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The Economic and Societal Value of Rich Interaction Applications

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Imprint

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Executive summary

Applications such as iMessage, KakaoTalk, LINE, Signal, Skype, Snapchat, Threema, Viber, WhatsApp and WeChat have become increasingly popular with consumers around the world. The applications facilitate rich interaction such as chat, photo/video sharing, location and payment between individuals, groups and enterprises.

A variety of specialized applications has emerged to cater to the needs of individual groups such as families and youths (Disney MIX) or the elderly (Care Messenger). Others like Hike (India), Jongla (Nigeria) and 2go (South Africa) predominantly serve local markets.

All these applications have a variety of functions and are constantly being updated, meaning any static definition is bound to be outdated fairly quickly; throughout the evolution of these applications, interaction has been at the heart of both their core and additional functions.

This study collates these applications under the banner of Rich Interaction Applications (RIAs) and sets out to analyze their socioeconomic impact in developed and developing countries. Our analysis is based on a review of 139 of the most commonly used RIAs.

We find that **RIAs generate a significant component of the socioeconomic impact of digitization and utilization of the internet itself.**

Each **10% increase in RIA usage has added on average US$5.6 trillion in GDP** (0.33% of GDP), exceeding the economic benefits of basic telecommunications services across a panel of 164 countries in the period 2000 to 2015.

This is a conservative estimate of RIAs' economic impact, given that only part of the impact from these services is measurable as Gross Domestic Product (GDP). Moreover, the increased usage of RIAs over the period suggests that their annual economic impact has also increased over the period, and can be expected to continue to increase going forward as more and more consumers have access to high-speed broadband connections.

The multi-sided interaction on RIAs enables new local value creation. For instance, local merchants gain access to new markets and can advertise their products and services globally with almost no barrier to entry and very little monetary risk. The integration of payment and money transfer functions with RIAs enables remittance payments at substantially lower cost; for India alone, these savings could amount to US$4.4 billion annually.

RIAs also generate significant social benefits. For example, standard RIA functions, including video and voice recognition, are often considered superior to specialized applications in supporting people with disabilities. RIAs can also play an important role in disaster relief as an increasing number of them offer broadband-free access. Thus, **up to 80% more people can receive potentially life-saving information** when it counts.

RIAs can help to reach the United Nations Sustainable Development Goals on health and education by providing crucial health information even in remote areas and empowering community health workers. By using RIAs, community health workers can learn more, take more responsibility and consult experts when required.

By delivering audio and video-based teaching aids, RIAs can also have a significant impact on education in developing countries. For instance, an Indian education project using these functions doubled the effectiveness of reading education when compared with schools counting on traditional learning materials.

Consumers use many RIAs alongside each other because of the unique feature set of RIAs corresponding to users' individual communication needs.

As these needs differ according to various sets of relationships, consumers are selective about the specific RIA which they use to communicate with a specific set of relationships. Thus, they use the technological seams between the applications to navigate their social spheres. The vast array and low (or, generally, no) cost of RIAs and the portability of contact data mean that consumers can and do subscribe to multiple RIAs. Also, they can switch easily to new RIAs. The Internet Protocol-based nature of RIAs means that consumers use RIAs across their different devices, and, increasingly, on mobile devices and even devices without broadband connectivity to the world beyond that community.

Consumers do not use RIAs and communications services as like-for-like substitutes; more often than not, consumers use them complementarily. **As a result, RIA use has a substantial positive impact on telecommunications providers' business**. RIAs drive consumers' willingness to pay for Internet Access Services (IAS), giving telecommunications providers more opportunities to earn revenue and finance new infrastructure.

Research shows a significant correlation between RIA usage intensity and the willingness to pay for IAS, as well as the likelihood of consumers having purchased a new IAS contract recently.

The spread of high-speed broadband, the decreasing cost of devices, and the continuous evolution of RIAs are likely to drive new functionality and uses. For example, speech interfaces may be just the first step in a new wave of innovation. Hence, **it can be expected that the positive socioeconomic impact of RIAs will continue to grow if in a conducive policy environment.**

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Abbreviations

AAC	Augmentative and Alternative Communication
AI	Artificial Intelligence
APAC	Asia-Pacific (region)
CAGR	Compound Annual Growth Rate
CHW	Community Health Worker
CTSS	Compatible Time-Sharing System
ECS	Electronic Communications Services
FE	Fixed Effects
FMCG	Fast Moving Consumer Goods
GDP	Gross Domestic Product
GNI	Gross National Income
GSM	Global System for Mobile Communications
IAS	Internet Access Services
ICT	Information and Communications Technology
ICT4D	Information and Communications Technology for Development
ITU	International Telecommunications Union
MDG	Millennium Development Goals
MSO	Multiple-System Operator
OECD	Organisation for Economic Co-operation and Development
Ofcom	Office of Communications (United Kingdom)
OTT	Over-The-Top (services)
PPP	Purchasing Power Parity
PSTN	Public Switched Telephone Network
RIAs	Rich Interaction Applications
ROI	Return On Investment
ROPO	Research Online Purchase Offline
SME	Small and Medium-sized Enterprises
SMS	Short Message Services
SOHOs	Small Offices/Home Offices
SPAN	Smart Phone Ad Hoc Network
UNHCR	United Nations High Commissioner for Refugees
UNICEF	The United Nations Children's Fund
VoIP	Voice over Internet Protocol
WHO	World Health Organization

1 Introduction

In recent years, general purpose interaction applications such as iMessage, KakaoTalk, LINE, Signal, Skype, Snapchat, Threema, Viber, WhatsApp and WeChat have become an increasingly popular means of personal and business interaction. In addition, there has been a rapid increase in the number of apps targeted at specific usage situations, such as Slack (enterprise), Disney MIX (youth and families) or Care Messenger (healthcare), and locally relevant ones, such as Hike (India), Jongla (Nigeria) and 2go (South Africa). A list of 139 of some of the most frequently used, at least for this moment, is included in Annex 1 of this study.

