257143   .0219331    -1.17   0.241    -.0687025    .0172738
       yr_14 |   -.0085673   .0166775    -0.51   0.607    -.0412546     .02412
       yr_15 |   (omitted)
       _cons |   -.4783899   .5337441    -0.90   0.370    -1.524509    .5677293
-------------+----------------------------------------------------------------
lmobusers    |
     lnrural |   -11.94281    1.29964    -9.19   0.000    -14.49006   -9.39556
     lnfixed |    1.809357   .1785271    10.13   0.000      1.45945    2.159264
      lgdpc1 |    .0023603   .2084703     0.01   0.991    -.4062339    .4109546
    lmobcost |    -.763087   .0985955    -7.74   0.000    -.9563305   -.5698434
  hhi_mobile |   -.7116089   .1358069    -5.24   0.000    -.9777855   -.4454323
       _cons |    42.68361   5.097892     8.37   0.000     32.69192    52.6753
-------------+----------------------------------------------------------------
lrevenuemo~e |
      lgdpc1 |   -.2015332   .1599081    -1.26   0.208    -.5149474    .1118809
    lmobcost |   -.1619883   .1142528    -1.42   0.156    -.3859196     .061943
  hhi_mobile |    -1.20187    .139146    -8.64   0.000    -1.474591   -.929149
       _cons |    31.06297   2.081509    14.92   0.000     26.98329    35.14266
-------------+----------------------------------------------------------------
mobgrowth    |
lrevenuemo~e |   -1.517594   .2107247    -7.20   0.000    -1.930607   -1.104582
       _cons |    29.18191   3.992632     7.31   0.000      21.3565    37.00732
------------------------------------------------------------------------------
Endogenous variables:  lgdp1 lmobusers lrevenuemobile mobgrowth
Exogenous variables:   lfcapital_3 llabedu_1 lnoil primavera2 yr_1 yr_2 yr_3
     yr_4 yr_5 yr_6 yr_7 yr_8 yr_9 yr_10 yr_11 yr_12 yr_13 yr_14 yr_15
     lnrural lnfixed lgdpc1 lmobcost hhi_mobile
------------------------------------------------------------------------------
```

Appendix 2

Econometric model measuring the contribution of mobile broadband to Jordanian economic growth

Fonction de production agrégée :

$GDPit=a_1K_{it}+a_2L_{it}+a_3Mob\_Bob\_Pen_{it}+a_4OilPrice_{it}+a_5Shock_{it}+e_{it}$

Fonction de demande :

$Mob\_Bob\_Pen_{it}=b_1Rural_{it}+b_2Mob\_Pen_{it}+b_3Mob\_Bob\_Price_{it}+b_4GDPC_{it}+b_5HHI\_MBB_{it}+e_{it}$

Fonction d'offre :

$Mob\_Bob\_Rev_{it}=c_1Mob\_Bob\_Pr_{it}+c_2GDPC_{it}+c_3HHI\_MBB_{it}+\square_{3it}$

Fonction d'infrastructure :

$Variation\ in\ MBB\_Pen_{it}= d_1MBB\_Rev_{it}+\square_{3it}$

