



The economic impact of mobile services in Latin America

A report for the GSMA, GSM Latin America and AHCIET

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Executive summary

I Objective of the Report

As usage of mobile services in Latin America has grown rapidly over the past five years, there have been calls to impose more regulations and taxes on the industry.

To demonstrate to policy makers the value of mobile services, the GSMA, GSM Latin America and AHCET commissioned Ovum and Indepen to produce an objective assessment of the economic impact which the mobile industry has had on Latin America over the past five years and the likely impact it will have over the next five years.

The objective of the study is to give government policy makers and telecommunications regulators the information they need to ensure that mobile services provide the maximum economic benefit going forward.

II The economic impact of mobile services

Over the past few years cellular mobile services have had a major impact on the economies of Latin America¹.

Figure S1 shows the main effects:

- investment in mobile services leads to take up of services, which in turn leads to further investment as demand outstrips supply. Take up of mobile services also generates free cash flow. Part of this is then reinvested in expanding the mobile networks
- the mobile industry itself generates substantial economic benefits, in terms of its contribution to GDP, generation of employment, and generation of government revenues through payment of various taxes
- use of mobile services also leads to productivity gains for the businesses whose staff are cellular mobile users
- the growth of the mobile industry has led to increases in the flow of foreign direct investment (FDI) into Latin America
- the combination of these effects has boosted GDP growth in Latin America

We describe each of these effects below.

¹ In this executive summary we use the term Latin America to stand for 6 countries in the region – Brazil, Chile, Colombia, Mexico, Peru and Venezuela. Together they make up 83% of the total mobile market in Latin America

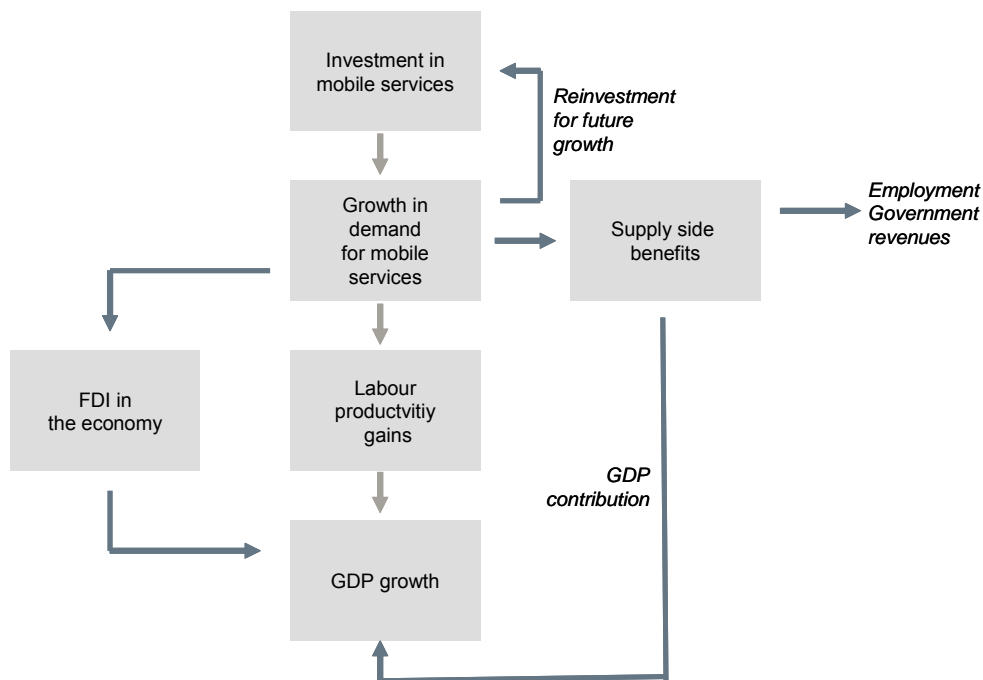


Figure S1 The economic impacts of mobile services

III Investment in mobile services in Latin America

The mobile operators of Latin America have:

- invested nearly \$16 billion between 2002 and 2004
- invested significantly more in their networks than mobile operators in other regions of the world. Over the past five years they invested 28% of revenues compared to 13 to 18% in the EU or US
- invested significantly more, as a % of revenue, than the fixed operators of the region. In other parts of the world the investment levels are about the same
- invest 2.5% of total capital investment in the region, more than twice the amount they generate in terms of end user revenues (1.14% of GDP)

This analysis indicates that the mobile industry in Latin America invests a much greater proportion of the revenues which it generates than other industries. Given that this investment goes into infrastructure, which helps makes the rest of the economy more efficient, it is important that governments and regulatory authorities ensure that there are strong incentives for investment in future mobile infrastructure if they wish to maximise economic growth.

Despite this investment, mobile take up in Latin America is below what we would expect for countries with similar GDP per head. We can only speculate on the reasons for this poor performance. It may reflect any one of a number of factors which include political instability, the application of industry specific taxes, import duties on network equipment and/or terminals, inappropriate interconnect arrangements, the level of licence and spectrum fees or the mix of technologies used.



IV The economic contribution of the mobile industry

The mobile industry in Latin America makes a significant contribution to the region's GDP, employment and Government revenues. For example we estimate that:

- the industry generates €16.9 billion each year in value add, just under half of which is retained in the region
- the industry generates €8.6 billion each year in Government revenues from:
 - VAT on services and terminals
 - corporation tax on mobile operators
 - import duties
 - income tax and social security payments generated by mobile dependent employment
- 2.3 million jobs are dependent, directly or indirectly, on the industry

V Productivity gains from using mobile services

Latin America badly needs improved productivity. Over the past 5 years labour productivity in the region has actually fallen by 0.5% per year. But we estimate that it would have fallen faster without the growth in use of mobile services.

Information and Communications technologies (ICT) are now a major source of economic growth. In the US for example effective use of ICT now accounts for 80% of labour productivity growth. And mobile services are an important component in that growth.

Use of mobile phones for **voice applications**:

- reduces unproductive travelling time. It enables field engineers and sales staff to use otherwise unproductive travel time in talking to customers, colleagues and suppliers
- significantly improve logistics. Companies can contact their field staff and so schedule visits more efficiently
- enables faster and more efficient decision making. For example staff within a company can contact each other from any location to hold a teleconference and reach an important decision.
- empowers small businesses and provide increased flexibility to farmers, plumbers, and builders who spend a high proportion of their time away from their home base²
- substantially improves the social and economic conditions of people living in rural areas

Latin American businesses are also just starting to improve productivity through use of **mobile data** services – following the lead of the US and the EU where firms are using mobile data services to:

- improved customer service
- make faster and better decisions
- improve the efficiency of workflow
- use resources better.

It is difficult to quantify the economic benefits from these gains in productivity. One way is to estimate the **consumer surplus** generated by the use of mobile services, which represents a

² J. Donner. "The mobile's behaviours of Kigali's microentrepreneurs: whom they call...and why." Paper presented at "The global and the Local in Mobile Communication." Budapest, Hungary, June 2004. <http://www.jonathandonner.com/>



measure of how much value users give to these services. Put simply, consumer surplus measures:

- the price which users are prepared to pay, on average, for cellular service **less**
- the price which they actually pay **multiplied by**
- the number of subscribers.

We estimate that the mobile services of the six study countries of Latin America generated a consumer surplus of around \$30 billion in 2004.

VI Impact of mobile take up on FDI

Foreign direct investment (FDI) involves foreign companies, often trans-national corporations, investing in companies in other countries. Such investment is important to Latin American countries because it leads to:

- additional investment
- additional formal employment
- skills and know-how transfer
- additional sources of government revenues in terms of revenues from income taxes, corporation tax, social security payments and VAT
- better local services.

The average telecommunications industry contribution to FDI in the region is more than 20%.

Mobile services play a very significant role in generating these flows, in two ways:

- **directly.** We have seen substantial FDI in mobile services in Latin America over the past five years. This has led to a substantial increase in the overall volume of FDI
- **indirectly.** The level of FDI in middle income countries like those of Latin America is positively correlated with take up of mobile services at a statistically significant level. In other words foreign companies are more likely to make FDI in countries with high mobile penetration than in countries with low mobile penetration.

VII The impact of mobile take up on GDP growth

In combination the supply side affects, the economic benefits from the use of mobile services and the FDI effects all act to boost GDP as mobile take up increases. But what is the nature of this relationship?

To answer this question we undertook econometric analysis to assess whether the level of mobile penetration effects GDP growth using panel data from 92 countries. We found that:

- mobile penetration levels are statistically important determinants of GDP growth
- in middle income countries, such as those of Latin America, increasing mobile penetration by 10% boosts GDP growth by 0.3% per year. This is a very significant increase in countries where overall national GDP is growing at only 1.5% per year.



VIII Future economic benefits

Mobile services in Latin America have generated substantial economic benefits for the region over the past 5 years. But all the evidence suggests that they will generate comparable additional benefits over the next five. Based on current trends we expect that:

- the contribution to GDP from the mobile industry, currently around €8 billion per annum, will nearly double
- the contribution to employment, currently 2.3 million jobs in the six study countries, will increase substantially. We do not expect the number of jobs to double because of productivity effects. But it is reasonable to assume that the industry will generate a further one million jobs or more by 2009.
- the contribution to government tax revenues made by the mobile industry will nearly double from its current €8.6 billion per annum
- the productivity gains from use of cellular mobile services will grow substantially over the next 5 years as more businesses use mobile phones for more applications. In particular we expect the use of mobile data services to substantially increase business productivity in Latin America, as it is already doing in the US and EU
- consumer surplus from use of mobile services will continue to grow as the volume of traffic increases and prices continue to fall. Extrapolating from current trends for these two variables, we expect the annual consumer surplus in the six study countries to double from €30 billion in 2004 to €60 billion in 2009.

IX Policy implications

The economic rewards of greater mobile take up are substantial. This raises the question of what policy makers and telecommunications regulators can do to maximise take up. Based on our work for governments, regulators and operators in other parts of the world we suggest the following.

Proposal 1: Create the right climate for investment by the mobile industry. To create the right investment climate policy makers might:

- forbear from regulating retail and/or interconnect prices for mobile services and leave price setting to competition
- maximise regulatory certainty so that mobile operators can invest - knowing that the rules within which they operate will not change, except for very good reason
- lift restrictions on the repatriation of profits to foreign direct investors

Proposal 2: Maximise regulatory certainty so as to maximise investment. Regulators must be able to respond to unforeseen but major changes in circumstances which invalidate current regulation. But they can improve regulatory certainty. For example they can:

- ensure that the regulator is independent – both of government and of any major telecommunications operators in the country
- establish principles which will guide all regulatory decisions (as Ofcom in the UK did recently)
- provide transparent decision making in which the regulator consults on all major decisions and provides explicit justification for decisions in which they demonstrate they have followed their guiding principles



- commit in advance to lifting regulation when certain conditions are met
- establish a mechanism whereby an operator can appeal against a national regulatory authority (NRA) decision on grounds of either merit³ or procedure⁴
- carry out regulatory impact assessments to check that the benefits of any regulatory measure outweigh the costs before implementing it
- forbear from ex-ante regulation if there is any uncertainty as to whether the benefits outweigh the costs.

Proposal 3: Do not raise the costs of the mobile operators unnecessarily. It is important to keep the unit costs of the mobile operators to a minimum. This keeps prices low, increases take up, and hence improves economic performance generally. So governments and regulatory authorities should:

- refrain from imposing industry specific taxes on the mobile industry.
- fund universal services programmes out of general taxation rather than out of a taxation on the telecommunications industry
- streamline procedures for authorisation of new cellular masts. A public disputes settlement body at a national level could help speed up authorisations whilst addressing public concerns on existing ones.

Proposal 4: Focus policy on maximising penetration. Mobile services are now reaching parts of the population previously unserved by telecommunications and penetration is reaching a critical mass where a given increase in penetration produce the greatest economic effects. If the NRA forces the mobile termination rates to long run incremental costs plus a mark up, then this has a number of consequences which might not be compatible with a government policy of maximising penetration. Such regulation of mobile termination rates could lead to higher handset prices, higher retail mobile prices and mobile services which are less affordable to the marginal customer, thus slowing mobile take up.

Proposal 5: Promote infrastructure based competition. It is clear that infrastructure based competition is superior where it is viable. It is also clear that infrastructure based competition in the mobile sector is functioning well in Latin America, with three to four operators in each country, extensive price and product innovation and steady price reductions. It is important to preserve this competition. In particular it is important not to undermine it through mandating MVNO (mobile virtual network operator) access, whereby a service provider can buy airtime from one or more of the mobile operators at a regulated price. Instead we suggest that mobile operators and MVNOs should negotiate deals.

Proposal 6: Consider whether to develop an industry to supply components to the mobile terminal or network equipment industry. Over 50% of the value add generated by the mobile services industry in Latin America flows to companies located outside the region. The bulk of this exported value add goes to terminal and network equipment suppliers. The governments of Latin America need to consider whether it is useful to take action to keep some of the exported value add within the region by establishing local industries to supply equipment components used at the upstream end of the value chain.

³ e.g. because the overall costs exceed the benefits

⁴ e.g. lack of transparency



1 Introduction

1.1 The Need for the Study

The economic, commercial and social importance of cellular mobile services in Latin America has grown rapidly over the last five years. At the same time, calls to regulate and tax the mobile industry are also growing significantly. This means there is now a need to demonstrate to policy makers the value of mobile services so that they can give these services proper weight when reaching decisions which affect the future of the mobile industry.

With this problem in mind, GSMA, GSM Latin America and AHCJET commissioned Ovum and Indepen to produce an independent, evidence based, assessment of the economic impact which the cellular mobile industry has had on Latin America over the past five years and the likely impact it will have over the next five. The objective of the study is to inform government policy makers and telecommunications regulators so that they can take appropriate action to maximise the future economic gains.

1.2 The Scope of the Study

The study sets out to assess the validity of the model shown in Figure 1.1.

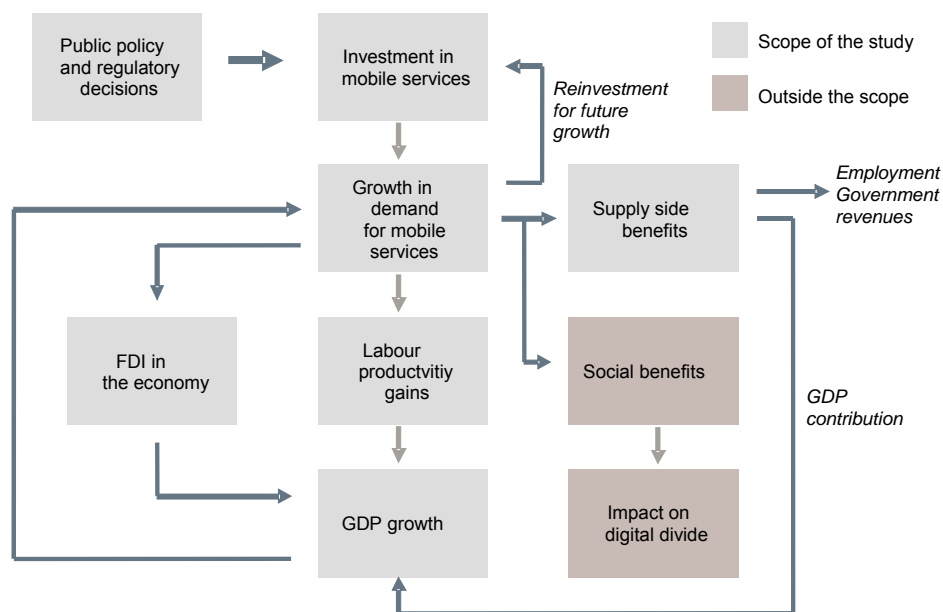


Figure 1.1 The economic impacts of mobile services

The assessment of the **social** effects of mobile services in Latin America and their role in preventing or reducing the digital divide are outside the scope of this study.

According to this model:

- investment in mobile services leads to take up of services, which in turn leads to further investment as demand outstrips supply. Take up of mobile services also generates free cash flow. Part of this is then reinvested in expanding the mobile networks. We look at the pattern of take up and investment in Chapter 2



- the mobile industry itself generates substantial economic benefits, in terms of its contribution to GDP, generation of employment, and generation of government revenues through payment of various taxes. We quantify these supply side effects in Chapter 3
- use of mobile services also leads to productivity gains for the businesses whose staff are cellular mobile users. We provide case studies on such productivity gains and quantify one measure of them, the consumer surplus, in Chapter 4
- the growth of the mobile industry has led to increases in the flow of foreign direct investment (FDI) into Latin America. We discuss this effect in Chapter 5
- the combination of these effects has boosted GDP growth in Latin America. We present econometric analysis which quantifies this relationship in Chapter 6.
- this in turn leads to greater demand for mobile services and a virtuous circle of endogenous growth is created (as shown for example in Figure 2.3)

Based on the analysis in these chapters we conclude that the model of Figure 1.1 is a valid one.

Chapters 2 to 6 look at the economic impact of mobile services so far. But governments and regulators are just as interested in future economic impacts when making policy decisions. So, in Chapter 7, we look at likely future economic benefits from mobile services in Latin America.

Finally in Chapter 8 we provide a set of proposals as to how policy makers might act to maximise future economic benefits from mobile services. These proposals are based on our experience in advising governments, regulators, and mobile operators in other parts of the world through similar studies.

To keep data collection and analysis as simple as possible this study focuses on six countries in Latin America – Brazil, Chile, Columbia, Mexico, Peru and Venezuela. In combination these countries account for over 80% of mobile subscribers in Latin America and, as far as we can tell, are typical of the region as a whole in terms of economic impacts of mobile services.



2 Current levels of use and investment

2.1 Take up of mobile services

Take up of mobile services in the six study countries of Latin America has increased steadily in the past five years as shown in Figure 2.1. The total number of subscribers has grown more than four fold - from 31 million at the end of 1999 to 135 million at the end of 2004.

Figure 2.1 also shows take up in the remaining countries of Latin America. We can see that the pattern of growth in the study countries is representative of Latin America as a whole.

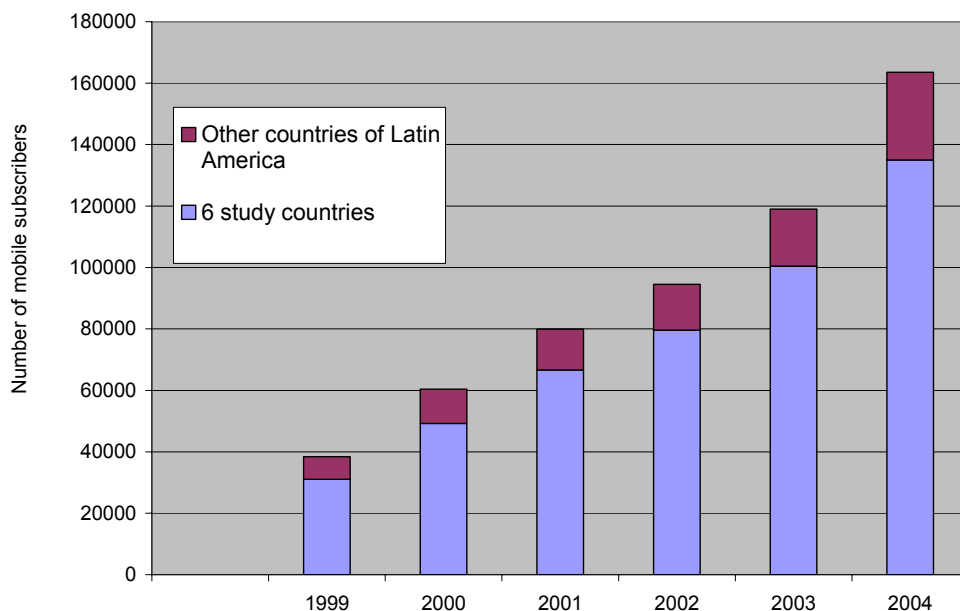


Figure 2.1 Take up of mobile services in the six study countries (thousands)

At an average of 34%, the penetration of mobile services in the study countries is now more than double that of fixed services, at 16%. This gap is widening. The number of mobile subscribers is growing at 39% per annum whilst the number of fixed lines was growing at 1.7% per annum in 2003. Figure 2.2 illustrates.