All of these applications enable consumers to interact in ways not possible through traditional communications channels, such as group chat, photo and video sharing. Moreover, as providers of such applications have competed with each other by innovating and rapidly adding new functionality, the range of features developed and offered has grown to include nearly the full range of common internet activities, including integration with services such as advertising and payment.

For the purpose of this study, we sum up these applications under the term Rich Interaction Applications (RIAs).[1] We have chosen this term deliberately as it is of greater use than the commonly used phrase 'Over the Top' (OTT) services. The phrase 'OTT' originates in the telecoms industry and simply describes any application or service travelling across telecoms infrastructure. That imprecise phrase therefore applies to any and all service running over the Internet from banking to government services. RIAs correspond more accurately to the focus of the present study on applications that are used for a wide range of functions, allowing two parties to interact with each other in a long and growing number of ways.

The overarching research objective of this study is to investigate the full impact of RIAs around the world, and to assist policymakers by systematically setting out the role that these services play in their economy and society. We find that these RIAs generate a significant component of the economic and social benefits of digitization and utilization of the internet itself.

- Chapter 2 *catalogs the characteristics and functionality of RIAs*, both to define the subject and set the framework used for the subsequent value analysis. Any static definition of RIAs is bound to fall short of reality within months or weeks due to the fast-paced innovation cycle of these applications; this chapter uses a sample of 139 diverse RIAs from around the world to develop a comprehensive overview of the current functionality, their evolution from desktop to mobile, and the further evolution of RIAs to integrate advertising and payment solutions.

1 We delineate “RIA” from other terms such as rich mobile applications, rich communications services and rich internet applications:
https://en.wikipedia.org/wiki/Rich_mobile_application
https://en.wikipedia.org/wiki/Rich_Communication_Services
https://en.wikipedia.org/wiki/Rich_Internet_application

- Chapter 3 *explores how consumers use these rich interaction opportunities provided by RIAs*. In particular, we find that consumer preference for RIAs has been driven by the diverse interaction and cross-device interoperability they provide. We also find that the demand for RIAs has driven a demand for increased Internet Access Services (IAS) to support their use.
- Chapter 4 looks more specifically *at the evolution of RIAs toward integration with functions* such as advertising, shopping and payment. We find that the ability to integrate RIAs with applications across the entire internet ecosystem enhances their value to consumers and businesses.
- Chapter 5 undertakes *an econometric estimate of the global economic impact of RIAs* and the effect on consumer surplus in selected countries. We find that the economic impact of RIAs exceeds the economic benefits of basic telecommunication services. Moreover, we find that as mobile broadband penetration reaches further into developing countries and RIAs evolve to provide many of the functions of a "full internet experience" with lower bandwidth and hardware requirements, the benefits may become particularly relevant for these communities.
- The second part of Chapter 5 *explores the broader societal and social impact of RIAs not captured in the econometric estimate of GDP contribution*. We draw on research from sociology and psychology as well as case study evidence to understand how rich communication helps to build bridges, keep social ties strong, and improve healthcare and education outcomes in both developed and developing countries. We also look ahead to the continuing evolution of RIAs, and how new features such as speech interfaces will further increase the positive socioeconomic impact of RIAs.
- Chapter 6 gives an outlook of the future evolution of RIAs as well as additional use cases that might be covered soon in developing countries once framework conditions allow it.
- The Annex provides additional information on the countries and RIAs that were covered in this study as well as the methodology and case studies used here sorted by country.

2 RIAs: An overview of functionality

Key Findings

- RIAs are not descended from telephony and Short Message Services (SMS); instead, they follow a distinct evolutionary line from the earliest desktop-based interactive applications.
- RIAs feature on average nine functions that offer consumers a wide range of interaction opportunities, including group chat, photo and video sharing, location sharing and real-time translation.
- The internet-based architecture of RIAs enables the rapid innovation and addition of new functions and integration with other applications.
- Some RIAs now enable access to all the most commonly used internet functions.
- RIAs can function with or without broadband.