```
. reg3 (lgdp1 lfcapital_3 llabedu_1 lmbbusers lnoil primavera2 yr_10-yr_15 ) (lmbbusers lnrural lmobu
> sers  lgdpc1  lmbbcost hhi_mb)     (lrevenuembb    lgdpc1 lmbbcost hhi_mb)     (mbbgrowth lrevenuem
> bb)    if yr>2008

Three-stage least-squares regression
------------------------------------------------------------------------------
Equation           Obs   Parms        RMSE    "R-sq"       chi2         P
------------------------------------------------------------------------------
lgdp1               24      10    .0054849    0.9985   16895.20    0.0000
lmbbusers           24       5    .2172135    0.9898    2624.70    0.0000
lrevenuembb         24       3    .4523575    0.9466     431.37    0.0000
mbbgrowth           24       1    .4457181    0.1295       3.12    0.0774
------------------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lgdp1        |
 lfcapital_3 |   .4627932   .0608062     7.61   0.000     .3436153    .5819711
   llabedu_1 |  -.2228202   .0753224    -2.96   0.003    -.3704494    -.075191
   lmbbusers |   .0387972   .0053984     7.19   0.000     .0282165     .049378
       lnoil |   .0471987   .0123373     3.83   0.000     .0230179    .0713794
  primavera2 |  -.0269233   .0050067    -5.38   0.000    -.0367362   -.0171103
       yr_10 |   .0476769   .0222135     2.15   0.032     .0041393    .0912145
       yr_11 |   .0321317   .0188947     1.70   0.089    -.0049013    .0691646
       yr_12 |  -.0131287   .0157971    -0.83   0.406    -.0440905    .0178331
       yr_13 |  -.0116568   .0115384    -1.01   0.312    -.0342717     .010958
       yr_14 |  -.0077203   .0068132    -1.13   0.257     -.021074    .0056333
       yr_15 |  (omitted)
       _cons |   .1105626   .3044989     0.36   0.717    -.4862443    .7073696
-------------+----------------------------------------------------------------
lmbbusers    |
     lnrural |    205.752   36.81618     5.59   0.000     133.5937    277.9104
   lmobusers |  -.2876481   2.192606    -0.13   0.896    -4.585077    4.009781
      lgdpc1 |   69.46864   5.917436    11.74   0.000     57.87068     81.0666
    lmbbcost |   2.378411   4.211616     0.56   0.572    -5.876205    10.63303
      hhi_mb |   -1.66111   .3526017    -4.71   0.000    -2.352196   -.9700229
       _cons |  -1155.859   119.9516    -9.64   0.000     -1390.96   -920.7583
-------------+----------------------------------------------------------------
lrevenuembb  |