This difference in penetration and growth rates between fixed and mobile services has significant economic and policy implications. Mobile telephony now provides the only method of telecommunications for a significant proportion of Latin American citizens. So the continued spread of mobile services is more important to support economic development in Latin America than in the EU or US. In the latter case the fixed network reaches into virtually every home and business and provides an **alternative** means of telecommunications in most circumstances. But in Latin America mobile services often provide the **only** means of telecommunications.



Country	Penetration		Growth rate	
	fixed (1)	mobile (2)	fixed (1)	mobile (2)
Brazil	22%	36%	0%	42%
Chile	22%	60%	-4%	29%
Colombia	18%	26%	0%	73%
Mexico	16%	36%	8%	27%
Peru	7%	14%	8%	41%
Venezuela	11%	32%	-2%	23%
Average (simple)	16%	34%	1.7%	39%

(1) At end of 2003 from ITU

(2) At end of 2004 from Merrill Lynch

Figure 2.2 The relative take up of fixed and mobile services in the study countries

2.2 The Performance of the Mobile Industry so far

2.2.1 Mobile take up

So far the mobile industry in the study countries has not done especially well in maximising take up. This is illustrated in Figure 2.3 which plots mobile penetration against GDP per head for all countries of the world with a population of over ten million people. This plot includes Argentina, Ecuador and Guatemala – Latin American countries not in the study but with populations in excess of 10 million. These are marked on Figure 2.3 with a small triangle.

We can only speculate on the reasons for this poor performance. It may reflect any one of a number of factors which include political instability, the application of industry specific taxes, import duties on network equipment and/or terminals, inappropriate interconnect arrangements, the level of licence and spectrum fees or the mix of technologies used. It is beyond the scope of this study to determine the cause. But, as we show in Chapters 3 to 6, the economic benefits which would be generated if take up performance could be improved are substantial.

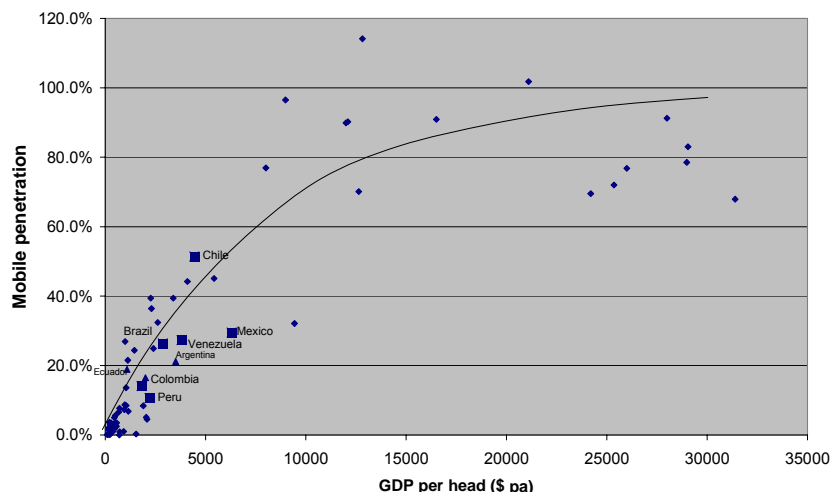


Figure 2.3 Mobile penetration vs. GDP per head⁵

⁵ From ITU data for end 2003



Other performance factors

Figure 2.4 makes further comparisons between the mobile industry in the six study countries of Latin America and that in other regions of the world. For simplicity of analysis we have chosen for comparison:

- the four biggest countries in the EU (the EU 4)
- the three biggest countries in Eastern Europe (excluding Russia).

When we examine Figure 2.4 a number of important points emerge.

First the six study countries of Latin America lag behind the other selected world regions in both fixed line and mobile subscriber penetration. This lag is mostly explained by the lower GDP per head in Latin America. But, as Figure 2.3 shows, income levels do not entirely explain the differences.

Secondly a high proportion of subscribers in Latin America use pre-pay. At 83% the proportion of pre-pay is comparable with Eastern Europe, but higher than in the EU. Only in Africa and some Asia Pacific countries are pre-pay levels higher - reaching in excess of 90% in many countries of these regions.

<i>Item</i>	<i>Latin America</i>	<i>EU 4⁷</i>	<i>Eastern Europe⁸</i>
GDP per head (\$ pa) – 2003	3571	25600	7470
Fixed line penetration – 2003	16%	57%	34%
Mobile subscriber penetration – end 2004	34%	95%	84%
% of mobile subscribers prepay	83%	64%	78%
Mobile operators' EBITDA %	28%	40%	43%
Unadjusted mobile revenue per minute – in and out (US cents)	17	25	22
Estimated average retail price per minute (US cents) ⁹	16	21	20
Mobile minutes (in and out) per subscriber per month	92	139	91
Mobile minutes (in and out) per capita per month	31	132	76
% of subscribers served by GSM	28%	100%	100%

Figure 2.4 Comparison – Latin America vs. other world regions

Thirdly the mobile operators of the six study countries are not especially profitable. At 28% the average EBITDA¹⁰ margin on revenues is lower than in the other selected regions. As a result operating profits are low. For example we estimate, from its US SEC 20-K filing, that

⁶ 2004 unless otherwise stated. Based on ITU yearbook of statistics and Merrill Lynch report "Global Wireless Matrix 1Q05", June 2005

⁷ France, Germany, Italy and UK

⁸ Czech Republic, Hungary and Poland

⁹ Assumes that MTR = retail price, prices adjusted to remove SMS revenues; revenue per minute reduced 20% for EU4, 10% for Eastern Europe; 5% for Latin America and 0% for US

¹⁰ Earnings before Interest, Tax, Depreciation and Amortisation



Telefonica, one of the main operators in the Latin American region, made an 8% operating loss¹¹ on its Latin America operations in 2004.

Fourthly, of the three regions, the EU and Eastern Europe use pure GSM technology for mainstream digital services, whilst operators in Latin America use a mix of different technologies which include GSM, TDMA and CDMA.

Finally outbound minutes of use per subscriber are lower in Latin American than in the EU but comparable with traffic levels in Eastern Europe. A more useful measure of the overall contribution of mobile services to economic development is provided by the number of minutes of use per month per **head of population** (rather than per **subscriber**). This parameter combines the effects of mobile penetration and levels of use per subscriber and measures the relative extent to which mobile services are used for economic and social purposes within each region. On this measure the Latin American region is a long way behind the two other regions selected for comparison - with 31 minutes of use per month per capita compared with 76 for Eastern Europe and 132 for the EU4. This comparison indicates that Latin American economies still have a long way to go before they use mobile services fully to support economic activity.

2.3 Investments in Mobile Services

Data on the level of investment in mobile services in Latin America is scarce. Figure 2.5 and 2.6 present the available data and sources. Figure 2.5 presents estimates of the level of investment at outturn prices and Figure 2.6 presents investment as a proportion of mobile revenues.

	2000	2001	2002	2003	2004
Brazil	2091	2490	1123	1917	3632
Chile	445	290	214	176	241
Colombia	na	na	112	500	331
Mexico	1845	1661	1043	957	1405
Peru	na	na	141	102	109
Venezuela	na	na	386	212	369
Total - 6 study countries	na	na	3019	3864	6087
Total - Latin America (2)			3637	4656	7334
By five biggest operating companies (1)			2397	3358	4766

(1) TIM, Telefonica, America Movil, Portugal Telecom and Bell South in 6 countries combined

(2) Grossing up investment pro rata to subscriber numbers

Figure 2.5 Investment in mobile services in Latin America (\$m)

Sources: ITU, NRAs and annual reports

¹¹ Earnings before interest and tax or EBITDA less depreciation and amortisation



	2000	2001	2002	2003	2004
Brazil	28%	38%	17%	24%	41%
Chile	69%	35%	22%	16%	18%
Colombia	na	na	18%	63%	26%
Mexico	72%	36%	18%	15%	18%
Peru	na	na	30%	21%	19%
Venezuela	na	na	21%	13%	15%
Weighted average	41%	37%	21%	25%	23%
Weighted average over 5 years		28%			
Telefonica in Latin America				22%	28%
America Movil			19%	16%	18%
TIM in Latin America				28%	33%

Figure 2.6 Investment in mobile services as a percentage of revenues

Sources: ITU, NRAs and annual reports of TIM, Telefonica and America Movil

We can see that:

- capital expenditure varies significantly – both year by year and country by country
- overall Latin American mobile operators have invested around 28% of revenues¹² in capital expenditure over the past 5 years.

By any standard this is a substantial level of investment. In other regions of the world mobile operators typically invest 13% to 18% of revenues in growing their network and supplying new services to customers. This is shown in Figure 2.7.

<i>Region and year</i>	<i>Investment in mobile as a % of revenues</i>	<i>Source</i>
Latin America – 2000 to 2004	28%	See Figure 2.6
Telefonica companies in Latin America – 2004	28%	See Figure 2.6
TIM in Latin America – 2004	33%	See Figure 2.6
America Movil in Latin America – 2004	18%	See Figure 2.6
EU15 - 2004	13%	Morgan Stanley Research note – April 2005
USA – 2004	18%	Morgan Stanley Research note – April 2005
Japan – 2004	15%	Morgan Stanley Research note – April 2005

Figure 2.7 Investment in mobile services – Latin America vs. other regions

The level of investment by mobile operators in Latin America is higher than that by fixed operators. This contrasts with investment by fixed and mobile operators in other parts of the world, where investment as a proportion of revenues is more nearly the same for fixed and mobile operators. Figure 2.8 illustrates.

¹² Averaging over the estimates of Figure 2.6



Region and year	Capex as % of revenues	
	Fixed services	Mobile services
Latin America – 2004	15%	23%
EU15 – 2004	14%	13%
Japan – 2004	19%	15%
USA – 2004	14%	18%

Figure 2.8 Investment in telecommunications – mobile vs. fixed services

Source Morgan Stanley Research note – April 2005 and Figure 2.6

Investment in mobile services also represents a substantially higher proportion of total investment in Latin America than end-user spend on mobile services does as a proportion of GDP:

- end-user spend on mobile services represents 1.14% of GDP¹³
- mobile investment represents 2.5% of total investment by all industries in the six study countries¹⁴. Figure 2.9 shows how this proportion varies across the six study countries.

So, while mobile services in Latin America contribute just over 1% of GDP, they generate 2.5% of the investment in the region.

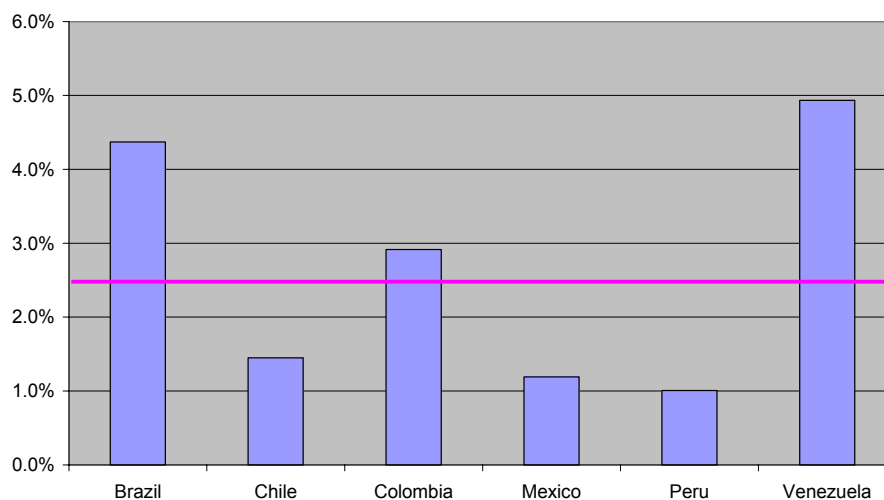


Figure 2.9 Mobile investment as a % of total investment in each of the six study countries

Source: Figure 2.5 plus World Bank statistics on gross capital formation

The analysis set out above indicates that the mobile industry in Latin America invests a much greater proportion of the revenues which it generates than other industries. Given that this investment goes into infrastructure, which helps makes the rest of the economy more efficient, it

¹³ €15.3 billion or \$18.5 billion in 2004 as set out in Section 3.3.

¹⁴ \$6407 million of capital expenditure in 2004, assuming 95% of total mobile investment is capital expenditure



is important that governments and regulatory authorities ensure that there are strong incentives for investment in future mobile infrastructure if they wish to maximise economic growth.

Anecdotal and statistical evidence suggests that the overwhelming proportion of this investment comes from private rather than public funds (or from the retained profits of Government owned operators). For example:

- in Peru the Government invested \$12 million in telecommunications in 2003 and a further \$7 million in 2004. But this represents less than 3% of telecommunication's investment in those years
- in Colombia nearly 50% of infrastructure investment in telecommunications is made by public companies¹⁵. But this reflects the fact that the main fixed line operator is government owned.

There is also a strong trend within the private sector to invest in mobile rather than fixed line communications. In the period from 2001 to 2003 over 30% of telecommunications investment went into mobile services.

¹⁵ Nevertheless, mobile operators are partially funding public fixed line operators' network deployment by contributing to universal service funds



3 Supply side effects

3.1 Introduction

In this chapter we quantify the supply side economic impacts of the mobile industry in the six study countries. We use a model developed for Vodafone and later extended for the GSM Association that has already been applied successfully in Germany, the UK, India, Ireland and the EU as a whole. Figure 3.1 shows the overall structure of the model:

- **Step 1:** we start by quantifying the value chain for the industry - from the purchase of services and terminals by end users through to the creation of the components which go into making the network equipment used to supply these services
- **Step 2:** we then consider how the value added¹⁶ at each step in the chain is distributed geographically between the countries of Latin America and the rest of the world
- **Step 3:** we then use our findings to estimate the GDP, employment and government revenues generated by the mobile services industry.
-

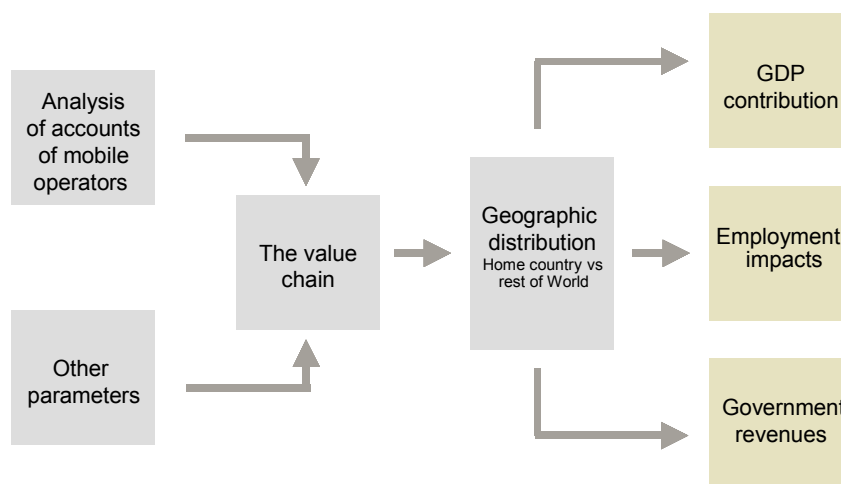


Figure 3.1 Ovum's model for estimating supply side effects

In this chapter we present the findings from the model. We specify the sources of our estimates and the assumptions made in Annexes A and B.

¹⁶ We use the terms **value add** and **GDP contribution** interchangeably since they are both terms for labelling the contribution to overall GDP which a firm makes. We define value added for a firm as EBIT **less** capital expenditure **plus** staff costs **plus** depreciation



3.2 The value chain

Figure 3.2 presents our quantification of the value chain in the six study countries. The amounts along side the arrows show the flow of revenues between players while the amounts in boxes are estimates of the value add retained by each type of player.

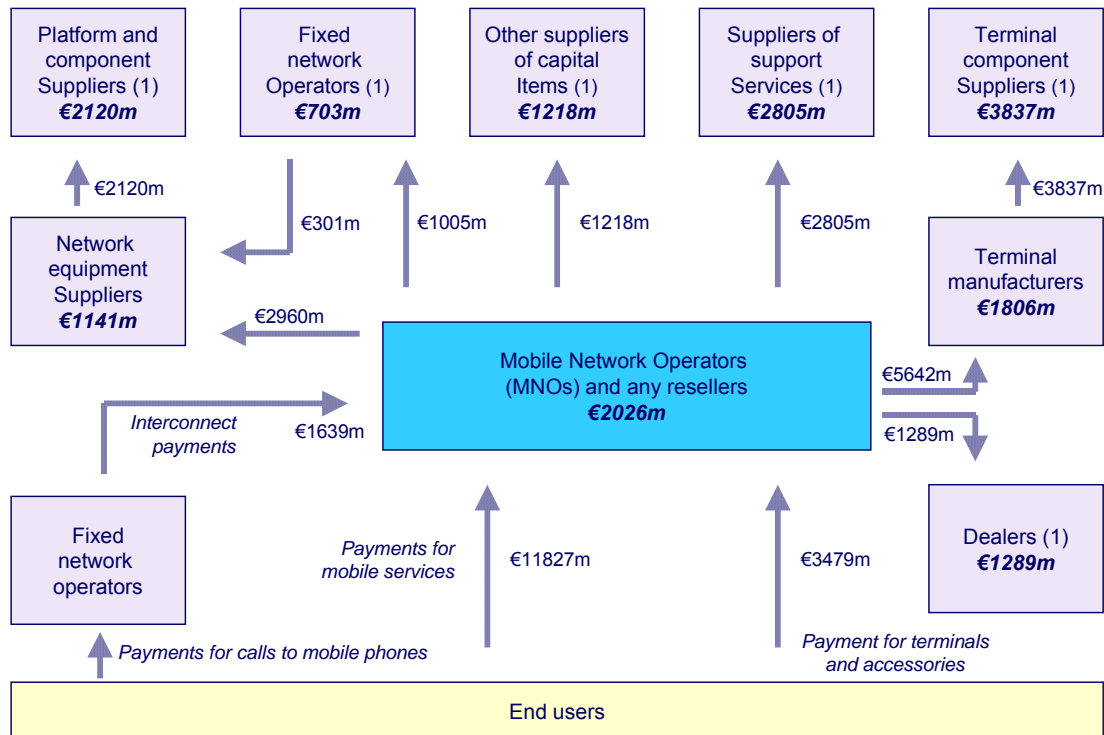


Figure 3.2 The value chain for wireless services in the six study countries of Latin America

(1) And their upstream suppliers (excluding mobile operators)

From an examination of Figure 3.2 we can see that, during 2004:

- end-users in the 6 study countries spent €11.8 billion on mobile cellular services¹⁷.
- the mobile operators also received €3.5 billion in end-user payments for terminals and €1.6 billion in payments from fixed network operators for terminating fixed to mobile calls
- end-users bought a substantial proportion of their mobile services from dealers rather from the carriers' own direct sales channels. But these end-user payments are booked by the mobile operators rather than by the dealers. The dealers receive commission on each sale. These commissions, which we estimate at €1.3 billion, formed the bulk of dealer revenues in 2004. So the dealers and their upstream suppliers¹⁸ generated a value add of €1.3 billion in 2004

¹⁷ This includes contract, prepay, roaming and value added services

¹⁸ Excluding the mobile operators



- cellular terminal suppliers, such as Motorola, Nokia and Samsung received revenues of €5.6¹⁹ billion from the mobile operators. In turn the terminal suppliers paid component suppliers²⁰ €3.8 billion, generating a total value add of €1.8 billion
- the mobile operators made substantial capital investments – with payments of €3.0 billion to network equipment suppliers and €1.2 billion to other suppliers of capital equipment, such as for IT systems, cellular site acquisition and vehicles
- the mobile operators paid the wireline operators €1.0 billion for leased lines for their networks and to terminate calls on the fixed line networks
- finally the mobile operators paid a substantial proportion of their revenues to suppliers of support services. This category of supply includes advertising agencies and associated media, professional service firms, and outsourcing companies providing customers support and IT services. These suppliers, together with their own upstream suppliers generated a value add of €2.8 billion in 2004
- given all these payments and revenues the mobile operators generated a value add of €2.0 billion in 2004
- the network equipment suppliers received revenues of €3.0 billion from the mobile operators and a further €0.3 billion from the fixed line operators for the supply of the equipment used to provide mobile operators with their leased lines and call termination services. The network equipment suppliers then paid their own component suppliers €2.1 billion leaving them with a value add of €1.2 billion.