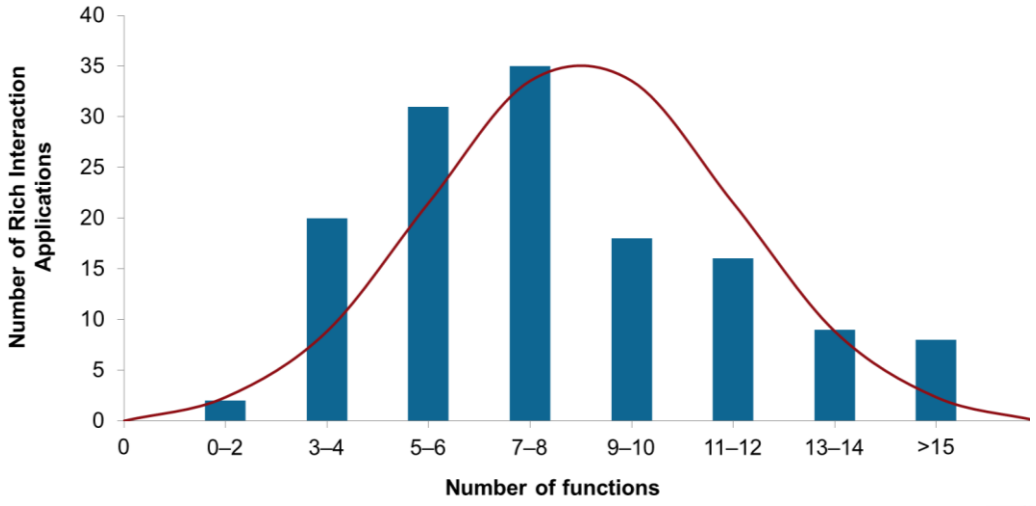
2.1 Mapping of RIA functionality

RIAs are sometimes mischaracterized as a “free calling application” or “improved SMS”, but this does not reflect the fundamental nature of these applications that enable a full suite of interactive options. Indeed, consumer research indicates that the breadth of functions of RIAs plays an important role in their success (Arnold, Schneider, & Hildebrandt 2016). Even though RIAs offer text and calling functionalities, they are in fact not an identical substitute for Electronic Communications Services (ECS), just as computers are not a direct substitute for typewriters.

The present study maps the functions of 139 RIAs that are currently most used worldwide, ranging from general purpose applications such as WhatsApp, Facebook Messenger, Skype or Snapchat, to RIAs that aim at specific usage situations such as Slack, Disney MIX or Care Messenger, to locally relevant RIAs such as Hike (India), Jongla (Nigeria) and 2go (South Africa).

What is immediately clear is the broad range of interactive options that RIAs can offer. The most comprehensive RIA (WeChat) in our sample features 23 functions. Figure 2-1 demonstrates that thirty percent of the sample features ten or more functions, and the average RIA has almost nine functions.

Figure 2-1: Number of functions of RIAs



Source: WIK.

Arguably, RIAs develop and adopt new features to keep up with or stay ahead of the competition. In fact, one may be reminded of a supply-side depiction of Rogers' seminal innovation curve (Rogers 1962); in this instance, the innovators are found at the right-hand side and laggards on the left-hand side of the curve. For example, only a few RIAs initially featured end-to-end encryption, but many others followed (including those with the most users) as soon as it was clear that consumers had an interest in this functionality. Table 2-1 shows in more detail the progression of functionality offered by a few of the RIAs with the largest user bases.