      lgdpc1 |   48.90461   11.55968     4.23   0.000     26.24805    71.56116
    lmbbcost |   15.48514   4.279883     3.62   0.000     7.096724    23.87356
      hhi_mb |   -2.86353   .7158797    -4.00   0.000    -4.266629   -1.460432
       _cons |  -403.1933   108.6826    -3.71   0.000    -616.2073   -190.1793
-------------+----------------------------------------------------------------
mbbgrowth    |
 lrevenuembb |  -.0820195   .0464399    -1.77   0.077      -.17304     .009001
       _cons |   1.714387   .7636923     2.24   0.025      .217578    3.211197
------------------------------------------------------------------------------
Endogenous variables:  lgdp1 lmbbusers lrevenuembb mbbgrowth
Exogenous variables:   lfcapital_3 llabedu_1 lnoil primavera2 yr_10 yr_11
     yr_12 yr_13 yr_14 yr_15 lnrural lmobusers lgdpc1 lmbbcost hhi_mb
------------------------------------------------------------------------------
```

Appendix 3

Econometric model measuring the contribution of fixed broadband to Jordanian economic growth

Fonction de production agrégée :

$GDPit=a_1K_{it}+a_2L_{it}+a_3Fix\_Bob\_Pen_{it}+a_4OilPrice_{it}+a_5Shock_{it}+e_{it}$

Fonction de demande :

$Fix\_Bob\_Pen_{it}=b_1Rural_{it}+b_2Fixed\_Tel\_Pen_{it}+b_3FBB\_Price_{it}+b_4GDPC_{it}+b_5HHI\_FBB_{it}+e_{it}$

Fonction d'offre :

$FBB\_Rev_{it}=c_1FBB\_Pr_{it}+c_2GDPC_{it}+c_3HHI\_FBB_{it}+\square_{3it}$

Fonction d'infrastructure :

$Variation\ in\ FBB\_Pen_{it}= d_1FBB\_Rev_{it}+\square_{3it}$

```
. reg3 (lgdp1 lfcapital_3 llabedu_1 lfbbusers lnoil primavera2 yr_11-yr_15 ) (lfbbusers lnrural lnfix
> ed lgdpc1  lfbbcost hhi_fbb)    (lreveruefbb    lgdpc1 lfbbcost hhi_fbb)    (fbbgrowth lreveruefbb)
>     if yr>2010 | (yr>2009 & qt>3)

Three-stage least-squares regression
```

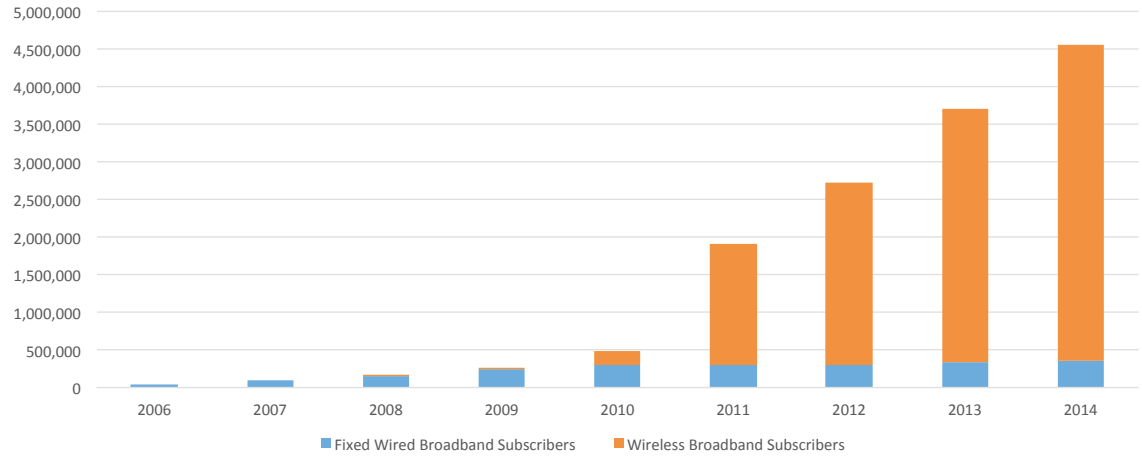
Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lgdp1	17	9	.0005318	1.0000	556576.43	0.0000
lfbbusers	17	5	.0122656	0.7766	263522.64	0.0000
lreveruefbb	17	3	.0282128	0.9341	251.01	0.0000
fbbgrowth	17	1	.0129676	0.0305	0.85	0.3570

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lgdp1						
lfcapital_3	.5922792	.0046451	127.51	0.000	.583175	.6013834
llabedu_1	-.0225151	.0112689	-2.00	0.046	-.0446017	-.0004285
lfbbusers	.0726106	.0130345	5.57	0.000	.0470635	.0981577
lnoil	.0059123	.0015517	3.81	0.000	.0028711	.0089535
primavera2	-.0000499	.0005943	-0.08	0.933	-.0012148	.0011149
yr_11	.0008911	.0007174	1.24	0.214	-.000515	.0022973