Annex A presents the sources and assumptions used in making these estimates.

3.3 GDP effects

In total the mobile industry in the six study countries generated €16.9 billion of end user revenues in 2004 in the six study countries. This is split as follows:

- end user payments for services of €11.8 billion
- payments for handsets and accessories of €3.5 billion. The bulk of these revenues go directly to the mobile operators (who then pay commissions to dealers)
- payments for fixed to mobile calls. A substantial proportion of this revenue flow, amounting to €1.6 billion, goes to the mobile operators as mobile call termination revenues.

Figure 3.3 shows how the value add from this revenue is distributed between the six study countries and the rest of the world and how it changes as we move along the value chain.²¹

¹⁹ This compares with terminal sales of €3.5 billion and shows that the mobile operators subsidised the sale of terminals to a significant degree

²⁰ Components such as chip sets, terminal casings, aerials, keyboards and displays

²¹ RoW = Rest of the World.

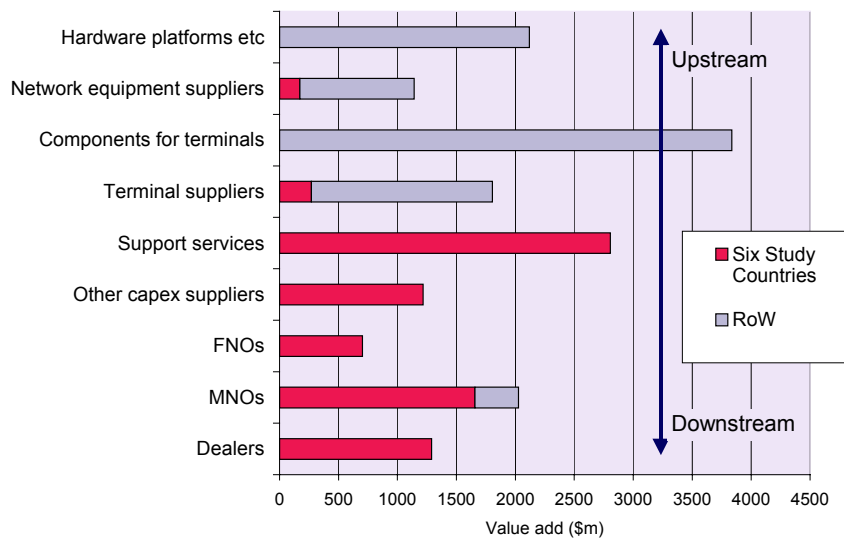


Figure 3.3 The GDP impact of the mobile services industry in the six study countries

Mobile services in the six study countries generate €16.9bn of end user revenues in 2004

Figure 3.4 then tabulates the same estimates while Annex B sets out the method and assumptions used to derive these findings.

Player	VA (€m)		Total
	Lat Am	RoW	
Dealers	1289	0	1289
MNOs	1658	369	2026
FNOs	703	0	703
Other capex suppliers	1218	0	1218
Support services	2805	0	2805
Terminal suppliers	271	1535	1806
Components for terminals	0	3837	3837
Network equipment suppliers	171	970	1141
Hardware platforms etc	0	2120	2120
Total	8115	8830	16945

Figure 3.4 Splitting the value add by category

We can see from Figures 3.3 and 3.4 that:

- the upstream end of the value chain, which involves the supply of network and terminal equipment, accounts for just over 50% of the total value add
- 95% of this value add flows to companies located outside the six study countries
- the downstream end of the value chain is dominated by the value add of the mobile operators and their support services suppliers. But at this end of the chain 95% of the value add is retained within the six study countries. The remaining 5% goes to the foreign owners of the main mobile operators in the region in the form of free cash flow
- of the value add retained in the region the mobile operators currently generate around €1.6 billion per annum while the rest of the chain generates €6.5 billion. In other words the mobile industry in the region currently generates 5 units of retained value add for every one generated by the mobile operators. As the profits of the mobile operators grow to



sustainable levels we expect this ratio to fall from 5:1 towards 2:1 - the current ratio in the EU

It is instructive to compare the value add distribution of Figure 3.3 with that of Figure 3.5 – which shows the equivalent distribution in the EU. We find that:

- EU mobile operators capture a much higher proportion of the value add than the Latin American mobile operators. This reflects the fact that the Latin American mobile operators enjoy much lower profits than their EU equivalents
- most of the EU value add which flows to the terminal and equipment suppliers is retained within the region. In comparison very little of this part of the value add generated by the Latin American industry is retained there. This is hardly surprising. The EU is home to global equipment suppliers like Nokia, Ericsson and Siemens. Latin America is not
- overall 48% of the end user spend on mobile services in Latin America is retained in the region. In the EU this proportion rises to over 80%.

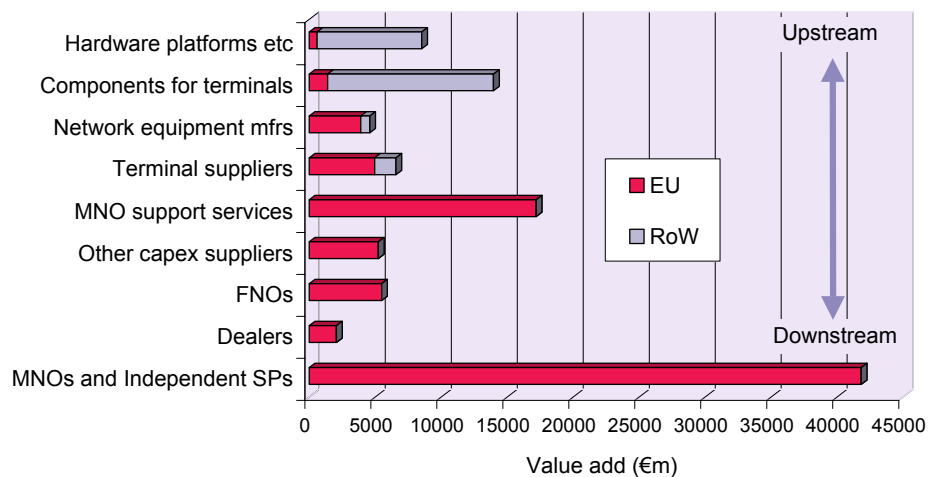


Figure 3.5 The GDP impact of the mobile services industry in the EU15²²

Source: *The economic contribution of mobile services in the EU before its 2004 expansion*, GSMA, January 2005

²² The EU before enlargement in 2004



3.4 Employment effects

Figure 3.6 shows our estimates of the employment in the six study countries generated by the mobile services industry.

<i>Employment from mobile services in the six study countries (000)</i>	<i>Direct</i>	<i>Support</i>	<i>Indirect</i>	<i>Total</i>
Dealers	109	82	82	273
Wireless carriers	38	98	20	155
Support services suppliers	0	475	119	594
Wireline carriers	69	60	30	158
Other capex suppliers	103	103	52	258
Terminal suppliers	4	26	6	36
Terminal component suppliers	0	0	0	0
Network equipment suppliers	3	16	4	23
Network equipment component suppliers	0	0	0	0
Total	326	860	311	1496

Figure 3.6 Employment in the six study countries generated by cellular mobile services

For each link in the value chain there are three main components:

- **326,000** jobs are generated by direct employment in the industry of which 38,000 are employed directly by the mobile operators
- the firms which provide support services to the industry employ a further **860,000** staff
- the industry generates a further **311,000** jobs indirectly. This is estimated on the assumption that Governments spend the taxes raised from the industry, and that owners and funders spend their returns from the industry in a way that generates further employment.

To make the estimates of Figure 3.6 we divide the value added by the Latin American industry by the appropriate labour rates. The process is shown in Figure 3.7.

Finally we need to take account of the multiplier effect which induces further employment. The 1,496,000 jobs which depend either directly or indirectly on the mobile services industry generate expenditure in the economy which, in turn, create other jobs. For example employees of cellular operators spend money on restaurants, holidays, food etc and generate additional jobs as a result. There are various estimates of this multiplier effect. For example:

- after a review of the literature, the Employment Policy Institute in the US assumed a multiplier of 1.5 when estimating these effects²³
- the Association Francaise des Operateurs Mobiles²⁴ assumes a multiplier of 1.7 when estimating this effect in a similar study
- the UK Office of National Statistics estimates a multiplier of 1.5 for telecommunications.

We take an average of these estimates and use a multiplier of 1.55. Using this multiplier increases the number of jobs dependent on the mobile services industry from **1,496,000** to **2,319,000**. The overall results of our calculations on employment are summarised in Figure 3.8.

²³ See Working paper on updated employment multipliers for the US economy, J Bevens, August 2003

²⁴ *La Filiere Mobile: quel impact sur l'economie Francaise?*, July 2003



VA area	VA (€m)	Split of VA	%	Wage costs (€k)	% in Lat Am	Employ Lat Am (000)
Dealers (12)	1289	Wage costs	40%	1 4.7 7	100%	9 109.2
		Other opex	30%	1 4.7 7	100%	9 81.9
		Other VA	30%	1 4.7 7	100%	9 81.9
Wireless carriers	2026	Wage costs	55%	3 29.2 7	100%	9 37.9
		Interest	23%	3 4.7 7	100%	10 97.6
		Other VA	23%	3 4.7 7	20%	10 19.5
Wireline carriers	703	Wage costs	40%	4 4.1 7	100%	9 68.6
		Other opex	40%	4 4.7 7	100%	9 59.6
		Other VA	20%	4 4.7 7	100%	9 29.8
Other capex (12)	1218	Wage costs	40%	5 4.7 7	100%	9 103.2
		Other opex	40%	5 4.7 7	100%	9 103.2
		Taxes, profit, interest	20%	5 4.7 7	100%	9 51.6
Support services (12)	2805	Wage costs	40%	5 4.7 7	100%	9 237.7
		Other opex	40%	5 4.7 7	100%	9 237.7
		Taxes, profit, interest	20%	5 4.7 7	100%	9 118.8
Terminal suppliers	1806	Wage costs	45%	6 29.2 8	15%	11 4.2
		Other opex	45%	6 4.7 7	15%	11 25.8
		Taxes, profit, interest	10%	6 4.7 7	15%	11 5.7
Components for terminals (12)	3837	Wage costs	45%	6 29.2 8	0%	11 0.0
		Other opex	45%	6 4.7 7	0%	11 0.0
		Taxes, profit, interest	10%	6 4.7 7	0%	11 0.0
Network equipment mfrs	1141	Wage costs	45%	6 29.2 8	15%	11 2.6
		Other opex	45%	6 4.7 7	15%	11 16.3
		Taxes, profit, interest	10%	6 4.7 7	15%	11 3.6
Hardware platforms etc (12)	2120	Wage costs	45%	6 29.2 8	0%	11 0.0
		Other opex	45%	6 4.7 7	0%	11 0.0
		Taxes, profit, interest	10%	6 4.7 7	0%	11 0.0
Total	16945					1496

1 From analysis of accounts of dealers

2 Assume split same as for dealers

3 From value chain analysis

4 Based on analysis of fixed operators in region

5 Assumed same as for fixed line operators

6 Based on accounts of Nokia, Motorola and Ericsson

7 From Government statistics and mobile operators

8 Assumed as for mobile operators employees

9 Assumed 100% local activity

10 Reflects high level of foreign ownership of MNOs

11 See text

12 And their upstream suppliers (other than wireless carriers)

Figure 3.7 Estimating employment from wireless services in Latin America

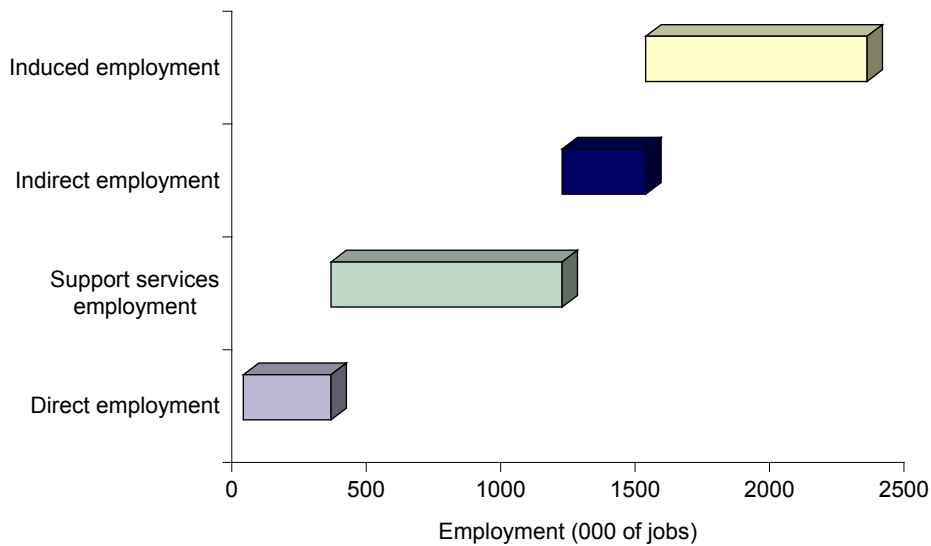


Figure 3.8 Latin American jobs dependent on its mobile services industry

The effects estimated above are very substantial. But they need to be interpreted with care:

- on the one hand they do not mean that, were the mobile services industry in the six study countries to disappear, that 2.3 million people would be permanently out of work. In this hypothetical event there would be severe economic disruption. But the economy would adjust in various ways and the long term impact on jobs would be relatively modest
- on the other hand they do not take account of the impact of mobile services on growth and innovation in Latin American economies. Nor do they take into account the many social and economic benefits that mobile services have the potential to provide through new services such as location-based services and high-speed data services.

3.5 Government Revenues from mobile services

The Latin American mobile industry also generates tax revenues for their governments. For the purposes of this study we estimate the tax revenues generated from three main sources: income tax on companies and on employees, VAT and social security contributions.

Country	VAT rate	Social security rates		Income tax rates (employee)	
		Employee	Employer	High wage	Low wage
Brazil	25%	8%	20%	27%	24%
Chile	19%	10%	0%	42%	20%
Colombia	20%	3%	10%	na	na
Mexico	15%	1%	0%	33%	30%
Peru	19%	8%	0%	16%	15%
Venezuela	15%	2%	5%	34%	34%
Weighted average	18.8%	5.7%	11%	28%	24.5%

Figure 3.9 Tax rates in the six study countries

Source: Government web sites on tax rates



Tax rates vary very considerably across the six study countries. We use weighted average tax rates as estimated in Figure 3.9.

We estimate that:

- directly or indirectly 2.3 million jobs were dependent on the mobile services industry at the end of 2004 in the six study countries
- we can split this employment into two categories – 45,000 high wage jobs²⁵ with average wage costs of €29,100²⁶ per year and the remainder low wage jobs with average wage costs of €4,700²⁷ per year
- to convert these wage costs to wages we need to deduct the 11% social security payments made by the employer. This leads to a total wage bill for the high paid workers of €1.2 billion (€29,100x45,000/1.11) and for the low paid group of €9.7 billion (€4,700x2.275 million/1.11) or €10.9 billion in all
- out of their wages workers paid 5.7% in social security payments and 28% (high wage group) or 24.5% (low wage group) in income tax
- in addition governments received VAT revenues on service and handset revenues at 18.8% on average

Overall the mobile services industry generated **Government revenues of €8 billion²⁸**. This is made up:

- €1.1 billion in social security payments from the employer (11% of €10 billion)
- €0.6 billion in social security payments from the employee (5.7% of €10 billion)
- €2.9 billion in VAT revenues on mobile service and handset sales (18.8% of €15.3 billion)
- €2.7 billion in income tax from workers dependent on the mobile services industry (24.5% of €9.7 billion + 28% of €1.2 billion)
- €0.7 billion in income tax from corporations²⁹

3.6 Productivity and employee value add

It is worth noting that productivity in the mobile industry is much higher than that in other industries in the six study countries. The average worker in the six study countries generates €5,000 in value add (GDP) each year. The average mobile services employee (mobile operators and dealers combined) generates €20,000 - four times that of the average worker. Figure 3.10 illustrates.

²⁵ In the mobile operators and their equipment suppliers

²⁶ Based on information supplied by Telefonica

²⁷ The weighted average of the average wage in each of the six study countries

²⁸ Other specific industry taxes, such as handsets import duties are considered in Chapter 8

²⁹ America Movil 2004 annual report. Income taxes for the rest of operators in the countries are negligible, as the majority of them incurred into losses

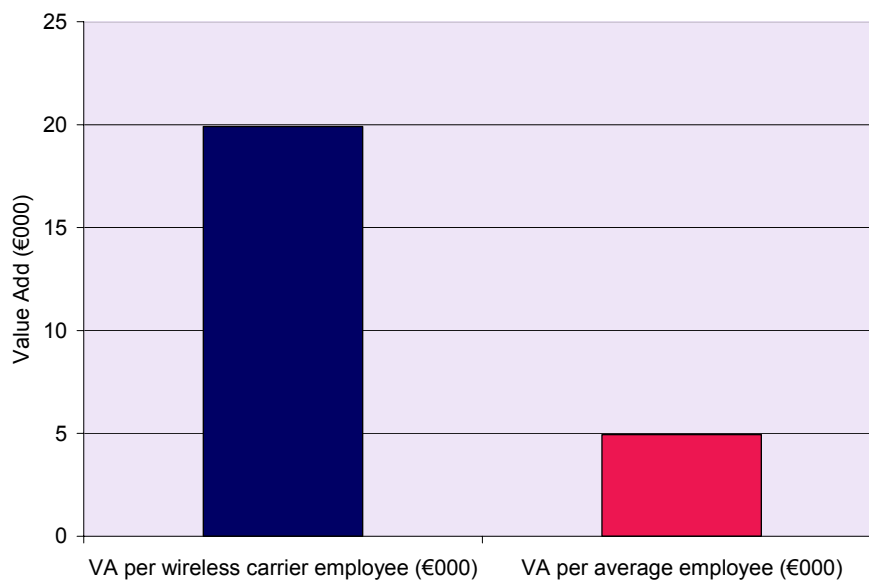


Figure 3.10 Value add - mobile services versus average employee in the six study countries

3.7 Impacts on individual countries

The estimates presented so far in this chapter are for the six study countries combined. Figure 3.11 provides estimates of the supply side economic impacts for the individual study countries. These estimates assume that:

- the value added by the mobile operators in the six study countries is distributed across them in proportion to the mobile industry revenues in each country
- employment is distributed in a similar way. This assumption ignores the fact that wage rates differ in the six study countries
- government revenues are calculated using the individual country specific tax rates of Figure 3.9

Item	Brazil	Chile	Colombia	Mexico	Peru	Venezuela	Total
Value added by mobile industry (€m)	5818	1119	1190	6325	633	1860	16945
Value added retained in country (€m)	2786	536	570	3029	303	891	8115
Employment dependent on industry (000)	796	153	163	866	87	255	2319
Tax revenues to Government (€m)	2211	898	895	2111	624	1028	7766

Figure 3.11 Estimates of supply side impacts in the six study countries

Finally, Figure 3.12 shows how the value add by the mobile services industry in the six study countries varies as a proportion of GDP. On average the mobile services industry contributes 1.3% of GDP.