Table 2-1: Timeline of featured functions for major RIAs

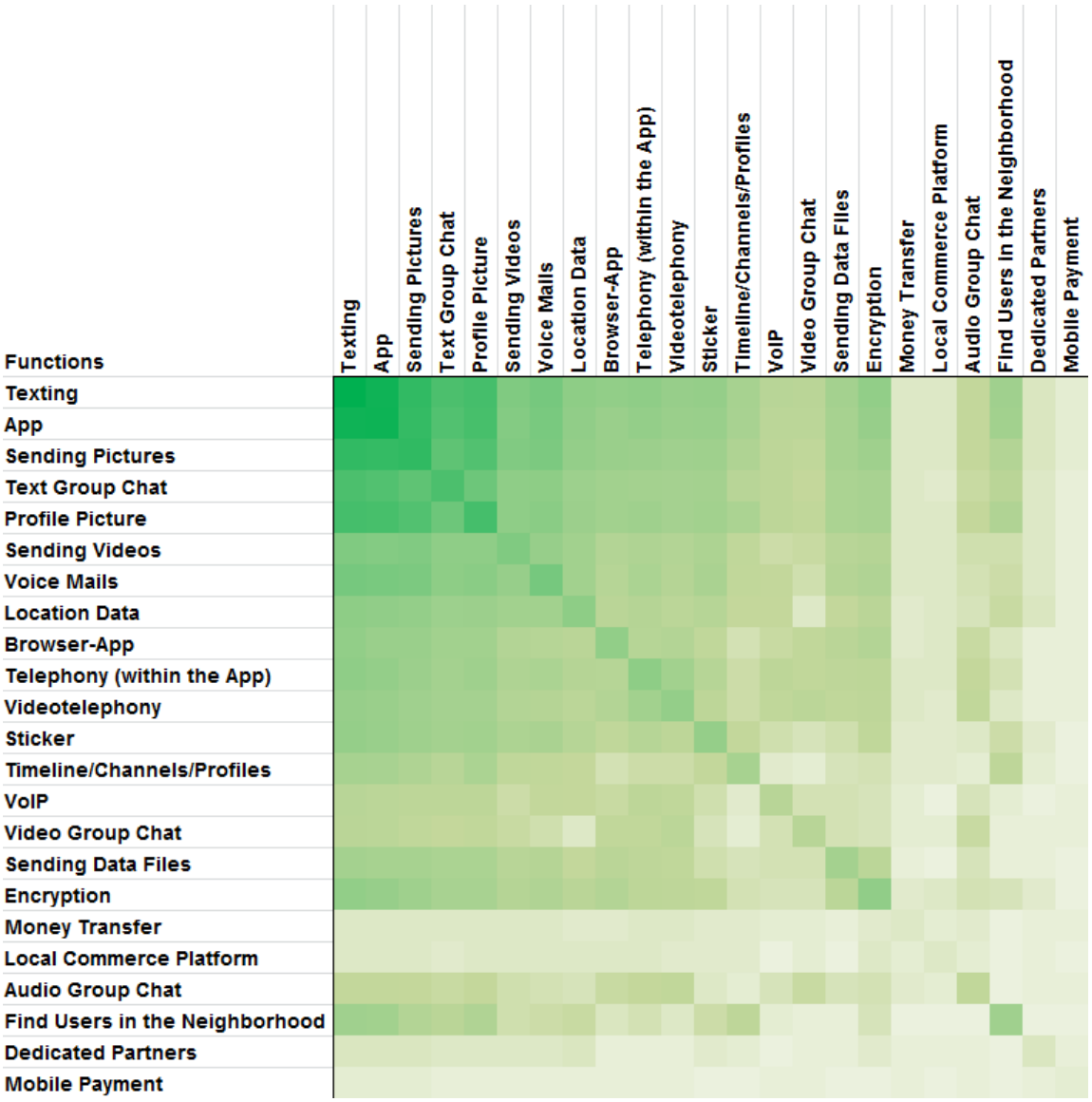
WeChat (launched Jan 2011)		WhatsApp (launched Feb 2009)	
Month/Year	Functionality	Month/Year	Functionality
Jan 2011	texting, voice clips, sending photos	Aug 2009	texting
Aug 2011	send videos, find friends in the neighborhood	Feb 2011	group chats (texting)
Jan 2012	browser-based use	Jun 2012	send location
Jul 2012	voice and video calls	Aug 2013	voice messages
Aug 2013	mobile payment	Jan 2015	browser-based use
Dec 2013	in-app gaming	Jun 2015	voice calls
Jan 2014	hail a taxi service	Apr 2016	end-to-end encryption
Feb 2014	real-time location status	Nov 2016	video calls
May 2014	translation feature	Facebook Messenger (developed from the chat feature within Facebook) which was introduced in Apr 2008	
Jun 2014	money transfer	Month/Year	Functionality
Jul 2014	unsend (recall sent messages)	Oct 2011	mobile app
Oct 2014	sight (6-sec animated video)	Aug 2014	standalone messenger app
May 2015	voiceprint (log in with your voice)	Mar 2015	money transfer
Sep 2015	3D touch	Apr 2015	video calling
Oct 2015	video group chat	Apr 2016	group voice calls
Dec 2015	WeChat out (voice over internet protocol to mobile and landline numbers)	Oct 2016	end-to-end encryption
Notably, WeChat offers many more features including but not limited to ordering groceries and food, paying bills, purchasing stickers, finding a new job, doctors' appointments, offering one's own app store or e-commerce outlet, "moments" (one's own news stream), integration with LinkedIn, and closed group chats for firms.			

Source: WIK based on company press releases and press reports; the functions listed represent major steps in the development of the three RIAs analyzed and are not meant as a full reflection of all functions offered.

Figure 2-2 provides a more in-depth view of the functions featured in RIAs today. The share of RIAs that feature specific functions or rather combinations of functions is depicted by the shade of green used. The darker the shade, the higher the share of RIAs that feature this particular function[2] or combination of functions.

2 Individual functions can be deduced from the diagonal of the matrix. For instance, the very dark shade of green for the combination of "Texting" and "Texting" indicates that almost all RIAs feature this functionality.

Figure 2-2: Overview of RIAs' functions



Source: WIK; number of RIAs analyzed: 139; the share of RIAs that feature a specific function or a combination of functions is indicated by the shade of green: the darker the green, the higher the share. If one follows the diagonal line, one can see the share of RIAs in our sample that feature the particular functionality denoted for that row and column.

First and foremost, Figure 2-2 shows the great variety of functions offered by RIAs. In total, the analysis identified 23 functions that at least three RIAs in our sample shared.[3] The most common functions revolve around texting and sending pictures; almost all RIAs feature these (between 77% and 99%) or combinations thereof. A Third of the sample RIAs allow group chats using live audio or video feeds, and it has been shown that rich group chat plays an important role in the success of RIAs as they are used like social networks (Seufert et al. 2016). This usage scenario frequently includes creating groups to share experiences, often including links to websites, pictures and videos. Two fifths of the RIAs in the sample also enable users to send videos (40%). Out of those, all enable texting and sending pictures.

Furthermore, the analysis of functions shows a clear focus of RIAs on usage on mobile devices. Only 25 out of the 139 RIAs (7%) analyzed are not available in an app, whereas 68% of the analyzed RIAs are not available on a browser version.