yr_12	(omitted)					
yr_13	-.0006354	.0006766	-0.94	0.348	-.0019614	.0006906
yr_14	.000094	.0010572	0.09	0.929	-.0019781	.0021661
yr_15	-.001171	.0013451	-0.87	0.384	-.0038073	.0014654
_cons	-1.138769	.0443004	-25.71	0.000	-1.225596	-1.051941
lfbbusers						
lnrural	-.7366837	.545923	-1.35	0.177	-1.806673	.3333058
lnfixed	.0254023	.0963031	0.26	0.792	-.1633483	.2141528
lgdpc1	.4204917	.1160644	3.62	0.000	.1930096	.6479738
lfbbcost	.2887615	.0888454	3.25	0.001	.1146277	.4628953
hhi_fbb	-.1113558	.0914274	-1.22	0.223	-.2905501	.0678385
_cons	(omitted)					
lreveruefbb						
lgdpc1	.5977948	.4081689	1.46	0.143	-.2022015	1.397791
lfbbcost	1.270386	.2257215	5.63	0.000	.8279801	1.712792
hhi_fbb	-.1733384	.2098562	-0.83	0.409	-.584649	.2379722
_cons	9.387208	5.665109	1.66	0.098	-1.716202	20.49062
fbbgrowth						
lreveruefbb	.0262383	.0284863	0.92	0.357	-.0295938	.0820704
_cons	-.4365963	.4789858	-0.91	0.362	-1.375391	.5021986

```
Endogenous variables:  lgdp1 lfbbusers lreveruefbb fbbgrowth
Exogenous variables:   lfcapital_3 llabedu_1 lnoil primavera2 yr_11 yr_12
     yr_13 yr_14 yr_15 lnrural lnfixed lgdpc1 lfbbcost hhi_fbb
```

Appendix 4

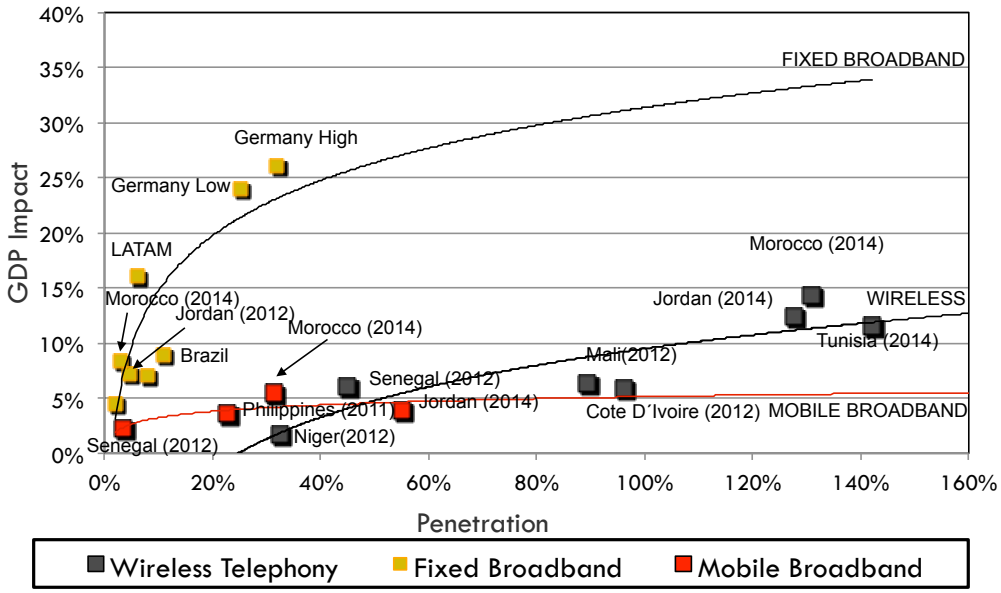
Jordan: Penetration of fixed and mobile broadband (2006-2014)



Sources: ITU World Telecommunication/ICT Indicators 2015; GSMA Intelligence (2015)

Appendix 5

Comparative impact of telecommunications on GDP growth



Source: TAS analysis

The chart in appendix 5 depicts three types of relationships between technology penetration and impact on GDP growth. By combining the study results on AMEA with those of prior studies conducted by the authors, the strength of the economic impact appears to be different. First, while all three technologies (fixed broadband, wireless broadband and broadband) exercise an increasing impact on GDP growth with higher penetration, the three of them show a diminishing return effect. In other words, at a certain point of adoption of each technology, the economic impact appears to diminish (a point of diminishing returns). Second, the strength of economic impact appears to vary by technology. The highest impact appears to be

linked to fixed broadband (e.g. stronger GDP growth linked to comparable penetration). However, considering that in emerging countries, mobile broadband is a substitute of fixed technology, one could assume that the economic boost related to the former might start looking more as the latter.

Appendix 6