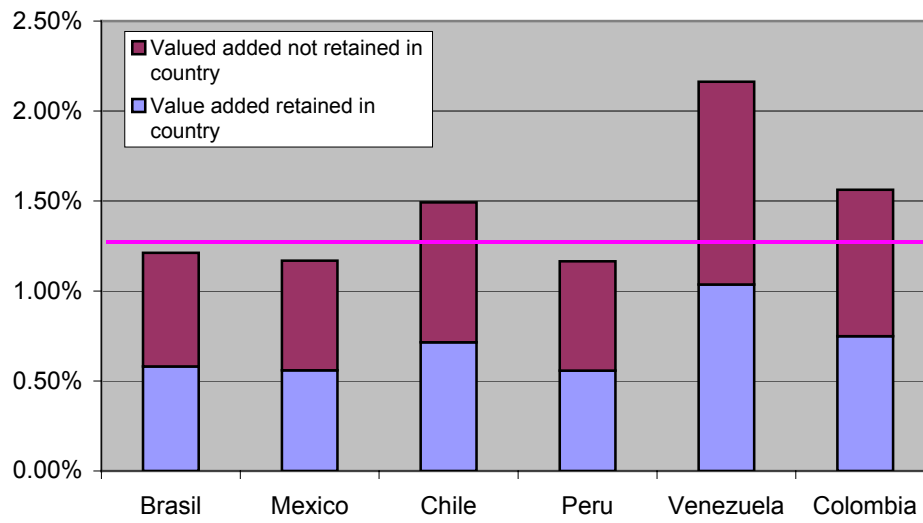


Figure 3.12 Value added by mobile services as a % of GDP per country



4 Productivity gains from the use of mobile services

4.1 Introduction

In addition to the economic benefits from the **supply** of mobile services, measured in Chapter 3, it is clear that the **use** of mobile services also generates substantial economic and social benefits. In this chapter we focus on the economic benefits which arise from use of mobile phones.

We start by reviewing evidence for labour productivity growth from the use of ICT and the role which mobile telecommunications plays in this process (Sections 4.2 to 4.4). We then go on to provide qualitative examples of how use of mobile **voice** services leads to economic development (Section 4.5), and on how mobile **data** services leads to productivity growth (Section 4.6). In neither case can we find any case studies from Latin America so our examples are drawn from a range of developing and developed countries. Finally we quantify the consumer surplus which use of mobile phones generates in the six study countries (Section 4.7). This surplus provides one measure of the benefits which arise from use of mobile phones.

4.2 The need for productivity gains in Latin America

This chapter looks at evidence for links between mobile take up and improvements in labour productivity. Labour productivity growth is an important factor of overall GDP growth since:

$$GDP \text{ growth rate} = \text{Workforce growth rate} + \text{Labour productivity growth rate}$$

Figure 4.1 shows this relationship for the six study countries with growth rates averaged over the period 1998 to 2003.

Country	Ave growth rate pa (1998 to 2003)		
	GDP	Labour force	Labour force productivity
Brazil	1.6%	1.5%	0.1%
Chile	2.3%	2.1%	0.2%
Colombia	1.1%	2.6%	-1.5%
Mexico	2.4%	2.5%	-0.1%
Peru	2.5%	2.8%	-0.3%
Venezuela	-3.8%	2.9%	-6.7%
Weighted ave - 6 countries	1.5%	2.0%	-0.5%
EU15			1.0%
USA			1.8%
Japan			1.5%

Source: World Development Indicators

Figure 4.1 GDP, work force and productivity growth

There is a strong need to boost the negative productivity growth observed in Latin America over the past few years. If governments there want to see GDP growth increase, and especially if they want to see increases in per capita income, then it is important to move to positive labour

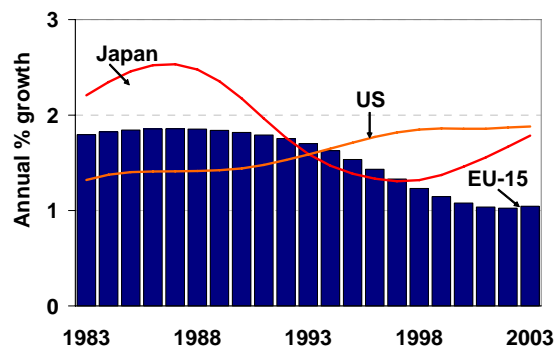


productivity growth rates. There is growing evidence that use of mobile services boosts labour productivity as set out below.

4.3 Labour Productivity Growth and use of ICT

In the last few years academics and policy makers around the world have put increasing efforts into measuring the impact which ICT has on labour productivity growth³⁰. Most of the research is focussed on the comparative performance of the major developed countries. We can find nothing on Latin America.

Figure 4.2 shows what has prompted this research. It plots the labour productivity growth for the US, EU and Japan for the last twenty years. Up until 1995 the EU15³¹ and Japan enjoyed significantly greater labour productivity growth than the US. But since then the US has surged ahead and the EU15 has slowed. For a while Japan followed the EU15 but has now (almost) caught up with the US again.



Source: European Commission

Figure 4.2 Labour productivity growth – EU vs US vs Japan

Why has the US enjoyed so much higher labour productivity growth since 1995? Further investigations³² are summarised in Figure 4.3.

This shows that:

- ICT has had an impact on labour productivity growth, and hence GDP growth, which is quite disproportionate to its size. So, in the EU, ICT contributes 6% of GDP but 18% of investment and 42% of productivity growth
- ICT has had a much greater impact on labour productivity growth in the US than in the EU. So whilst ICT again contributes 6% to GDP in the US, it contributes 29% to investment and 80% to productivity growth (cf 18% and 42% in the EU)
- these differences between the impact of ICT in the EU and US explain virtually all of the differences observed in Figure 4.2.

³⁰ We define use of ICT as use of computer software and hardware, use of IT services and use of the fixed and mobile telecommunications networks

³¹ The EU before enlargement in May 2004

³² For example *Does the EU need to revive productivity growth?*, B van Ark, April 2005, Groningen Research Centre, Memo GD-68

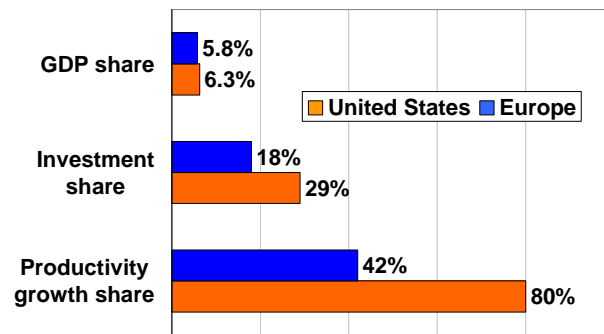


Figure 4.3 ICT contribution to GDP, investment and productivity growth

Source data: IMF 2004, O'Mahony and van Ark CD-ROM (2003), and Timmer, Ypma and van Ark (2003)

This boost to labour productivity in the US is a result of more effective use of ICT rather than greater production of ICT products and services. The productivity of the ICT supply industry has grown substantially since 1995. But this industry constitutes only 6% of the US economy. So the impact from this source is relatively modest.

Much more important is that US companies across a wide range of industry sectors have reengineered their business processes to take advantage of ICT. Such reengineering requires flexible labour markets and flexible product markets³³. The US has much more flexible labour and product markets than the EU. So it can take full advantage of ICT, generate greater returns on its ICT investment, and hence invest more in ICT and boost labour productivity growth more than in the EU.

4.4 The Role of Telecommunications in Boosting Labour Productivity Growth

It is clear that telecommunications have an important role to play in boosting labour productivity growth:

- end user spend on telecommunications represents around 50% of ICT spend in most countries
- ICT started to boost labour productivity growth in the US in 1995, the same year that demand for the Internet exploded
- it is clear that virtually all ICT applications now require networking of some kind to realise their full value
- mobile telecommunications based applications are especially important in boosting labour productivity growth (as set out in Sections 4.5 and 4.6)
- telecommunications services are a component of ICT which must be produced locally. Latin American businesses can buy other ICT components such as software, hardware and IT services on international markets. But they must buy their telecommunications services locally.

³³ With few restrictions on the products sold and the ability to start up and close down companies easily



The precise contribution of telecommunications within ICT to labour productivity and GDP growth is hard to measure. Various econometricians have attempted to do so with the focus on GDP rather than labour productivity growth. Roeller and Waverman³⁴ found that:

- the links between telecommunications investment and GDP growth are complex. GDP growth leads to greater telecommunications investment which in turn leads to greater GDP growth
- once this effect is modelled properly around one third of the OECD growth rate of 2% per annum in the period 1971 to 1990 was accounted for by telecommunications investment. Without additional telecommunications investment over this period the increase in GDP would have been 35% lower than it actually was
- there is a critical mass effect here. Only when penetration rates approach universal service levels, around 60 lines per 100 households or 30 lines per 100 population, do countries realise the full economic benefits of telecommunications' investment. This critical mass reflects network externalities. Only when a high proportion of the population can be reached using telecommunications is the investment in it fully realised.

Waverman et al³⁵ and others³⁶ have subsequently attempted to isolate the impact of mobile service take up on GDP growth and hence labour productivity growth. Waverman for example found that:

- differences in mobile penetration rates help explain differences in GDP growth rates. So a country with a 24% mobile penetration rate³⁷ would enjoy a GDP growth rate 0.95% per annum higher than a country with an 8% penetration rate³⁸
- the impact of higher mobile take up rates on economic growth is greater in low and middle income countries than in high income countries. This reflects the fact that take up of mobile phones increases the number of people with access to telecommunications more in middle and low income countries. In the EU and US fixed lines reach well over 90% of households and mobile phones offer an alternative means of telecommunications. But in Latin America fixed lines reach less than 40% of households. So for many users there mobile phones are the only means of telecommunications. This means that the labour productivity gains from mobile services in Latin America are likely to be substantially greater than in high income countries. We look further at these effects in Chapter 6.

4.5 Economic benefits from use of mobile voice services

Until now voice applications have generated the bulk of the economic benefits which come from using mobile services. There are three main effects:

- productivity gains
- increased flexibility for small businesses

³⁴ *Telecommunications infrastructure and economic developments: a simultaneous approach*, Roeller and Waverman, American Economic Review, 2001, 91(4)

³⁵ *The impact of telecommunications on economic growth in developing countries*, Waverman, Meschi and Fuss, March 2005, Vodafone Policy Paper 2

³⁶ Eg *Telecommunications infrastructure and economic growth*, Sridhar and Sridhar, National Institute of Public Finance and Policy, Working Paper 14, 2004

³⁷ Such as Morocco in 2003

³⁸ The average for a developing country in 2003



- improvements in rural development.

4.5.1 Productivity gains

Use of mobile phones for voice applications:

- **reduces unproductive travelling time.** It enables field engineers and sales staff to use otherwise unproductive travel time in talking to customers, colleagues and suppliers. Increasingly they also supply relevant data which the traveller can use whilst on the move.
- **significantly improve logistics.** Companies can contact their field staff and so schedule visits more efficiently. For example taxi drivers and car breakdown service operators can function more effectively through the use of mobile communications
- enables **faster and more efficient decision making.** For example staff within a company can contact each other from any location to hold a teleconference and reach an important decision. Without mobile phones such meetings could take days or weeks to schedule or could exclude key decision makers. In Bangladesh, “the ability to check market prices by mobile phone also leads to higher prices for eggs chickens and ducks and lower prices for poultry feed.”³⁹
- **empowers small businesses and provide increased flexibility** to farmers, plumbers, and builders who spend a high proportion of their time away from their home base⁴⁰
- enables women to **create micro-businesses** in rural areas by owning their own phone and selling mobile phone services to neighbours⁴¹.

Boxes 4.1 and 4.2 provide two case studies which illustrate some of these effects.

4.5.2 Increased flexibility for small businesses

Small businesses need telecommunication services which provide them with:

- flexible telecommunications capacity which they can scale up or down rapidly as their business changes in size. This requires their suppliers to respond flexibly and quickly to increased and decreased demand
- the ability to keep their telephone number when they move the location of their business within a city

Fixed services in Latin America, with relatively long waiting lists in many countries, do not meet these requirements. Mobile services do.

³⁹ N Cohen, “What Works:Grameen Telecoms Village Phones.” A Digital Dividend Study by the World Resources Institute, June 2001. <http://www.digitaldividend.org/pdf/grameen.pdf>

⁴⁰ J. Donner. “The mobile’s behaviours of Kigali’s microentrepreneurs: whom they call...and why.” Paper presented at “The global and the Local in Mobile Communication.” Budapest, Hungary, June 2004. <http://www.jonathandonner.com>

⁴¹ See <http://www.grameenphone.com/village.htm> for more information.



The mobile phone boom has underpinned activity in the small business sector, which employs most workers in the nation of 32 million people which is east Africa's largest economy. In 2004 the sector created about 437,900 new jobs, according to the government's 2005 Economic Survey.⁴²

In particular the mobile phone has become the most essential work item for small businessman in Kenya who make a living from holding various jobs at the same time. For example:

- due to the growth of mobile networks in Kenya over the past five years a plumber/electrician claims his business has grown by 50%. In addition to the plumbing and electricity business he also operates a community payphone via the mobile network and benefits from the growth of mobiles by charging up mobile phone batteries for a fee. The plumber states that *"sometimes I receive as many as five calls a day for different jobs. Were it not for mobile phones, jobs would have been very minimal. With the phone, I am well known."*
- painters and masons advertise their numbers on trees by the roadsides in Nairobi. In the past, they would have sat outside hardware shops looking for work from people who have just bought nails, cement and other building supplies
- vegetable vendors make orders for supplies without leaving their stalls. They also avoid being swindled because they can use text messaging to check around for the best prices.

Box 4.1 Use of mobile phones by small businesses in Kenya

Groups of small farmers in remote areas of Côte d'Ivoire share mobile telephones so they can follow hourly fluctuations in coffee and cocoa prices. This means they can choose the moment to sell their crops when world prices are most advantageous to them. A few years ago, they could only have found out about market trends by applying to an office in the capital, Abidjan. Their deal-making was based on information from buyers, and this was not always reliable.⁴³

Box 4.2 Use of mobile phones by farmers in Cote d'Ivoire

4.5.3 Improvements in rural development

There is considerable evidence to show that having access to telecommunications would substantially improve the social and economic conditions of people living in rural area such as the mountainous regions of Peru or Brazil. Access would:

- allow dispersed families⁴⁴ to stay in touch on a regular basis without the need for expensive and time consuming visits. See Box 4.3 for an example
- give villages much better access to education, health and financial services
- enable villagers to initiate and monitor payments from urban family members more effectively
- enable the development of non agricultural economic activity. Studies in Thailand⁴⁵ for example show that it is villages with telecommunications that develops small scale

⁴² "Mobile Phones Boost Kenya's Small Businesses" from http://today.reuters.co.uk/news/newsArticle.aspx?type=reutersEdge&storyID=2005-07-18T102209Z_01_NOA837140_RTRUKOC_0_FEATURE-MOBILES-KENYA.xml

⁴³ "The south goes mobile" See http://www.unesco.org/courier/2000_07/uk/connex.htm

⁴⁴ Typically with some members living in big towns and others living a remote village

⁴⁵ Bruns, Bryan et al, *Village Telephones: Socio-economic Impact and Implications for Rural Futures*, paper presented at 6th International Conference on Thai Studies, October 1996. <http://www.cm.ksc.co.th/~bruns/rurtele.html>



manufacturing businesses. At the same time many tourist facilities, such as ecolodges, are rural by definition. These require telecommunications to co-ordinate the arrival and departure of guests, the ordering of food and the payment of bills if they are to function effectively

- improve significantly the bargaining power of farmers. Without telecommunications farmers must rely on middlemen to provide them with inputs⁴⁶ and to buy their produce. This dependency means that the available profits accumulate largely to the middleman. With telecommunications farmers are better informed about prices of both inputs and outputs and can act together to demand better deals from the middlemen or to eliminate them completely⁴⁷.

Some Senegalese people living in Dakar or abroad have bought their relatives a mobile phone to stay in touch. Sometimes, several families living in places where the dream of getting a fixed phone line is unlikely to come true for at least 20 years share a mobile handset that they charge up from car batteries. Children run to neighbours to tell them that a relative will be calling back in a few minutes from New York or Rome.⁴⁸

Box 4.3 Use of mobile phones in rural Senegal

4.6 Productivity gains from mobile data services

The current economic benefits from mobile services in Latin America arise mainly from the use of voice services. If Latin America follows other developed markets then the next set of benefits will be from the use of data services on PDAs such as the RIM Blackberry or Microsoft PC Pocket and smart phones. Mobile technologies, which can allow employees to telecommute or work outside the office, can help improve their businesses' productivity.⁴⁹

We provide eight short case studies from the USA and UK which illustrate the benefits to businesses and government of mobile data services. Many firms operate in a distributed work environment which creates the need for mobile networks and versatile and flexible application connectivity software to give employees and partners access to corporate information while in remote field operations or outside the office. Applications of this sort will be of growing importance in Latin America over the next 5 years.

The benefits of mobile business data services fall into three categories:

- Improved customer service
- Improved workflow and use of resources
- Better decision making.

4.6.1 Improved customer service

Case Study 1: McDonald's Restaurants are using mobile technology, Pocket PCs, which are designed to collect data to assess product quality, customer service and cleanliness. The

⁴⁶ eg seeds, fertilisers, tools

⁴⁷ See for example the ITU case study: "n-Logue: Building a Sustainable Rural Services Organisation, Jhunjhunwala and Ramachandran, 2004

⁴⁸ "The South goes mobile". Op Cit.

⁴⁹ "Businessmen turn to mobile technologies for productivity." Business World, 5 August 2005.



information obtained can be uploaded to a central database, cutting out the time-consuming manual process of transferring the data to paper-based files. This enables instant access to information.⁵⁰

Case Study 2: Scottish Water in the UK is looking for new ways of working to break down functional boundaries and deliver business benefits and improve customer service. They are employing mobile technology as an enabler and designing business processes to fit their customer needs to increase efficiency. Through the use of the mobile network and wireless enabled laptops Scottish Water is able to provide better customer experiences through real-time communications with field workers.⁵¹

4.6.2 Improved workflow and use of resources

Case Study 3: Applications that connect mobile workers with their offices using a mobile phone based, in-field application that communicates with a password protected website for job dispatch and workflow visibility in real-time lowers administrative costs and improves productivity for mobile workforces through paperless job dispatch, timely invoicing and real-time inventory control.⁵² Verizon Wireless offers such a service called 'Get It Now'. In this case study mobile workers regularly receive and log job details while in the field. The work-flow improvement approach provided by this service produces a very high return on investment for the companies who use it in terms of increased in-field productivity and reduced costs with respect to data entry, error correction and inventory management.