It is interesting to see in this chart an evolution of RIAs to provide an increasingly full suite of common internet functions. Taking the UK Office of Communications' (Ofcom's) typology of internet use, for example, we see that profile pictures and timelines accord with personal use; rich messaging functions, photo and video sharing (including through group chats), and even translation correspond to consumers' communication and social networking usage; payment and purchasing functions match transaction use (Ofcom 2015); integrated games offer entertainment use; and integration with news feeds reflect information and leisure-related usage.[4]

In addition to the organic expansion of functionality that we see in Figure 2-2, RIAs are also beginning to integrate services provided by commercial partners, such as hailing an Uber taxi ride through Facebook Messenger or an Ola taxi ride through Hike.[5] Given the competitive pressure originating from the multitude of actors in the market, as well as the demonstrated economic benefits of intermediaries (Hildebrandt & Nett 2016), it is likely that more and more RIAs will look to integrate other services in order to enrich the consumer experience with the application.

At the same time as RIAs are expanding their functionality organically or through tighter integration with third-party applications, we also see that other online services – including games, e-commerce and content distribution – are incorporating rich interaction features to enhance the functionality (and consumer appeal) of their services. For instance, YouTube recently introduced a test phase for in-app messaging to enable consumers to communicate with others about the content.

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3 Notably, the figure would feature more functions if all possible functions had been listed, i.e. also those that two or fewer RIAs feature. Furthermore, the depicted distribution may understate the variety of functions as some of them may only be available in specific countries or regions and may not have been picked up in our research due to language barriers.

4 See also Helsper, Duersen & Eynon (2016); McKinsey (2010). The following chapter elaborates in more detail the relevance of these uses and corresponding functions in consumer behavior.

5 Hike is a local RIA popular in India. Ola is the Indian equivalent of Uber.

The trend of integration of RIAs with the broader range of internet applications is discussed in more detail in the following chapters.

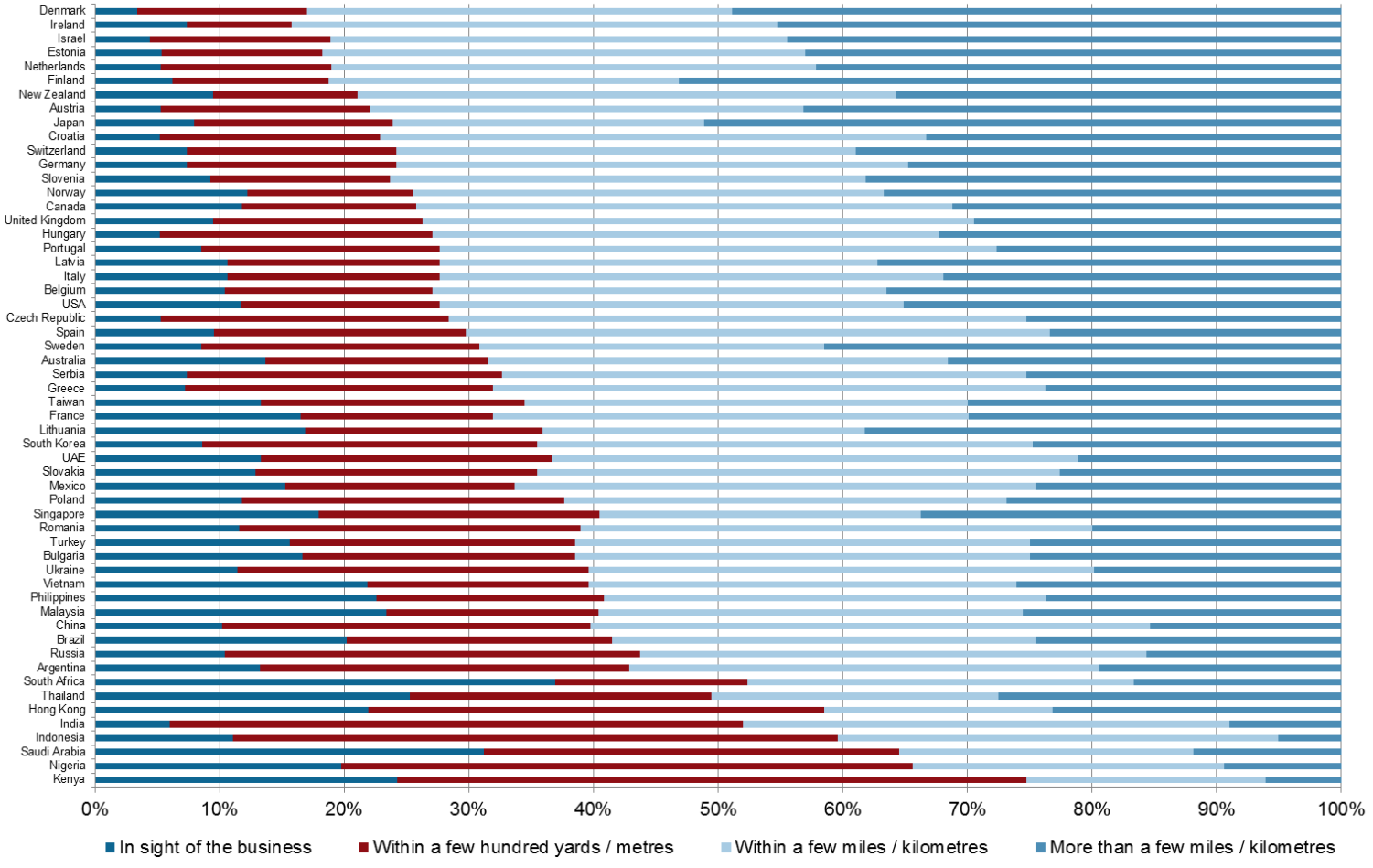
A more recent evolution in the functionality of RIAs is a trend toward becoming less reliant on broadband access.[6] More and more RIAs feature functions that allow messages, pictures, videos, etc. to be sent without being connected to the internet. This functionality is realized by ad hoc mobile networks[7] using Wi-Fi or Bluetooth interfaces integrated in modern smartphones. It extends the availability of rich interaction experience by making it more affordable and more resilient/accessible in situations where smartphones and/or broadband access are not available.