Case Study 4: Another application is a mobile timesheet software solution that enables employees to log time, attendance and job information remotely via their Verizon Wireless mobile phones. In a similar way to the above study, the mobile timesheet software connects mobile workers to the office by using a mobile to capture timesheet information. The data is then transmitted in real-time for instant back-office visibility via a password protected website. The solution allows users to access past and present timesheet information, eliminating the need for paperwork transactions. It is beneficial to employees who are on a site for long periods of time as it enables them to submit information without having to go back to the office.

Case Study 5: A further example is a project implemented by Leeds City Council entitled Digital Pen and Paper, which is poised to transform the way paper-based information can be stored, retrieved and analysed. The project employs innovative mobile technology to meet the changing demands of local government. The council's primary objectives included implementing the project throughout the city, in which 1,600 home care assistants are employed, using this technology to send care data directly to corporate systems from clients' homes via a secure mobile link.

4.6.3 Better decision making

Case Study 6: A service by Verizon wireless keeps mobile professionals connected to their email, contacts, calendar, notes, tasks and other critical business applications and allows enterprise customers to increase productivity when away from their desk. However to make the

⁵⁰ "BCS IT professional awards Finalists such as Leeds City Council and McDonald's demonstrate how mobile technology can transform processes and boost productivity How to capitalise on mobile advances." Computer Weekly, 13 September 2005.

⁵¹ Presentation entitled "Mobilising your Field Teams" by Barry Lawson.

⁵² "HVAC Companies Increase Productivity and Cut Costs Using These Applications Exclusively Available on Verizon Wireless 'Get It Now'." PR Newswire, 12 September 2005



service successful professionals need a Pocket PC phone and high speed broadband access.
53

Case Study 7: A wireless operator in the USA is working to make critical patient information available to doctors in real-time anywhere. Instead of using pagers and faxes for communications, the wireless operator and the doctor use a solution called PatientKeeper. This solution enables doctors to see clinical results when they are available. It allows doctors to respond immediately to medical emergencies which are uncovered during laboratory work or to check medical records of patients. It makes it easier for doctors to write and send prescriptions to the pharmacy with wireless technology immediately. Dictation of patient notes to a device allows for faster and more effective patient information. This service enhances productivity in the healthcare field, reduces prescription errors, improves and streamlines record keeping all of which help to reduce healthcare costs and improve patient satisfaction.

Case Study 8: A US wireless service is employed by McDonalds in the USA to allow the franchise owner to keep in touch with his set of restaurants and coordinate when issues arise. The stores use text messaging to coordinate their peak demand needs and shift supplies from one store to another. Store managers also use the camera in phones to document problems such as broken tiles for repair.

4.6.4 Estimating the consumer surplus from use of mobile services

Contribution to GDP and employment by the mobile industry is not a complete measure of mobile services benefits. The reason is that benefits to subscribers are not taken into account.

Yet, it is clear that consumers and businesses in Latin America enjoy substantial social and economic benefits as a result of using mobile services. It is very difficult to quantify the economic benefits from mobile phone use as described in Sections 4.5 and 4.6. One way to quantify this benefit is to estimate the **consumer surplus** generated by mobile services.

Put simply, consumer surplus measures:

- the price which users are prepared to pay, on average, for cellular service **less**
- the price which they actually pay **multiplied by**
- the number of subscribers.

In other words, consumer surplus is a measure of how much value users give to mobile services (it could be seen as a measure of “usefulness”).

Annex C provides details on how we estimate this consumer surplus using two independent approaches. Based on this work we conclude that:

- the mobile services of the six study countries of Latin America generated a consumer surplus of around \$30 billion per annum in 2004
- there is uncertainty attached to this estimate. The true figure may be up to 30% higher or lower.
- this consumer surplus is probably an order of magnitude greater than the producer surplus generated by the industry. At the moment the operating profits generated by the mobile

⁵³ “Business Users Enhance Productivity With GoodLink on the Powerful Verizon Wireless EVDO Network for Faster Access to Email, Attachments and Corporate Data.” PR Newswire, 16 August 2005.



services industry in Latin America are modest. EBITDA⁵⁴ margins as a proportion of revenues are low, while investment as a proportion of revenues is higher comparing with other regions of the world. If capital expenditure and depreciation are assumed equal then this implies operating profits of only a few percentage points and a producer surplus, equal to the operating profits of the mobile operators, of around \$1 billion to \$2 billion per annum.

⁵⁴ Earnings before interest, tax, depreciation and amortisation



5 Impact of mobile take up on FDI

5.1 Introduction

In this chapter we provide a review of the impact of the mobile services industry on the level of foreign direct investment (FDI) in the six study countries of Latin America.

FDI involves foreign companies, often trans-national corporations, investing in companies in other countries. This investment takes one of three forms:

- Equity investment where the foreign company purchases shares in the local company
- Reinvestment which is measured by net profits which are not returned to the foreign owner in dividends
- Intra company loans in which the foreign company lends money to the local company in which it has invested.

In analysing FDI we need to distinguish between *inward FDI*, in which foreign companies invest in local firms and *outward FDI* in which local companies invest overseas. We concentrate in this chapter on inward FDI in the six study countries.

We also need to make the distinction between *services FDI* and *manufacturing FDI*. We concentrate here on the former - given that it includes the mobile services sector. But we also highlight some key differences between service and manufacturing FDI.

5.2 Key Characteristics of FDI

Inward FDI:

- varies with income per head. Countries with a high GDP per head attract more FDI as a proportion of GDP than low or middle-income countries. Figure 5.1 illustrates
- is substantially greater than outward FDI for low and middle countries. Figure 5.2 illustrates for the services sector
- has grown rapidly over the last 15 years. In 1990 the stock of services FDI was at \$990 billion. By 2002 it had reached over \$4000 billion – a four-fold increase⁵⁵. In telecommunications growth was even more spectacular, with a 16 fold increase in the stock of FDI over this period
- is changing in nature. In particular services FDI is displacing manufacturing FDI. By 2002 services FDI had reached 72% of all FDI in high income countries and 52% in low and middle income countries
- varies considerably in nature between the services and manufacturing sector. The trend is towards greater services FDI, but the arrangements are different. Non-equity forms of FDI, such as franchises, partnerships, concessions and build transfer operator (BTO) projects are more common in the services sector.

⁵⁵ World Investment Reports 2004, UN, 2004

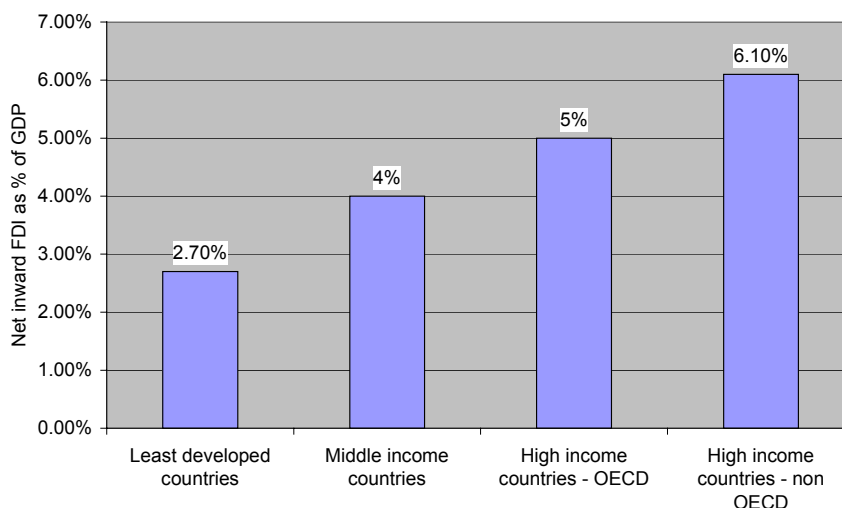


Figure 5.1 FDI and income per head

Source: World Development Indicators 2004

Item	High income countries	Low and middle income countries
Inward FDI stock in	76%	24%
Outward FDI stock from	93%	7%

Figure 5.2 Distribution of services FDI in 2002

Source: UNCTAD

5.3 The Benefits of Inward Services FDI

Inward FDI in the services sector generates both benefits and costs for the host country. On the benefits side such FDI leads to:

- additional investment. In many low and middle income countries investment capital is scarce and additional investment can generate substantial economic benefits, especially when made in infrastructure projects such as telecommunications, power or water
- additional formal employment. Research indicates that access to employment in the formal sector is the most important factor in shifting poor people out of poverty⁵⁶
- skills transfer. FDI usually involves transfer of skilled staff to the host country where companies employ and train significant numbers of local staff
- additional sources of government revenues in terms of revenues from income taxes, corporation tax, social security payments and VAT
- better local services. Foreign companies often adapt services developed in their home country and localise them for sale in the host country. This means lower cost services brought to market more quickly, with a consequential acceleration in productivity.

⁵⁶ FDI in Southern Africa, Jenkins and Thomas, 2002



FDI also has an important advantage over other forms of inward investment in that it usually involves a long term relationship between the investor and the host country. Once FDI is made there are substantial barriers to the investor moving that investment elsewhere.

On the costs side, FDI can lead to displacement of local firms and a reliance on expatriate staff, which can block the skills development of the local workforce. It can also create environmental problems.

On balance most governments in low and middle income countries have taken the view that inward FDI is highly desirable and many have gone to considerable lengths to attract it. So we need to ask the question – what determines why some countries are more successful than others in attracting inward FDI?

5.4 The Determinates of Inward FDI

A number of studies have used econometric techniques to try to identify the factors which determine the level of FDI. Findings are mixed. Figure 5.3 summarises the results.

<i>Factor</i>	<i>Positive effect</i>	<i>Insignificant effect</i>	<i>Negative effect</i>
Openness of economy	3 studies		
Quality of infrastructure	3 studies	3 studies	
Real GDP per head	3 studies	3 studies	2 studies
Labour costs	1 study	1 study	3 studies
Political instability		2 studies	3 studies
High taxes		3 studies	2 studies

Figure 5.3 Determinants of FDI

Source: Asiedu, On the determinants of FDI to developing countries- is Africa different?, World Development, Vol 30 , No 1, 2002

We can see that:

- there is general consensus that an open economy has a strong positive impact on the level of FDI
- there is reasonable agreement that the quality of infrastructure, low taxes and political stability increase the level of FDI
- there is little agreement about the impact of labour costs and GDP per head on the level of FDI (even though Figure 5.1 suggests a clear correlation with the latter).

Our specific interest is on the extent to which one aspect of infrastructure – the take up of mobile services – affects FDI. We focus on this issue in the remainder of this chapter.

5.5 The Impact of Mobile Services on Inward FDI

Our analysis suggests that the mobile services industry in the six study countries has two major effects on inward FDI:



- a **direct** effect. We have seen substantial FDI in mobile services in Latin America over the past five years. This has led to a substantial increase in the overall volume of FDI. Section 5.6 provides details and quantification
- an **indirect** effect. The level of FDI in middle income countries like those of Latin America is positively correlated with take up of mobile services at a statistically significant level. In other words foreign companies are more likely to make FDI in countries with high mobile penetration than in countries with low mobile penetration. Section 5.7 provides more detail.

5.6 The Mobile Service Industry Attracts FDI

An examination of the trade statistics provided by UNCTAD⁵⁷ provides clear evidence of the scale of inward FDI by telecommunications operators into the six study countries of Latin America. There are two measures here:

- the flow of FDI into the six countries year by year
- the cumulative stock of FDI in each country at any point in time. The stock consists of the sum of the flows to date less any reductions in FDI e.g. as a result of the foreign company disposing of one of its investments to a local enterprise.

Figure 5.4 presents a summary of extracts from this database for **stocks** of FDI. The latest date for which information is generally available is 2002.

Country	Sector	1990	2002
Brazil	Posts and communications	0	18762
	All	37243	103015
	%	0%	18%
Colombia	Transport, storage and comms	na	2341
	All	na	17626
	%	na	13%
Peru	Posts and communications	0	3695
	All	1304	12273
	%	0%	30%

Data on stocks of FDI by industry are not available for Chile, Mexico and Venezuela

Figure 5.4 Stocks of FDI (\$m) in the telecommunications sector in Latin America⁵⁸

We can see that:

- the contribution of the posts and communications sector to FDI in 2002 varied from 13% (Colombia) to 30% (Peru)
- the stock of FDI in this sector was 0% in 1990. So it is likely that the increase is due to FDI in the telecommunications sector
- if we make this assumption then the stock of FDI from telecommunications is three to seven times the GDP contribution of the telecommunications sector⁵⁹

Figure 5.5 then presents similar data for the flows of FDI. Here we can see that:

- the flow of FDI into the sector which contains the telecommunications industry varies considerably, year by year, and country by country, peaking in 2000 and 2001

⁵⁷ www.unctad.org/template

⁵⁸ From UNCTAD statistics. See www.unctad.org/templates

⁵⁹ Which is around 3.5 to 4% GDP in the study countries



- again the flow of FDI into the sector which contains the telecommunications industry is several times higher than the contribution of telecommunications to GDP.

Country	Sector	1999	2000	2001	2002
Brazil	Posts and communications	7792	10897	4130	4190
	All	31255	33331	21092	18778
	%	25%	33%	20%	22%
Chile	Posts and communications	340	855	1246	331
	All	9086	2977	4848	3322
	%	4%	29%	26%	10%
Colombia	Transport,storage and comms	189	876	416	345
	All	1508	2299	2488	2043
	%	13%	38%	17%	17%
Mexico	Transport,storage and comms	278	2372	2913	750
	All	12856	15848	25334	9696
	%	2%	15%	11%	8%
Peru	Posts and communications	255	1025	14	302
	All	1397	1433	696	669
	%	18%	72%	2%	45%
Venezuela		na	na	na	na
Average contribution to FDI flow for telecoms sector		20%			

Figure 5.5 Flows of FDI (\$m) in the telecommunications sector in Latin America⁶⁰

In Chile the post and communications sector accounted for 22% of FDI in 2003 and 35% in 2004

The trade statistics do not tell us to what extent the contribution of FDI from telecommunications is distributed between fixed and mobile services. But we can see from Figure 5.6 that mobile services have played a major part in boosting telecommunications FDI. This figure tabulates the country of origin of the different operators by subscriber market share in each of the six study countries.

It shows that:

- in Peru the mobile industry is now 100% owned by operators with a majority foreign stake⁶¹
- over 60% of the industry in Brazil, Chile, Colombia and Venezuela is now foreign owned
- only in Mexico are foreign operators in the minority. This is consistent with Figure 5.5 which shows that the flows of FDI in the sector containing the telecommunications industry make up a much lower proportion of total FDI in Mexico than in the other five study countries.

⁶⁰ Source as for Figure 5.4

⁶¹ Telecom Italia, Telefonica, America Movil and/or Nextel



Owner	Brazil	Chile	Colombia	Mexico	Peru	Venezuela
Telefonica -Spain	19%	50%	30%	15%	66%	46%
Portugal Telecom	19%	0%	0%	0%	0%	0%
TIM - Italy	21%	0%	0%	0%	0%	0%
America Movil - Mexico	21%	16%	58%	76%	29%	17%
Nextel - USA	1%	0%	0%	2%	5%	0%
Other Local	19%	34%	12%	7%	0%	37%
Total	100%	100%	100%	100%	100%	100%
% foreign owned	81%	66%	88%	17%	100%	63%

Figure 5.6 Foreign ownership of Latin American mobile operators ⁶²

In contrast a high proportion of the fixed telecommunications industry remains locally owned. This suggests that a high proportion of the FDI attracted to Latin American telecommunications flows to the mobile rather than to the fixed sector.

FDI in the mobile service industry generates the net benefits listed in Section 3. In the case of mobile services it also means that Latin American subscribers get higher functionality services, imported from the EU or the US, earlier and at lower costs than if they were supplied by local companies. The foreign owners adapt services developed in the country of origin for the specific circumstances of the host country. This is normally cheaper and quicker than a local operator developing the same service specifically for the host country. Foreign owners of the mobile companies in Latin America have also started to invest in R&D in the host country recently. They now spend a significant proportion of their revenues on paying local companies to develop new and innovative services to run on their networks.

5.7 Mobile Take Up Increases Inward FDI

There are many studies which consider the general determinants of the level of FDI. But we can find only one which looks specifically at the effect of mobile take up on the level of FDI – the paper on FDI published by Vodafone in its policy paper on mobile phones in Africa⁶³. This paper considers how variations in FDI as a proportion of GDP across 70 countries is explained by a series of variables. These include mobile penetration, fixed line penetration, the openness of each economy, the size of the country, and the quality of the paved road network⁶⁴. It finds that:

- the level of FDI is positively correlated with the openness of the economy and GDP per head
- the level of FDI is also positively correlated with the level of development of telecommunications infrastructure – both fixed and mobile
- the level of penetration of mobile services is an increasingly important determinant of FDI and is significantly more important, once we have allowed for the impact of GDP on mobile penetration.

⁶² From Mobile@Ovum service

⁶³ Mobile networks and FDI in developing countries, M Williams. March 2005

⁶⁴ As an indicator of the quality of non telecoms infrastructure



When we complement the findings of this study with those of Waverman et al⁶⁵ (described in Chapter 4) we find that the likely relationship between GDP growth, mobile take up and greater FDI is as shown in Figure 5.7.

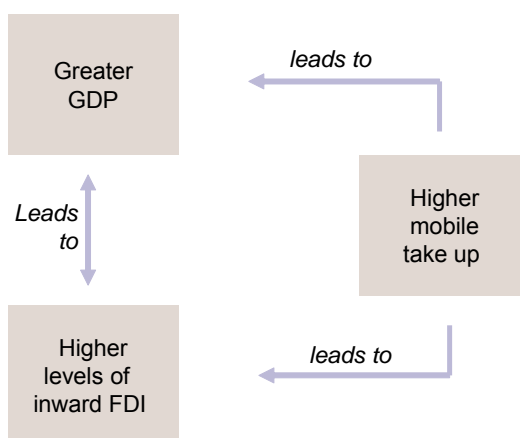


Figure 5.8 The relationship between mobile take up, FDI and GDP

It suggests that the model which we proposed in Figure 1.1 is valid in that:

- growing mobile take up increases FDI which, in turn, increases GDP through productivity gains
- higher GDP leads to greater FDI
- greater mobile take up increases productivity and so leads to higher GDP and greater FDI

Figure 5.7 points to an important policy conclusion. **Governments should do whatever they can to encourage mobile investment so as to promote mobile take up if they want to maximise economic growth.**

⁶⁵ For example *The impact of Telecoms on Economic Growth in Developing Countries*, Waverman, Meschi and Fuss, March 2005, Vodafone Policy Paper 2



6 The impact of mobile take up on GDP growth

6.1 Introduction

In combination the supply side effects described in Chapter 3, the economic benefits from the use of mobile services outlined in Chapter 4 and the FDI effects of Chapter 5 all act to boost GDP as mobile take up increases. But what is the nature of this relationship? In this chapter we summarize the findings of the econometric analysis which we undertook to answer this question. The detailed analysis is set out in a separate document as Annex D.