Usage of alternative non-internet-based networks can also further a trend toward hyperlocal use, i.e. where users connect with individuals and businesses within close proximity. The potential for such hyperlocal services becomes obvious when one considers that consumers often seek hyperlocal information, for example information about shops near their location. The Google Consumer Barometer results in Figure 2-3 show that, especially in developing countries, more than half of consumers search for local products, services, etc. when they are within a few hundred yards of a shop's location.

6 This feature is strongly related to "Finding Users In The Neighborhood" in Figure 2-2.

7 Smart Phone Ad Hoc Networks (SPANs) are often used. (Definition of SPANs: "Smart Phone Ad hoc Networks (SPANs) leverage the existing hardware (primarily Bluetooth and Wi-Fi) in commercially available smart phones to create peer-to-peer networks without relying on cellular carrier networks, wireless access points, or traditional network infrastructure. SPANs differ from traditional hub and spoke networks, such as Wi-Fi Direct, in that they support multi-hop relays and there is no notion of a group leader so peers can join and leave at will without destroying the network." (Wikipedia site: https://en.wikipedia.org/w/index.php?title=Special:CiteThisPage&page=Smart_phone_ad_hoc_network&id=769740003 accessed March 2017).

Figure 2-3: The relevance of local search (% of internet users). Question: “How far away were you from the business or shop you visited or contacted when you started looking for this type of business?”



Source: Google Barometer (2015)

2.2 The history of RIAs

What we can see in the following analysis is that RIAs are not descended from telephony and SMS; instead, they follow a distinct evolutionary line from the earliest desktop-based interactive applications, e.g. MIT's Compatible Time-Sharing System (CTSS) (Van Vleck 2012), the Zephyr Notification System (DellaFera et al. 1988), the SDC[8] time-sharing system (Hemmendinger 2014), and the bulletin board system (Rafaeli 1984, James, Wotring, & Forrest 1995).

During the late 1990s and early 2000s, flat-rate data plans made it affordable and attractive to be always online (Arnold & Waldburger 2015). The evolution of these early interaction applications coincided with a resulting steep increase in take-up of broadband access in most developed countries. During this period, AOL Instant Messenger (AIM), ICQ, MSN Messenger and Yahoo! Messenger were released, offering many of the functions that can be found with today's RIAs, including profile pictures, icons, away messages and chatrooms (group chats). The majority of internet users at the time had at least one instant messaging account. In fact, by the early 2000s, multi-homing had become so common that services such as Jabber offered consumers a way to integrate several instant messaging accounts. The number of messages sent during that time increased quickly.

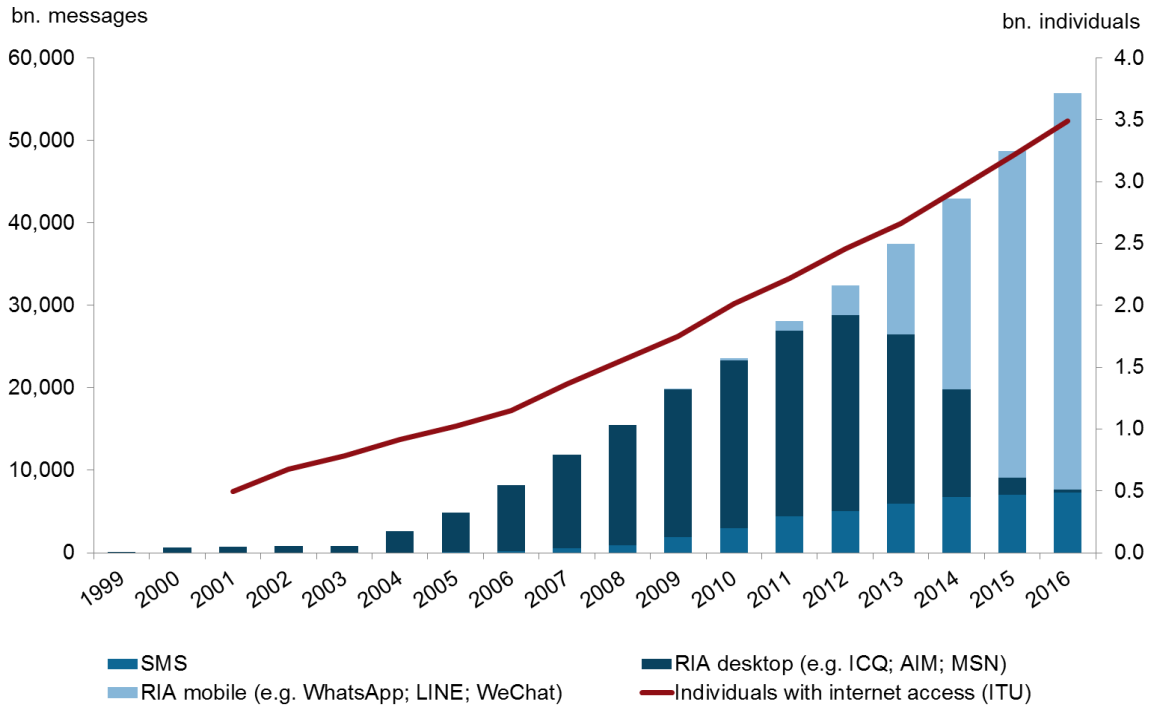
The 2000s saw the introduction of Skype (in 2003) and the rise of social networks like Friendster, Orkut, MySpace and Facebook. All of these services feature at least a chat functionality. With increasing usage of these sites as well as more and more consumers coming online, the number of messages sent via desktop and laptop RIAs increased rapidly. For instance, Facebook launched its chat functionality in August 2008.[9] By June 2009, the company reported that more than 1 billion messages were sent each day on its chat service.[10]