6.2 The Overall Approach

We take as our baseline model:

$$GDP_{8003} = \alpha + \beta_1 GDP_{80} + \beta_2 K_{8003} + \beta_3 TPEN_{80} + \beta_4 MPEN_{9603} + \beta_5 APC15_{80} + \epsilon$$

where:

GDP_{8003} = the average growth rate of real GDP over the period 1980 to 2003

GDP_{80} = real GDP in 1980

K_{8003} = the average share of investment in GDP and over the same period

$TPEN_{80}$ = the fixed telephony penetration rate in 1980

$MPEN_{9603}$ = the average level of mobile penetration over the period 1996 to 2003

$APC15_{80}$ = the proportion of 15 and over population who had completed at least primary school in 1980

β_i = unknown parameters

ϵ = a stochastic disturbance term.

This is the model used by Waverman, Meschi and Fuss (WMF) in a recent paper⁶⁶. We then estimate the parameters of the model using regression analysis applied to relevant data for 92 low, middle and high income countries so as to reproduce the WMF results. These include the six study countries.

We then construct a number of variants on this basic model:

- we estimate separate coefficients for the variable $MPEN_{9603}$ for low income countries⁶⁷, for middle income countries which included the six study countries, and for high income countries⁶⁸. This significantly improves the explanatory powers of the model and produces coefficients which are statistically more significant
- we vary the time window for the long term variables by replacing 1980 with 1990 and 1996. This produced unsatisfactory results and we retain 1980 as a starting point for our time window

⁶⁶ *The impact of telecommunications on economic growth in developing countries*, Waverman, Meschi and Fuss, March 2005, Vodafone Policy Paper 2

⁶⁷ Bottom quartile of countries in terms of GDP per head

⁶⁸ Top quartile of countries in terms of GDP per head



- we introduce additional controlled variables to explain GDP growth, selecting them from those identified by Sala-i-Martin, Doppelhofer and Miller (SDM)⁶⁹ as correlating with GDP growth over a wide range of studies. This change again significantly improves the explanatory power of the model
- we test the model for endogeneity and find none. That is GDP growth is dependent on mobile take up but mobile take up is not dependent on growth in GDP.

6.3 Findings

Figure 6.1 tabulates the coefficients of our final model and compares them with the original WMF model (we have excluded the SDM control variables from the table for simplicity).

Variable	WMF basic model	Ovum/Indepen final model
GDP80	-0.0026 (1)	0.0020 (1)
K8003	0.0017 (1)	0.0011 (1)
TPEN80	0.042	0.000
MPEN	0.003 (1)	na
MPENL	na	0.0040 (1)
MPENM	na	0.0003 (1)
MPENH	na	0.00009 (1)
APC1580	0.0002 (1)	0.00005
R ²	0.55	0.665

Figure 6.1 Findings from the econometric models

(1) Significant at the 5% level

We can see that:

- our final model explains a substantially higher proportion of the variants in the data set of 92 countries than the WMF model⁷⁰
- this model suggests that **mobile penetration is an important and statistically significant variable in explaining GDP growth**, even when eight other control variables are included in the model
- **mobile penetration has a very substantial impact on GDP growth in low income countries** (less than \$2200 per head per year), a more modest impact in middle income countries (\$2200 to \$12,000) and relatively little impact in high income countries (greater than \$12,000). This finding is consistent with what we might expect. In low income countries mobile services offer the only form of telecommunications to most people. In high income countries they simply offer an alternative to fixed line services
- in middle income countries, which include the six study ones, a country with an average of 10 more mobile phones for every 100 people should enjoy an additional 0.3% of GDP growth each year (all else being equal)

69 Sala-i-Martin, X., Doppelhofer G, and R. Miller. 2004, *Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach*. American Economic Review 94(4): pp.813-35.

70 WMF look at alternative models but these did not improve the R² of 0.55



- there are a number of areas where further investigation is needed. For example, in the context of the present model, the number of explanatory regressors (dependent variables) might be augmented. As described in Chapter 8, institutional and regulatory environment variables play a very significant role in mobile take up and economic growth, but they have not been incorporated in this model. Other effects, such as the presence of network externalities, should also be considered.

Again these findings point to the need for governments in Latin America, and other middle income countries, to maximise mobile take up if they are to maximise economic growth.



7 Future economic benefits

7.1 Introduction

It is clear from previous chapters that the Latin American mobile services industry has already generated substantial economic benefits. In deciding future policy towards mobile cellular services, the government and their regulatory authorities in the region should take these **existing** benefits into account. However, they are equally interested to consider the impact of their decisions on **future** benefits streams. So in this chapter we discuss these future benefits. There a number of ways in which the economic benefits from mobile services in Latin America will grow over the next five years. We consider each of them below.

7.2 Supply side effects

Mobile industry revenues (at out-turn \$ prices) have grown at an average rate of 14% per annum over the past four years in the study countries. There is no sign of this growth diminishing. If the industry continues to grow at this rate for the next 5 years then we can expect that:

- the contribution to GDP from the mobile industry, currently around €8 billion per annum, will nearly double
- the contribution to government tax revenues made by the mobile industry will nearly double from its current €8 billion per annum
- the contribution to employment, currently 2.3 million jobs in the six study countries, will increase substantially. We do not expect the number of jobs to double because of productivity effects. But it is reasonable to assume that the industry will generate a further one million jobs or more by 2009.

7.3 Productivity Gains

The productivity gains from use of cellular mobile services will grow substantially over the next 5 years as more businesses use mobile phones for more applications. In particular we expect the use of mobile data services to substantially increase business productivity in Latin America, as it is already doing in the US and EU.

7.4 Increases in Consumer Surplus

Consumer surplus from use of mobile services will continue to grow as the volume of traffic increases and prices continue to fall. Extrapolating from current trends for these two variables, we expect the annual consumer surplus in the six study countries to double from €30 billion in 2004 to €60 billion in 2009.



7.5 The Impact on GDP

The rate at which mobile take up increases will have a substantial effect on the GDP generated in Latin America. We can illustrate the scale of these effects by applying the findings of our econometric analysis from Chapter 6:

- under a **low growth scenario** mobile penetration might increase by an average of 10% per annum over the next five years. So by 2009 mobile take up will have boosted GDP by €26 billion per annum in the six study countries combined
- under a **higher growth scenario** mobile penetration might increase by an average 20% per annum over the next five years. By 2009 this would mean GDP is boosted by €61 billion per annum

So, if governments in Latin America can maintain mobile growth at rates comparable with current growth rates⁷¹, then they can boost GDP in the region by around €60 billion per annum in 2009. But if they follow policies which halve mobile take up growth rates, then this GDP premium will be reduced by €35 billion per annum by 2009.

⁷¹ Subscriber numbers grew at an average rate of 29% per annum over the past four years in the six study countries



8 Policy Implications of Our Study

8.1 Benefits of Effective Policy

It is clear that the mobile industry in Latin America has had a very substantial effect on economic development there over the last few years. It also has the potential to improve economic development over the next decade. For example the industry:

- makes a substantial and growing contribution to GDP
- supports a substantial and increasing number of jobs
- generates substantial revenues for Latin American governments through income tax, value added tax, and revenues from social security payments
- increases the productivity of the workforce – through use of voice and, increasingly, data cellular services
- generates substantial foreign direct investment in the region – both direct FDI in the mobile industry and FDI in other industries, which grows as mobile take up increases.

In combination these effects mean that continuing investment in, and higher take up of, mobile services leads to higher GDP growth rates. The findings of our econometric analysis indicates that a 10% increase in mobile penetration (e.g. from 30 to 40%) should lead to a 0.3% increase in GDP growth per annum.

The economic rewards of greater mobile take up are substantial. This raises the question of what policy makers and telecommunications regulators can do to maximise take up. Based on our work for governments, regulators and operators in other parts of the world we suggest the following.

8.2 Proposals for maximising mobile take up

Proposal 1: Create the right climate for investment by the mobile industry. It is important that mobile operators invest in expanding their networks. This is an essential prerequisite for increasing mobile take up. Without investment the network will become congested and take up will gradually slow down and eventually stop. To create the right investment climate policy makers might:

- forbear from regulating retail and/or interconnect prices for mobile services and leave price setting to competition. It is clear that mobile operators in Latin America are still not making economic profits⁷². Regulated prices could make mobile services more affordable in the short term. But it would also kill investment incentives and slow take up in the medium and long term. Regulated retail prices would also constrain tariff innovation – again leading to reduced market growth and take up
- maximise regulatory certainty so that mobile operators can invest - knowing that the rules within which they operate will not change, except for very good reason. As an example, mobile trunking operators in Latin America were granted licences (at much lower prices than traditional mobile operators) for offering closed user group (CUG) services using PTT over IDEN technology, but now, regulators in many Latin American countries have forced

⁷² i.e. their return on capital employed is less than their weighted average cost of capital



the traditional operators to offer them interconnection, changing the rules dramatically. We set out suggestions on how to achieve greater regulatory certainty in Proposal 2

- lift restrictions on the repatriation of profits to foreign direct investors. FDI in the mobile industry of Latin America is substantial. For this FDI to continue the governments in the region need to signal to potential foreign investors that they will have access to the long term profits generated by their investments.

Proposal 2: Maximise regulatory certainty so as to maximise investment. Mobile operators need regulatory certainty if they are to minimise their regulatory risk and so maximise their investment incentives. Governments and regulators clearly cannot give absolute regulatory certainty. They must be able to respond to unforeseen but major changes in circumstances which invalidate current regulation. But they can improve regulatory certainty. For example they can:

- ensure that the regulator is independent – both of government and of any major telecommunications operators in the country
- establish principles which will guide all regulatory decisions (as Ofcom in the UK did recently)
- provide transparent decision making in which the regulator consults on all major decisions and provides explicit justification for decisions in which they demonstrate they have followed their guiding principles
- commit in advance to lifting regulation when certain conditions are met. For example in the EU NRAs are required to remove regulatory obligations when an operator loses significant market power
- establish a mechanism whereby an operator can appeal against an NRA decision on grounds of either merit⁷³ or procedure⁷⁴. Such an appeal mechanism provides a strong discipline on NRA decision making
- carry out regulatory impact assessments to check that the benefits of any regulatory measure outweigh the costs before implementing it
- forbear from ex-ante regulation if there is any uncertainty as to whether the benefits outweigh the costs. Regulatory decisions often have unforeseen negative consequences. A policy of “wait and see” preserves the option to intervene later. A decision to intervene immediately can lead to substantial economic costs and can be very difficult to reverse (as Ofcom has recently recognized⁷⁵).

Proposal 3: Do not raise the costs of the mobile operators unnecessarily. Governments are imposing high taxes and social obligations on mobile operators, thereby raising their costs. But otherwise it is important to keep the unit costs of the mobile operators to a minimum. This keeps prices low, increases take up, and hence improves economic performance generally. So governments and regulatory authorities should:

- refrain from imposing industry specific taxes on the mobile industry. Such taxes include differential high value added tax rates, licence royalty payments, and import duties on mobile terminals and network equipment (Box 8.1). As an example, based on Figure 3.4,

⁷³ e.g. because the overall costs exceed the benefits

⁷⁴ e.g. lack of transparency

⁷⁵ “Better Policy Making – Ofcom’s approach to Impact Assessment”, July 2005



85% of the handsets sold in the six study countries in 2004 (54 million⁷⁶) came from foreign countries. With an average handset price of €75 and applying the taxes on import duties for each country, the Governments received €0.6 billion in addition to the €8 billion estimated in Section 3.5. It is worth noting that the cumulative amount, €8.6 billion, is even higher than the total value added (in terms of GDP) by the mobile industry retained in the six study countries (€8.1 according to Figure 3.10). Box 8.1 provides some other examples of mobile specific taxes.

- fund universal services programmes out of general taxation rather than out of a taxation on the telecommunications industry. Given the central role of mobile operators in generating economic growth it is perverse to handicap that industry with additional taxation. Using general tax revenues for universal service funding would lead to lower priced services and higher mobile take up. This, in turn, would soon generate enough additional economic growth to more than compensate for any lack of universal service funds from the telecommunications industry
- streamline procedures for authorisation of new cellular masts. For example local authorities may delay authorisations or seek more restrictive limits than those specified by international guidelines on exposure levels. This kind of measures lead to higher costs for mobile operators and prevent final prices to be lower. A public disputes settlement body with relevant expertise could help speed up authorisations whilst addressing public concerns.

There are Government levies on mobile companies revenues in Brazil (2.5%), Colombia (5%), Peru (4%) and Venezuela (5%).

There are handset import duties in all six countries⁷⁷:

- 20% in Brazil
- 6% in Chile
- 5% in Colombia
- 15% in Mexico
- 25% in Peru
- 15% in Venezuela

In addition there are substantial local taxes, licence fees and spectrum charges in all six countries. These industry specific taxes raise both service and handset prices, so reducing affordability, slowing take up and lowering economic growth

Box 8.1 Examples of mobile specific taxes in the six study countries

- **Proposal 4: Focus policy on maximising penetration.** Mobile services are now reaching parts of the population previously unserved by telecommunications and penetration is reaching a critical mass where a given increase in penetration produce the greatest economic effects. (See Section 4.4). Fixed subscribers also benefit from mobile take up, as they are able to call to an increasingly number of users.

As mobile (as well as fixed) take up is a desirable effect, authorities should consider carefully the appropriate level of mobile termination rates. This last point requires further elaboration which is set out in Box 8.2.

⁷⁶ Source : Strategy Analytics (Central&Latin America Handset Forecast)

⁷⁷ Source : GSM Association (Tax and the Digital Divide study)



In a competitive mobile market the operators have incentives to increase mobile termination rates so as to subsidise lower handset and retail call prices. If the NRA forces the mobile termination rates to long run incremental costs plus a mark up, then this has a number of consequences which might not be compatible with a government policy of maximising penetration. Such regulation of mobile termination rates would lead to:

- higher handset prices
- higher retail mobile prices (fixed fees or mobile call prices)
- mobile services which are less affordable to the marginal customer, thus slowing mobile take up.

Box 8.2 Factors to consider in setting mobile termination rates

Proposal 5: Promote infrastructure based competition in the mobile sector. It is clear that infrastructure based competition is superior where it is viable. Two operators offering rival networks can compete on a wide range of attributes including price levels, price innovation, product functionality, marketing, customer service, and cost efficiency at both the retail and network levels. Service based competition, in which service providers buy airtime from the mobile operators and resell it, involves a much more limited form of competition which is restricted to marketing, customer support, retail cost efficiency and, to a limited extent, price levels. In addition, this kind of competition discourages network mobile operators from investing.

It is clear that infrastructure based competition in the mobile sector is functioning well in Latin America, with three to four operators in each country, extensive price and product innovation and steady price reductions. It is important to preserve this competition. In particular it is important not to undermine it through mandating MVNO access, whereby a service provider can buy airtime from one or more of the mobile operators at a regulated price. Instead we suggest that mobile operators and MVNOs should negotiate deals. Mandation has two main undesirable effects:

- it undermines infrastructure-based competition, especially from the smaller of the mobile operators, if the mandated price is set wrongly. The smallest mobile operators normally have the highest unit costs because of economy of scale effects. Mandating MVNO access at a wholesale airtime price which is too low reduces investment incentives for this mobile operator, who might switch to become an MVNO instead. This reduces the level of infrastructure based competition
- it reduces the prospects for negotiation of MVNO deals. A mobile operator has strong incentives to negotiate MVNO deals with organisations which can reach certain segments of the market more effectively than its own retail arm. But if the mobile operator is required to offer MVNO access to all organisations on non-discriminatory terms than it is likely to stop offering deals or to offer poor terms. It fears that, if it offers a deal to its preferred MVNO partner, then it must also offer the same deal to others. Some of these prospective MVNOs might constitute a major threat to its business e.g. the fixed incumbent.

Proposal 6: Consider whether to develop an industry to supply components to the mobile terminal or network equipment industry. The analysis of Chapter 3 shows that over 50% of the value add generated by the mobile services industry in Latin America flows to companies located outside the region. The bulk of this exported value add goes to terminal and network equipment suppliers. It is beyond the terms of reference of this study to examine



whether this flow of value add is inevitable or whether the governments of Latin America can take action to keep some proportion of it within the region by establishing local industries to supply some of the equipment components used at the upstream end of the value chain. But, given the size of the market involved and its continued prospects for growth, we believe it is a problem well worth considering further.



Annexes



Annex A Estimating the value chain

We estimate the value chain of Figure 3.2 from a variety of sources. These are listed in Figures A1 and A2⁷⁸. The overall process is as follows:

- estimate the total revenues generated by the mobile operators in the six study countries
- subdivide the revenues by source as shown in Figure A1
- estimate the overall level of free cash flow generated by the mobile operators. This is difficult. Few of the main operators provide estimates of either operating profit or free cash flow for the study countries individually or combined. So we estimate as follows:
 - the overall level of EBITDA for the mobile operators in the six study countries is just above 30%
 - these mobile operators are investing 28% of their revenues in capital expenditure
 - free cash flow is therefore around 5% of revenues
- estimate the breakdown of the outbound cash flows using Telefonica's SEC filing 20-F for 2004 plus additional information on cost breakdowns supplied by Latin American operating companies in the 6 study countries. This gives us the outbound cash expenditure flows.
- combine the estimates with the supplementary assumptions of Figure A2 to produce the value chain shown in Figure 3.2.

Note that our analysis ignores transfer payments between mobile operators. These do not add value to the chain. Consider the case of a mobile to mobile call where the value add is equal to the retail price paid. Part of this value add is captured by the originating operator and its suppliers and the other part by the terminating operator and its suppliers. It would be double counting to include both the retail revenue to the originating operator and the call termination revenue to the terminating operator. Equally the costs of producing a minute of mobile termination should exclude the payments made by each mobile operator to the others.

<i>Category of revenue</i>	<i>Estimate (€m)</i>	<i>Source/assumptions</i>
Handset sales	3479	% of Telefonica's total revenues from handset sales based on SEC 20-F filing for 2004
Revenues from other MNOs eg call termination revenues	1490	Assumed same as payments to other MNOs. See Figure A2
Revenues from fixed operators	1639	110% of revenues from MNOs. Based on equivalent ratios in Germany, UK and Ireland
Revenues from services – including any reseller revenues	11827	Balancing item
total	18435	From ITU for 2003 updated using Pyramid supplied estimates for 2004

Figure A1 The breakdown of mobile network operator (MNO) revenues

⁷⁸ Certain confidential information has been deleted from this annex



<i>Parameter</i>	<i>Value used</i>	<i>Source of estimate</i>
% of terminal value add retained by their manufacturers	32%	Analysis of accounts of Motorola, Nokia and Ericsson
% of network equipment value add retained by their manufacturers	35%	Analysis of accounts of Motorola, Nokia and Ericsson
% of MNO capex spent on network equipment	71%	Based on US and EU practices
% of FNO revenues from MNOs spent on capex	30%	Based on US and EU practices

Figure A2 *Supplementary assumptions and source*



Annex B Geographic distribution of value added

B1 Introduction

Having estimated the value added by each type of player in the value chain we need to consider how the value add is distributed geographically between the six study countries and the rest of the world (RoW). To do this we:

- estimate the split of value add for each player type into value add categories. These are:
 - wage costs, ie wages and associated employers' cost
 - other operating expenditure which converts into value add for upstream suppliers of this player type and
 - taxes, profits and interest payments.

Figure B1 presents our estimates and assumptions

- estimate the geographic split of value add for each combination of player type and value add category between the six study countries and rest of the world. Figure B2 presents our estimates.