Figure 2-4 shows WIK's estimate of how RIA-based messaging and SMS messaging have developed in terms of total messages sent worldwide between 1999 and 2016. Worldwide, the number of SMS messages correlates strongly with the number of mobile subscriptions, showing a steady growth. The number of RIA messages sent strongly correlates with the number of people who have internet access. Essentially, the number of RIA-based messages per user has not changed significantly over time, only the technology underneath, as mobile RIAs have largely displaced desktop RIAs.

8 The System Development Corporation (SDC) was a spin-off of the Rand Corporation. It is commonly known as the first software company. Today, it is owned by Unisys. (Source: Wikipedia site: https://en.wikipedia.org/wiki/System_Development_Corporation, accessed March 2017).
9 https://www.facebook.com/notes/facebook/facebook-chat-now-were-talking/12811122130/
10 https://de-de.facebook.com/notes/facebook-engineering/chat-reaches-1-billion-messages-sent-per-day/91351698919/

As mobile broadband connections became more affordable, consumers switched a large part of their online activity to mobile devices, including their demand for a complete RIA experience. Mobile RIAs have flourished, and the vast majority of messages that are sent today are sent via mobile RIAs such as WhatsApp, Facebook Messenger, Hike or Threema, compared to messages previously sent via desktop-/laptop-based RIAs such as AOL Instant Messenger, ICQ or Yahoo! Messenger.

Figure 2-4: Number of SMS and RIA messages sent annually (worldwide in billion messages; individuals with internet access in billion)



Source: WIK estimate based on Nielsen (cf. statisticbrain.com), press releases, International Telecommunications Union (ITU) and news articles.

In sum, the above analysis of the functions of RIAs shows a provenance and evolution that is distinct from traditional telecommunications services. And, as RIAs have evolved along their own technology pathway, the user experience with RIAs is becoming closer to people's use of the internet in general. Whether one looks at the core rich interaction functionality or the developing integration with the "full internet experience", any categorization (or regulatory regime) tied to the thin overlap with traditional telecommunications services truly falls short of reality (Arnold, Hildebrandt, & Waldburger 2016).

3 Consumer preferences and RIA usage

Key Findings

- Consumers prefer RIAs because of the many different functions and audience reach they offer.
- RIAs offer interoperability across devices and across services.
- Many RIAs are designed to address the interests and needs of a particular set of consumers or businesses.
- Consumers rely on "seams" between RIAs to manage their social ties.
- Demand for RIAs drives consumers' willingness to pay for IAS.

3.1 RIAs fulfill consumer preferences for rich communication and interaction tools

"Humans are profoundly social animals" (Scholl 2013, 3). Throughout evolution, humans have developed ever more subtle codes and cultural practices that all form our contemporary communication system. The nature of communication is by definition rich, drawing on numerous cues beyond just the words that are written down or spoken. This character of communication explains consumers' preference for rich communication and interactions if face-to-face contact is not available. This preference can be traced through history (Purdy, Nye, & Balakrishnan 2000, McGrath, Vance, & Gray 2003, Sterelny 2016, Skågeby 2009).