Type of player	% split of VA		Source
	wages	operating income	
Resellers and dealers	40%	30%	30% Analysis of accounts of US and EU dealers
Mobile operators	50%	50%	0% Value chain analysis
Fixed line operators	40%	20%	40% Split for fixed operators in US and EU
Other capex suppliers	40%	20%	40% As for fixed line operators
Support service suppliers			
Terminal manufacturers	45%	10%	45% Analysis of manufacturers accounts
Their component suppliers			
Network equip manufacturers	45%	10%	45% Analysis of manufacturers accounts
Their component suppliers			

(1) For upstream value add by their suppliers

Figure B1 Splitting the value add (VA) by category

Type of player	% value add		Source
	Lat Am	RoW	
Dealer	100%	0%	These activities are assumed 100% national
Wireline operator	100%	0%	These activities are assumed 100% national
Other capex supplier	100%	0%	These activities are assumed 100% national
Support service suppliers	100%	0%	These activities are assumed 100% national
Wireless carrier			
wages	100%	0%	These activities are assumed 100% national
operating income	20%	80%	Given the level of foreign ownership of the mobile operators
Terminal manufacturer	15%	85%	See text
Terminal component suppliers	0%	100%	See text
Network equipment manufacturer	15%	85%	See text
Network equipment component su	0%	100%	See text

Figure B2 Splitting the value add (VA) between Latin America (Lat AM) and the Rest of the World (RoW)



In many cases the geographic distribution is obvious. So for example all the value added by the Latin American dealer networks remains in the region. In other cases the geographic distribution requires some research. We discuss the geographic distribution for the equipment supply part of the chain below.

Note that, in distributing the value add, we treat the cost of sales to each final upstream supplier (that is suppliers which terminate the upstream ends of the value chain of Figure 3.2) as value add in the country of that supplier.

B2 VA by geography for terminal and network equipment supply

Based on analysis of the accounts of some of the main network equipment and mobile terminal suppliers in Latin America⁷⁹ we estimate that:

- they incur around 50% of the costs of selling and marketing to the region in the region itself
- they incur none of their R&D, manufacturing or central administration functions in the region
- sales and marketing represents 30% of their value add

We therefore assume that 15%⁸⁰ of the value add of the terminal and network equipment suppliers to the industry remains in the region and the other 85% flows to countries outside the six study countries

Further analysis of the activities of the main component suppliers, such as the semi conductor suppliers and the PC manufacturers, indicates that they locate very few of their activities in the six study countries. We therefore assume that 0% of the value add of these players is retained in the region.

B3 Value Add by Geography – Results

Applying the geographic split of Figure B2 to the value chain of Figure 3.2 produces the distribution of value add by player type and geography shown in Figure B3.

<i>Player</i>	<i>VA (€m)</i>		<i>Total</i>
	<i>Lat Am</i>	<i>RoW</i>	
Dealers	1289	0	1289
MNOs	1658	369	2026
FNOs	703	0	703
Other capex suppliers	1218	0	1218
Support services	2805	0	2805
Terminal suppliers	271	1535	1806
Components for terminals	0	3837	3837
Network equipment suppliers	171	970	1141
Hardware platforms etc	0	2120	2120
Total	8115	8830	16945

Figure B3 Splitting the value add by category

⁷⁹ eg Nokia, Ericsson and Motorola

⁸⁰ 50% of 30%



Annex C The consumer surplus from use of mobile services in Latin America

C1 Economic welfare and the consumer surplus

Graphically, the consumer surplus is the area ABC shown in Figure C1.

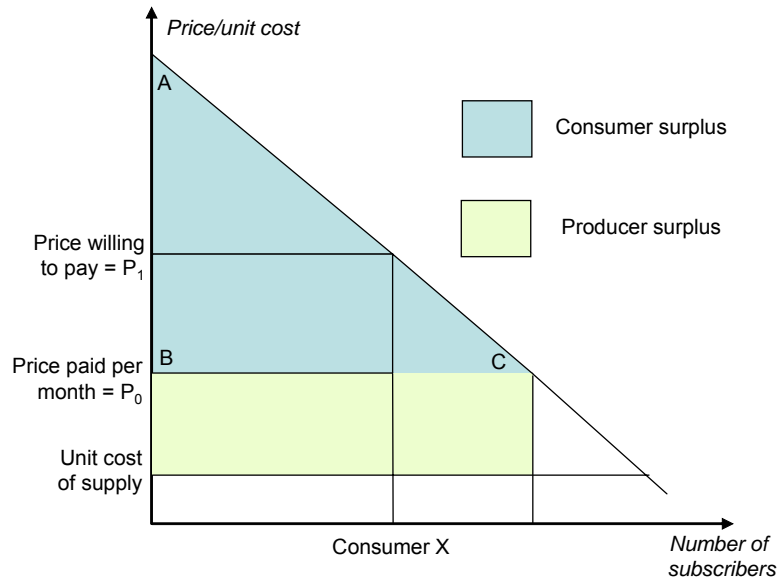


Figure C1 A definition of the consumer surplus

The figure shows that Consumer X is willing to pay a price P_1 per month for mobile service, but actually pays price P_0 . So Consumer X enjoys a consumer surplus of P_1 less P_0 per month. This is disposable income which Consumer X can spend on other goods or services, or invest in the economy in some way. The area ABC represents the total consumer surplus, which covers both early adopters, with a high valuation of cellular services, and marginal consumers, for whom the current price just tempts use of cellular. The consumer surplus measures the combined social and commercial benefits which Latin American users generate from cellular mobile services.

In addition the use of mobile services generates a **producer surplus** – the other shaded area of Figure C1. This is the price paid per month less the cost of supply per month times the number of subscribers or, more simply, the profit to wireless operators from supplying service. Together the consumer and producer surplus measure the **overall economic welfare** from cellular wireless services.

C2 Previous Estimates of the Consumer Surplus

Various authors have estimated the consumer surplus from cellular wireless services in the past. In particular:



- Jerry Hausman first estimated the consumer surplus for the USA in 1997⁸¹. He used price elasticity models to establish the demand curve from which to estimate the consumer surplus
- since then he has updated his estimate. In 2003⁸² he estimated that the US consumer surplus was in the range \$80 billion to \$150 billion per year in mid 2002. During 2002 the US industry generated \$77 billion in revenues
- in testimony to the US senate, Thomas Haslett⁸³ estimated that the US consumer surplus was at least \$80 billion per year in 2003.
- the UK's Radio Communications Agency also estimated a consumer surplus for UK cellular services, there, using a willingness to pay survey. In 1999 cellular services generated revenues of £4.8 billion while the consumer surplus was estimated at £7.2 billion for the year.

C3 Estimates for the six study countries of Latin America

We can use two different approaches to estimate the consumer surplus from mobile services in the six study countries of Latin America:

Method 1: scale the consumer surplus estimates for the US and the UK to the six study countries

Method 2: use data from the six study countries to estimate a lower bound to the demand curve in the region and use the curve to estimate a lower bound on the consumer surplus.

C3.1 Method 1

Based on the estimate presented in Section C2 we calculate that the mobile services in the six study countries generated a consumer surplus of \$36 billion in 2004. Figure C2 provides that calculation. This estimate assumes that the consumer to revenue ratio in the US and UK is applicable to Latin America as well.

It is difficult to validate this assumption. Mobile prices and minutes of use lie between the US and EU levels (Working Paper 1) but average incomes are much lower in Latin America. So it is difficult to tell if the price demand curve in Latin America is of a similar shape to that in the US or EU.

⁸¹ Hausman J, Valuing the effect of regulation of new services in telecommunications, Brookings papers on economic activities, microeconomics, 1997, 1-38

⁸² See Shann Lecture, March 2003

⁸³ Exit strategies for the digital TV transmission, testimony to the US Senate Commerce Committee, T Hazlett, June 2004



<i>Estimate</i>	<i>Revenues</i>	<i>Consumer surplus</i>	<i>Consumer surplus/Revenues</i>
Hausman estimate for mid 2002	\$77bn pa	\$115bn pa ⁸⁴	1.49
UK Radio Communications Agency estimate for UK in 1999	£5.0bn pa	£7.2bn pa	1.44
Estimate for six study countries of Latin America in 2004	\$24.3bn pa	\$35.7bn pa	1.47 ⁸⁵
Estimate for whole of Latin America in 2004	na	\$43bn pa ⁸⁶	1.47

Figure C2 Consumer surplus from wireless services in Latin America – Method 1

C3.2 Method 2

To estimate the consumer surplus from empirical data we would need to construct the current demand curve. This usually involves collecting data via willingness to pay surveys. We do not have access to such data for Latin America. But we can use another approach to provide a lower bound on the consumer surplus. We can plot revenue per minute at 2004 prices against the volume of use per year in billable minutes. This provides the curve shown in Figure C3 for the six study countries combined.

This curve forms a lower bound on the demand curve of Figure C1 – with the number of subscribers exchanged for the number of minutes of use on the X-axis. Clearly the subscribers who used cellular services in 2000 are willing to pay at least the price shown at that time. But we can also see that the true demand curve is likely to be to the right of that shown in Figure C3. Diffusion effects means that, without a change from the 2000 price for cellular services, the volume of use by subscribers who joined before 2000 would have grown between 2000 and 2004 as these subscribers found new ways of using cellular services. So the data point for 2000 on the current demand curve is to the right of that shown in Figure C3. This means that the area under the curve of Figure C3 represents a lower limit, and substantially underestimates, the current consumer surplus.

⁸⁴ Mid point of Hausman range between \$80bn pa and \$150bn pa

⁸⁵ Mid point of two previous ratios

⁸⁶ Assuming the consumer surplus increases in proportion to the number of subscribers when compared to the six study countries

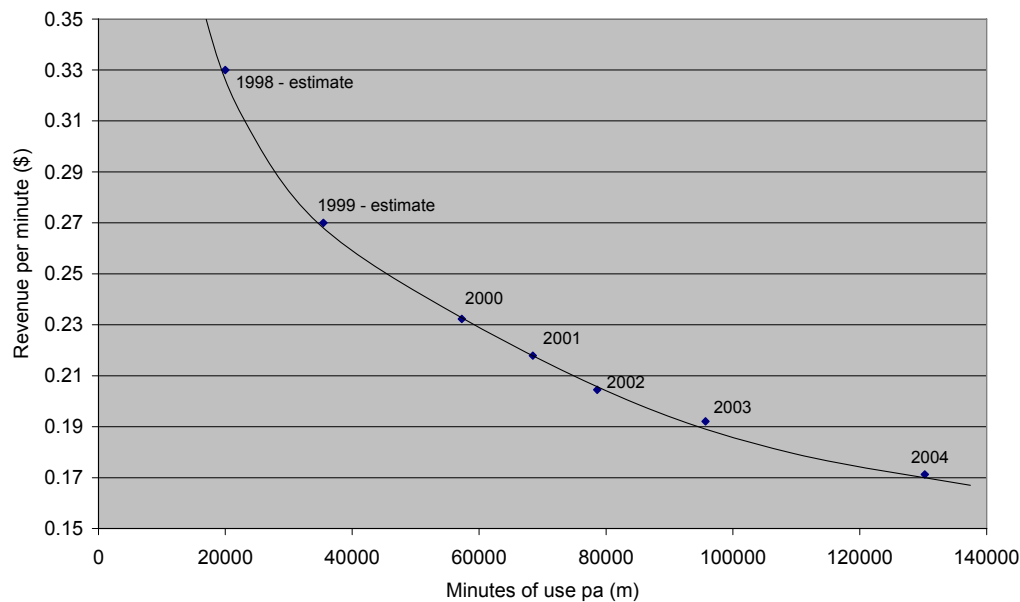


Figure C3 A lower bound on the consumer surplus from mobile services in Latin America

Source: Merrill Lynch

We have applied this approach to the US, to the UK, and to the six study countries of Latin America as shown in Figure C4. Let us assume that the uplift factor which converts this lower bound into the measured consumer surplus for the US and the UK applies in Latin America. Then the consumer surplus from mobile services in the six study countries in 2004 was \$25 billion per annum as calculated in Figure C4. This estimate is consistent with, if lower than, the estimate of \$36 billion per annum derived using Method 1.

Consumer surplus	Area under price curve (A)	Estimate of consumer surplus (B)	Ratio B/A
US in 2002	\$60 bn pa	\$115 bn pa	1.91
UK in 1999	£4.8 bn pa	£7.2 bn pa	1.50
6 study countries of Latin America in 2004	\$14.4 bn pa	\$24.6 bn pa	1.71 ⁸⁷
Latin America as a whole in 2004	na	\$29.6bn pa ⁸⁸	1.71

Figure C4 Consumer surplus from wireless services in Latin America – Method 2

⁸⁷ Mid point of US and UK ratios

⁸⁸ Assuming the consumer surplus increases in proportion to the number of subscribers when compared to the six study countries



C4 Conclusions

Based on the analysis set out above we conclude that:

- the mobile services of the six study countries of Latin America generated a consumer surplus of around \$30 billion per annum in 2004
- there is uncertainty attached to this estimate. The true figure may be up to 30% higher or lower.

This consumer surplus is probably an order of magnitude greater than the producer surplus generated by the industry.



Annex D Examining the Relationship between Mobile Take Up and Economic Growth

D1 Introduction

In a recent study using a large sample of developed and developing countries Waverman, Meschi and Fuss(2005) –here after WMF, utilize an endogenous growth model and locate a statistically significant link between GDP growth and mobile take up. The authors also find that this effect is larger in developing countries where mobile services provide the main telecommunications networks given the often prohibitive cost of fixed line telephony. In this paper we seek to replicate the findings of WMF, and using updated data, explore the robustness of the findings. In addition we also consider how the findings enable us to quantify the extent to which higher mobile take-up in the six study countries -Brazil, Chile, Columbia, Mexico, Peru and Venezuela -might impact on economic growth.

The paper is organised as follows. In section 2 we briefly consider the theory which underpins the empirical analysis and in seeking to both replicate and extend WMF, outline a number of the problems faced by growth empirics. In taking the WMF study as a point of departure, in section 3 we report our results based on replicating the findings of WMF. Section 4 examines the problem of robustness of our findings in terms of an alternate classification of countries, the impact of omitted factors, and the time window. In Section 5 we present our results and section 6 discusses a number of areas for future research.

D2 Modelling Economic Growth

Since the mid-1980s, the study of long term growth has made a major re-appearance on the research agenda in economics. An important stimulus for this revival has been the renewed interest in the empirics of growth, and especially the evidence that rates of long-run convergence of per capita output and incomes between nations appear to be much slower and far more variable than predicted by the standard neoclassical growth model. Although several variants of this new endogenous growth theory have been developed, all permit a wider set of possibilities with regard to convergence behaviour. The methodology generally employed is a standard cross-country regression in which a set, say F , explanatory variables are identified, and then used to explain rates of growth across a set of countries for a given period. Variables that comprise f include the initial level of income, the investment rate, and measures of human capital. However, in different contexts the analysts augment F with one or more specific set of factors. Policymakers have done this to examine, for example, the effects of health care spending on growth, to determine the impact of monetary policy, and the impact of different institutional/cultural factors such as the rule of law. In this particular application we seek to determine the nature of the returns to telecommunications capital, and specifically the impact of mobile penetration on economic growth, particularly in developing countries.

Of late there have been a large number of papers that have considered the problems faced by empirical growth studies.¹ Although we do not intend to review these problems in depth, the essence of the problem is recognisable from other areas of empirical investigation in



economics, namely how confident can we be in making causal statements in the face of observational data given competing theories of the same phenomenon, and lack of access to the full set of explanatory factors we believe to be important. One should also stress that the problem is more acute than this in that even if we have access to all possible explanatory factors, it may be the case that for a relatively small sample (for example the 92 countries used in the WMF study) that the dimension of F becomes very large. This may happen as a result of an analyst having at his disposal a large number of similar measures of the same underlying construct. For example, although the theory underlying endogenous growth attributes a significant effect to human capital, there are a very large number of competing measures of this effect. In WMF the authors utilise the proportion of the fifteen and above population that have completed primary school. However, there is no absolute certainty that this is the correct measure.

Within the field of economic modelling there has, of late, been a considerable number of studies that have sort to account for this type of uncertainty in undertaking empirical analysis.² Since it is often not clear a priori which theory is correct and which variables should be included in the “true” regression model, a naïve approach that ignores specification and data uncertainty generally results in biased parameter estimates, over-confident (too narrow) standard errors and misleading inference and predictions. Such an approach assumes that the economic analyst has complete and non-disputable knowledge as to the correct model. For example, in the context of the present exercise, one might augment the set of explanatory regressors used in WMF to control better for the type of country, geographical location, and both the institutional and regulatory environment. However, in the face of uncertainty one analyst may do this in a different way than another, such that we face the problem of how to weight different sets of results? More generally we note that standard approach to model comparison and testing is not viable in a situation characterised by a small sample size, where the dimension of f is large, and many of the regressors comprising f are collinear. An alternative approach addresses this problems³ and explicitly accounts for uncertainty by averaging over a l (potentially) large number of models.³_{dfj}

D3 A Point of Departure: The WMF Study

In seeking to replicate the findings in WMF we first present in Table 1 summary statistics both as presented in WMF and based on comparable data collected by Indepen. Immediately we observe a number of differences in the properties of the variables. In some cases these differences are relatively small. For example, mean per capita gross domestic product(gdp) in1980 is 6.97 for the WMF data set and 7.61 in the data we are using -hereafter Indepen. The income classification utilised by WMF generates two regimes: 69 countries in the low and 23 in the high income group. We note that for the measures of mobile and fixed line penetration, our summary statistics are generally comparable to those in WMF, although in their Table 1 the number of countries contributing to the mean for fixed line penetration is 22 and not 23.

1 See for example, Levine and Revelt(1992)

2 See for example, Sala-i-Martin, Doppelhofer and Miller(2004).

3 There is a recent and growing literature on this topic. See, for example, the paper by Brock, Durlauf and West(2003) on applying model averaging to economic policy decisions.



If we now turn to Table A2, we report parameter estimates from the baseline model (Model1) in WMF, where the authors estimate a simple cross-section endogenous growth model, making the assumption that any growth dividends attributable to either fixed or mobile line penetration are constant across all countries. This model has exactly the same specification as that presented in WMF (Appendix B), and is written as

$$GDP_{8003} = \alpha + \beta_1 GDP_{80} + \beta_2 K_{8003} + \beta_3 TPEN_{80} + \beta_4 MPEN_{9603} + \beta_5 APC15_{80} + \varepsilon,$$

where GDP_{8003} denotes the average growth rate of real gdp over the period 1980-2003⁵ K_{8003} denotes the average share of investment in gdp and over the same period. GDP_{80} and $APC15_{80}$, are state variables, respectively real gdp, and the proportion of 15 and over population who had completed at least primary school in 1980. Measures of telecoms penetration are: $TPEN_{80}$, the fixed telephony penetration rate in 1980, and $MPEN_{9603}$, the average level of mobile penetration over the period 1996-2003. α , $\beta_k, k=1, \dots, 5$, are unknown parameters, and ε is a stochastic disturbance term.

In comparing our results in Table A2 with those reported in Table II in WMF, we first note that in Table II the regression results are based on a sample of 91 countries. Presumably this is due to the single missing value on $TPEN_{80}$ as indicated in Table 1. Model 2 reports regression results based on partitioning countries into two income groups as in WMF. In this instance we observe a number of significant discrepancies. Most notably the result in WMF that the mobile penetration dividend for low income countries is double that for high income is not revealed. Moreover, although we find a significant effect for high income countries, the effect is not statistically significant for the low income group at either the 5 or 10 % significance level.^{6 sig}

As WMF note, although an assumption of exogeneity of the state variables, namely 1980 levels of human capital and fixed line telephony is reasonable, it is necessary to examine whether the same assumption is tenable for the average level of mobile penetration over the period 1996 to 2003. Using the average level of fixed telecoms penetration during the period 1960-79 as an instrument ($FPEN_{6079}$), WMF fail to reject a null hypothesis that $MPEN_{9603}$ is exogenous to economic growth over the period 1980-2003. Using our data we performed two tests of endogeneity with the following results.⁷

Wu-Hausman F test: 0.32097 F(1,85) P-value = 0.57252

Durbin-Wu-Hausman chi-sq test: 0.34610 Chi-sq(1) P-value=0.55633

The findings of WMF were thereby upheld.

⁴ Note that in all regressions reported standard errors are, as in WMF, corrected for heteroscedasticity.

⁵ In constant 1995 International Dollars.

⁶ The p value is 0.124.

⁷ We do not report the parameter estimates of the instrumental variable regression, although all estimates are available if required

⁸ See Roeller and Waverman(2001).



D4 Robustness

It is important to emphasise that the original impetus for the use of the endogenous growth model in WMF was due to problems that were encountered when trying to use the Roeller-Waverman approach.⁸ Specifically the authors cite problems in the robustness of this methodology to sample size and small changes on model specification. Below we consider a number of issues related to the robustness of the endogenous growth model as applied to determine the impact of mobile penetration on growth rates. First, and due in part to our inability to replicate the WMF findings when allocating countries to two income groups, we consider an alternate the classification of countries. Second, we consider the critical question of whether the parameter estimates reported in WMF are robust to additional control variables. Third, we consider the impact of changing the period over which growth rates are calculated.

D4.1 Robustness to Country Classification

In the original report countries were allocated to a high income group if they were in the top quartile of per capita gross domestic product (pgdp) in the base year; low income economies were defined as the remainder. An obvious problem here stems from the potential problem of heterogeneity within the low income group. Subsequently, given our prior beliefs that the growth dividend from the expansion of mobile services will be higher in countries with low income, then we may be underestimating the dividend for the extremely low income economies if our country classification is too coarse. WMF also acknowledge this point (see footnote 32 in their paper) noting that their particular classification is likely to under estimate the effects of mobile penetration on the most underperforming developing countries. An insight into the possible effects of utilising the WMF grouping can be seen from Table 2. Here we present summary statistics for two income classifications, where pgdp for income group j is denoted $GDP80_j$. Given that ceteris paribus we would expect a lower impact of mobile penetration for the presence of higher fixed line telephony, it is also instructive to characterize these different groupings based upon the per 100 fixed line penetration in 1980.

Compared to the trichotomous low, med, high grouping, we observe considerable heterogeneity in terms of per capita gdp within the dichotomous low, high classification. Subsequently, for the low income group it is obvious that with the minimum and maximum per capita gdp spanning \$610 and \$12,020, this group incorporates very different economies. For example, Mozambique and Malawi with 1980 pgdp levels of, respectively, \$682 and \$609, had fixed line penetration levels of 0.27 and 0.24 per 100 population. However, this low income group also includes Portugal. In 1980 Portugal's pgdp was \$10,120 and had a fixed line penetration level of 10.2.

In contrast an income classification which isolates a low income group based on position with the bottom quartile of gdp per capita in 1980, defines a relatively homogenous group. The consequences of choosing either classification are straightforward. Notwithstanding the greater precision that will be afforded to parameter estimates in the low income group under the WMF classification, based upon the summary statistics in Table 1, we note that such a coarse classification automatically imposes a constant dividend over a diverse set of economies, which includes the group of six case study countries. Therefore under a simple dichotomous classification, any effects on per capita gdp of mobile penetration that it is attributed to low income economies will be assigned to these economies. As a result it is likely that the dividend



to mobile penetration for this group of countries will be overestimated; and that the impact of the diffusion of mobile services to the poorest countries will be underestimated.

Using the trichotomous classification as a base, our default assumption will be that the six case study countries, namely Brazil, Columbia, Chile, Mexico, Peru and Venezuela are representative of middle income countries. However, despite the small size of this group, we will attempt to determine whether after controlling for the three broad income groupings, there are any significant differences in terms of the impact of mobile penetration for these economies.

D4.2 Robustness to Omitted Factors

There are many examples in economics where inference which is based on a model where key explanatory factors are omitted may be erroneous.⁹ Although the WMF study provides a useful point of departure for examining the impact of mobile penetration on economic growth, as the authors WMF acknowledge, one cannot take their results as definitive given that a number of potentially important explanatory variables have been omitted. The essence of the problem relates to the existence of one or more third factors (such as institutional quality¹⁰) which are correlated both with growth rates and mobile penetration. Consider the following example. Lets assume that country z and country v appear relatively similar in terms of observable initial levels of income, human capital and investment. However, z has a high rate of growth and high mobile penetration; country v has both relatively low rate of growth and mobile penetration. In this instance casual empiricism might lend itself to attributing a positive effect of mobile penetration on growth rates. However, if institutional conditions, such as the rule of law and shareholder rights are better in z and/or the regulatory environment is more conducive to private sector expansion, then without taking into account how these factor differ between the two countries there are limits to the type of inference than can be made.

To address this issue, and given the time constraints of this study, we utilise the findings of Sala-i-Martin, Doppelhofer and Miller (2004), hereafter SDM. In examining the determinants of economic growth for a large sample of 98 countries over the period 1960-92, SDM sort to examine the question of whether when faced with a very large set of potential explanatory variables, it was possible to locate a number of variables that were robustly correlated with growth. In this context an explanatory variable, say xk, is considered robustly correlated with growth if across them any different models generated by the combination of a large set of regressors, this variable appears statistically significant in a large proportion of models. In contrast variables which are non-robust may initially appear as significant, but the impact both falls and becomes statistically insignificant, when other factors are controlled for.^{for}

⁹ Perhaps the best example of the fact that correlation of effects does not necessarily imply causation, is the many years and many millions of dollars that it has taken before there is general agreement across doctors and lawyers that smoking causes cancer

¹⁰ WMF refer to this factor as being potentially important.



D4.3 Robustness to Time Periods

In the analysis conducted by WMF an endogenous growth model is used to examine the relationship between average growth rates over the period 1980-2003 and measures of fixed and mobile telephony, with controls for initial income and human capital together. It is important to emphasise that the relationship is framed in terms of average growth rates calculated over a specific time window -a period of twenty three years. One advantage of this approach is that the relatively long time period facilitates a focus on long-run relationships; and for this period basing a regression on an average growth rate removes the effect of short-term idiosyncratic fluctuations. Nonetheless we sought to examine the robustness of the WMF findings when we changed the time period. Two additional time windows were considered: average growth rates over the period 1990-2003 and 1996-2003. Obviously as the time window is reduced the nature of the inference changes from a focus on long-run relationships, to, in the case of 1996-2003, a relationship more in keeping with the duration of a business cycle.

In summarising our results we note that for both new time windows none of the measures of telecoms penetration were significant. Moreover, although we would not ordinarily focus on R^2 as a single measure of fit with which to judge any given model, it is instructive to note that over the three periods 1980-2003, 1990-2003 and 1996-2003, the extent of variation in growth rates that is explained by our model (in this case Model 1) falls considerably -from 56, to 43, then 31 per cent. Our general conclusion here is that as we shorten the time window from 23 to 13 to 7 years, our cross-section model is increasingly influenced by year-on year short-term fluctuations, rather than long-run economic relationships.

D5 Results

In Table 3 we collect the parameter estimates¹¹ of the impact of mobile penetration (MP) levels on growth rates of per capita gross domestic product based on a number of different model specifications. In addition we report the impact on per capita gdp of an increase in MP of 10 phones per 100 population. Model specifications 1 and 2 are as introduced in section 3. Model 3 utilises a different income classification, introduced in section 4, which isolates both the very rich and very poor economies using per capita gdp. Model 4 extends model 3 by including a number of additional controls based on the discussion in section 4.2. The remaining parameter estimates and model diagnostics are presented in Table A2.^{a2}

In model 1 a parameter estimate of 0.00033 implies that a 10% increase in mobile penetration generates a 0.33% increase in growth, comparable to the 0.38% reported for the same model in WMF. As stated in section 3, we were unable to replicate the parameter estimates for model 2, and as a result our findings in terms of the impact of mobile penetration are different. For high

¹¹ Parameters are reported to 4 decimal places.

¹² We note that given the aggregate nature of the data, for this model specification and all others presented here, we are not able to incorporate any measures of shared use. Subsequently, given that for lower income countries mobile purchase may still be prohibitive for large numbers of individuals, there are many cases where phones are shared amongst members of, for example, a small community or a village. In such cases statistics which capture the numbers of phones in use per head of population, may underestimate the impacts on growth.



income countries the effect of a 10% increase in mobile penetration is estimated to be a 0.5% increase in growth. For low income countries the effect is not significant.¹²

Of particular note are the findings from model 3, based on the trichotomous income classification. Across the low, medium, and high-income countries we estimate a significant effect, with (respective) impacts on growth rates of a 10% increase in mobile penetration being 5, 0.6, and 0.3 per cent.¹³ In this respect what is notable is the extremely large effect on growth for low income countries.

Models 1, 2, and 3 are based on the specification considered by WMF. Model 4 extends model 3 by incorporating a number of additional controls,¹⁴ following the discussion in section 4.2. Our prior hypothesis here would be that by including additional controls the magnitude of the effect of mobile penetration would be reduced. The logic of this prior follows from the definition of the parameter itself namely, the impact of mobile penetration after the effects on economic growth of all other contributing factors have been controlled for. These additional controls are¹⁵: dummies for East Asia, sub-Saharan Africa, and Latin America, a dummy for whether a country was a Spanish colony, the fraction of time spent in war,¹⁶ political rights, civil liberties, fraction of the country in the tropics, and number of years open.¹⁷ Based on this particular extension of model 3,¹⁸ we found that the effects are still significant for low and medium income economies, but not for high income. As expected the magnitude of the effects fall: to 4% for low, and to 0.3% for medium income countries. We also note that model 4 represents an improvement given that a higher proportion of variance in growth rates is explained, and unlike models 1-3, passes the Ramsey test of model misspecification.

D5.1 Multiple Extensions of Model 3

In model 3, we have stated that there are statistically significant and large growth dividends to mobile penetration in both low and medium income economies. A question that naturally motivates an examination of the robustness of such inference is: Utilising an endogenous growth model which controls for three state variables (initial income, human capital, and fixed line telephony), together with average mobile penetration over the period, is the estimated dividend specific to this particular representation?

¹³ In Ding and Haynes (2004) the authors find a similar growth impact for the penetration of combined mobile and fixed line telephony in China.

¹⁴ Given that our interest is primarily on those variables initially considered by WMF, we do not report the parameter estimates for these additional controls in Table 2. They are available on request.

¹⁵ A number of the robust explanatory variables in SDM cannot be used here given that they are specific to the time period examined, 1960-92.

¹⁶ For the period 1960-90.

¹⁷ For the period 1950-94.

¹⁸ In examining these variables it is clear that many represent what are often referred to as fixed effects, that is characteristics of countries that are important for growth (and also determinants of effects are still significant for low and medium income economies, but not for high income. As expected the magnitude of the effects fall: to 4% for low, and to 0.3% for medium income



The expansion of model 3 to model 4 was based on the inclusion of a number of additional controls that were found to be robust in the SDM study. Therefore in estimating a single alternate specification we might be tempted to say that the effect we have identified is robust. However, it is important to underline the distinction between this simplistic notion of robustness and the meaning of robust in the methodology employed by SDM. Consider the following very simple example. An analyst has at his disposal seven possible determinants of growth rates. If one were to take a fully agnostic standpoint, then the number of possible linear models, considering all combinations of explanatory variables, is $2^7 = 128$. If we were now to estimate all possible regression models, and focussing on a particular regressor of interest, say MPEN, we could determine the proportion of times that this variable was significant and with the expected sign over the set of models. Moreover, by assigning probabilities to each estimated model, we could construct a parameter estimate for the telecoms measure MPEN that is a weighted average of these estimates. This is, broadly, what we mean by robust. Namely, an effect of mobile penetration on growth that is not specific to one or a small number of model specifications. Although such an investigation is beyond the remit of this study, in a preliminary investigation our findings suggest that the effects of mobile penetration on growth are robust in this more general sense (mobile penetration) which are time invariant.

D6 Conclusions and Areas for Further Study

In this short study we have extended WMF in a number of directions, largely based on an investigation of robustness. Although we were unable to fully replicate their findings, our results strongly suggest that there are growth dividends to mobile telephony, and that such dividends are larger for less developed countries. In utilising a different income classification, our findings indicate that for the poorest countries, in this study those in the first quartile of gdp per capita in 1980, the returns to increasing mobile penetration are substantially larger than those reported in WMF. In the case of the six case studies, our results are consistent with those in WMF, although we do observe a considerable fall in the impact once we condition on additional control variables.

There are a number of areas where further investigation might be useful. First, as WMF noted, although the issue of the potential endogeneity of the mobile penetration variable has been addressed, it is necessary to investigate whether there are other regressors that might be endogenous. Second, all specifications that have been considered have assumed that over all levels of mobile penetration, the effect of a ten percent increase is the same. Although our results suggest that the return to mobile penetration are inversely related to the general level of economic development, other effects, such as the presence of network externalities work in the opposite direction. In this regard it is likely to be worthwhile to explore in more detail, both the source and the effects of nonlinearity on the relationship between mobile penetration and growth rates.

Third, a fully fledged analysis of robustness would require collecting more data that is specific to the particular period examined. For example, SDM found that a number of state variables, such as life expectancy in 1960 were robust correlates of growth. However, given that we are utilising a different time window [1980-2003], it is as only possible to utilise variables that were identified as robust in SDM that were time invariant.



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	N	Table 1: Summary Statistics: Variables in WMF					
		μ		s		Min	Max
		Indepen	WMF	Indepen	WMF	Indepen	
<i>GDP</i> ₈₀₀₃	92	0.0125	0.01	0.0195	0.02	-0.049	0.078
<i>GDP</i> ₈₀	92	7.606	6.97	6.776	6.25	0.609	25.08
<i>K</i> ₈₀₀₃	92	20.904	20.86	5.449	5.48	9.103	43.381
<i>TPEN</i> ₈₀	92	10.336	10.22	14.07	14.11	0	57.995
<i>TPEN</i> _{80L}	69	3.314	3.32	5.078	5.07	0	25.38
<i>TPEN</i> _{80H}	23	31.402	31.84	11.025	11.10	11.418	57.995
<i>MPEN</i> ₉₆₀₃	92	19.622	19.23	21.02	20.95	0.057	67.318
<i>MPENL</i>	69	10.631	10.27	14.378	14.40	0.057	67.318
<i>MPENH</i>	23	46.597	46.10	13.239	12.96	16.995	64.991
<i>APC</i> ₁₅₈₀	92	44.696	45.13	25.494	25.97	3.900	97.300
<i>FPEN</i> ₆₀₇₉	92	2.864	7.52	4.253	10.66	0	19.067

Note: 1. All variable definitions are as reported in WMF

2. We have reported means (μ) and standard deviations (s) for both Indepen and WMF data

Note: 1. All variable definitions are as reported in WMF

2. We have reported means (μ) and standard deviations(s)for both Indepen and WMF data



Table 2: Income Groups - Summary Statistics

	GDP_{80}					$TPEN_{80}$			
	μ	s	n	min	max	μ	s	min	max
	Low, Medium, High								
GDP_{80L}	1.19	0.40	24	0.61	2.10	0.25	0.13	0.06	0.57
GDP_{80M}	5.48	2.77	45	2.27	12.02	4.52	5.25	0	25.38
GDP_{80H}	17.97	2.97	23	12.50	25.07	31.40	11.02	11.42	58.00
	Low, High (Waverman et al)								
GDP_{80L}	4.15	3.18	69	0.61	12.02	3.31	5.08	0	25.38
GDP_{80H}	17.97	2.97	23	12.50	25.07	31.40	11.02	11.42	58.00

Table 3: Mobile Penetration and Growth

	Mobile Penetration				R^2	White	Ramsey
	MPen	MPenL	MPenM	MPenH			
Model 1 +10/100 mob phones	0.0003 ⁺ [0.3%]	-	-	-	0.556	0.019	0.004
Model 2 +10/100 mob phones	-	0.0003 [0.3%]	-	0.0004 ⁺ [0.4%]	0.560	0.014	0.008
Model 3 +10/100 mob phones	-	0.005 ⁺ [5%]	0.0006 ⁺ [0.6%]	0.0003 ⁺	0.600	0.177	0.006
Model 4 +10/100 mob phones	-	0.004 [~] [4%]	0.0003 ⁺ [0.3%]	0.00009 -	0.665	0.04	0.125

Notes: ⁺, [~] significant at the 5%, 10% level

Model 2: High Income countries (Top Quartile GDP 1980)

Low Income countries (1st 3 Quartiles GDP 1980)

Model 3: High Income countries (Top Quartile GDP 1980)

Low Income countries (Bottom Quartile GDP 1980)



Table A1: Country Classifications

Low, Medium, High*Composition*

Y_{80L}	BGD, BEN, CAR, CHN, GHA, IND, IDN, KEN, LSO, MWI, MLI, MOZ, NPL, NER, PAK, RWA, SEN, SLE, LKA, SDN, TGO, CON, ZMB
Y_{80M}	DZA, ARG, BOL, BWA, BRA, BUL, CMR, CHL, COL, CRI, CYP, DOM, ECU, EGY, SLV, FJI, GMB, GTM, HND, HKG, HUN, IRN, IRL, JAM, JOR, MYS, MUS, MEX, NIC, PAN, PRY, PER, PHL, PRT, SGP, ZAF, SWZ, SYR, THA, TTB, TUN, TUR, URY, VEN, ZWE,
Y_{80H}	

Low, High*Composition*

Y_{80L}	BGD, BEN, CAR, CHN, GHA, IND, IDN, KEN, LSO, MWI, MLI, MOZ,
Y_{80H}	As Y_{80M} above plus:



Table A2: Parameter Estimates

Variable	Model 1		Model 2		Model 3	Model 4
	Indepen	WMF	Indepen	WMF		
GDP80	-0.0024 ⁺	-0.0026 ⁺	-0.0024 ⁺	-0.0025 ⁺	-0.0020 ⁺	-0.0020 ⁺
K8003	0.0020 ⁺	0.0017 ⁺	0.0021 ⁺	0.0018 ⁺	0.0018 ⁺	0.0011 ⁺
TPEN80	0.0050 [~]	0.042	-	-	-	0.0000
TPEN80L	-	-	0.0002	-0.0002	-0.005	-
TPEN80M	-	-	-	-	-0.000	-
TPEN80H	-	-	0.0003	0.0005	0.001	-
MPEN	0.0003 ⁺	0.0003 ⁺	-	-	-	-
MPENL	-	-	0.0003	0.0006 ⁺	0.005 ⁺	0.0040 ⁺
MPENM	-	-	-	-	0.0006 ⁺	0.0003 ⁺
MPENH	-	-	0.0004 ⁺	0.0003 ⁺	0.0003 ⁺	0.00009 ⁺
APC1580	0.0018 ⁺	0.0002 ⁺	0.0002 ⁺	0.0002 ⁺	0.0001	5.01e - 06
R^2	0.556	0.55	0.560	0.55	0.600	0.665
White	0.019	-	0.014	-	0.177	0.040
Ramsey	0.004	-	0.008	-	0.600	0.125

Notes: ⁺, [~] significant at the 5%, 10% level

Additional Notes R^2 , the percentage of variation of the growth of gdp per capita over the period examined explained by the model. White denotes the p-value based on White's test for heteroscedasticity. Ramsey denotes the p-value based on Ramsey's Reset test for model misspecification. All standard errors are corrected for heteroscedasticity.