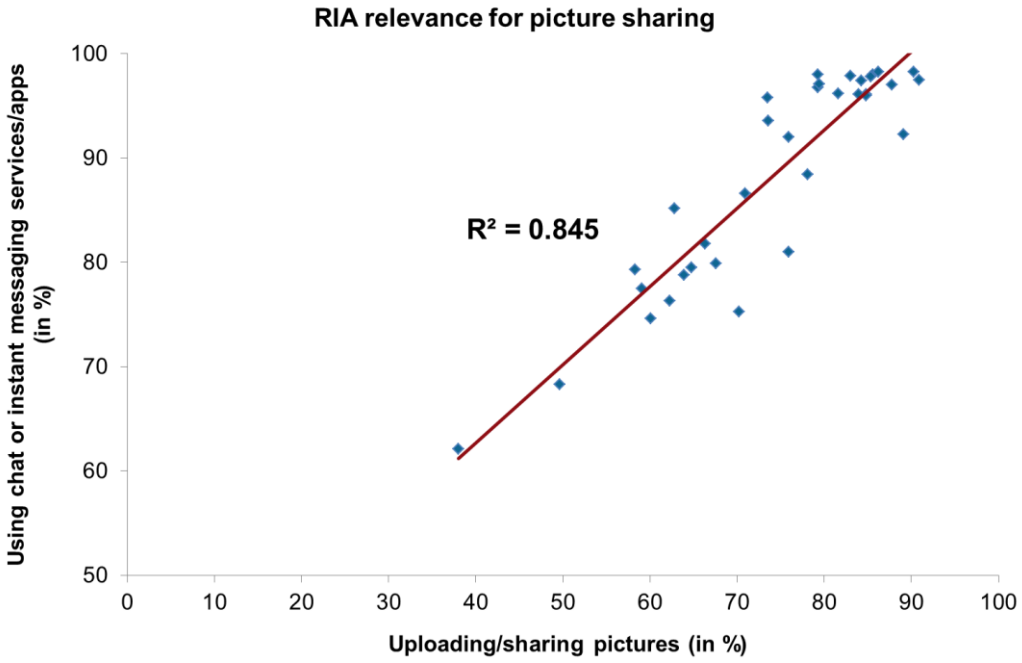
The importance of audiovisual information is explained further by Brubaker et al. (2012) in concurrence with media richness theory (Daft & Lengel 1986). Audiovisual communication significantly aids the understanding of emotional and similar cues, and enables shared phatic[11] experiences. Such shared experiences gain particular importance when people relocate and want to retain their emotional ties to spouses, family and friends. The more familiar consumers become with video communications services, the more intimate shared experiences become. Indeed, the availability of video communication is perceived most positively by consumers when they seek strong emotional ties, like contacting siblings or children who may be far away (Arnold & Schneider 2016).

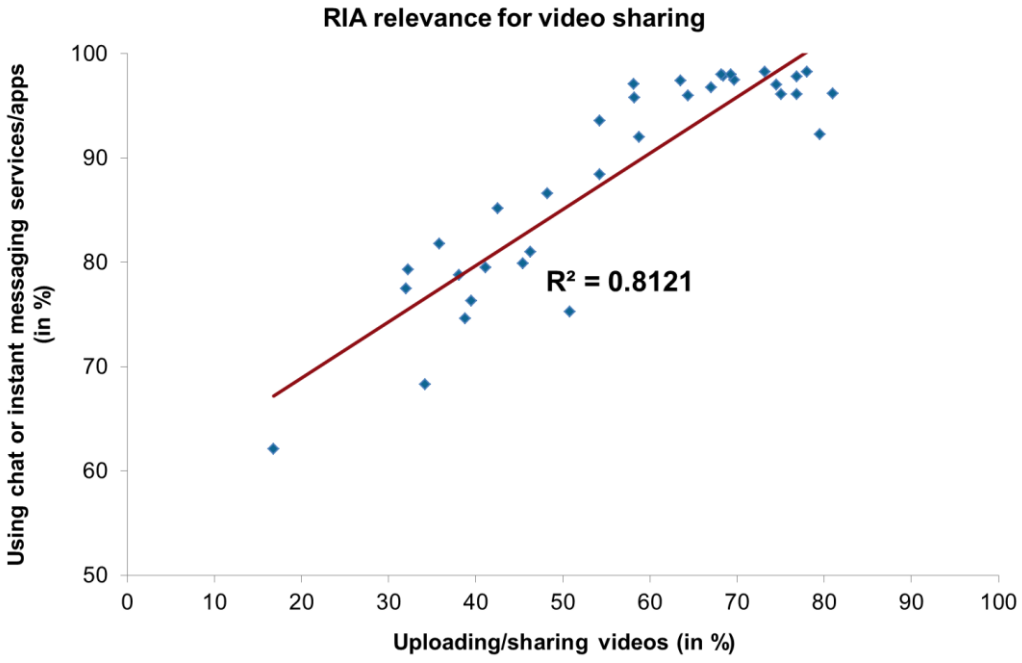
Figure 3-1 illustrates how consumers use RIAs to craft rich communications that incorporate photo and video. Data from 34 countries in the Global Web Index (2017) show a significant association between the use of a chat or instant messaging

11 Denoting speech used to express or create an atmosphere of shared feelings, goodwill, or sociability rather than to impart information.

application and the act of uploading/sharing a picture or a video in the past month. This indicates that RIAs are fulfilling an important function in supporting consumers' interest in this sort of rich interaction.

Figure 3-1: Relevance of RIAs for picture and video sharing





Source: WIK calculations based on Global Web Index (2017); survey data from Q4/2016 across 34 countries; annually, Global Web Index interviews 200,000 individuals aged 16 to 64 who use the internet.

In addition, RIAs offer other functions that go beyond rich messaging. Three types of function appear to be particularly salient in reflecting consumers' communication behavior:

- Group chat;
- Notification and awareness; and
- Presentation of self.

Social groups fulfill many functions in our lives. These functions range from pragmatic purposes, such as teamwork at the office or a group to organize someone's wedding, to phatic experiences with close friends and family to whom one has strong emotional ties. All of these situations are difficult if not impossible to negotiate in the one-to-one communication that ECS and in particular SMS offer. However, RIAs enable group chats, sometimes with audio or audiovisual features. For instance, groups can be set up for a specific topic or occasion (e.g. "John and Jane's wedding") (König 2015). Due to the one-to-many communication and vivid interaction in such groups, social behavior can be enacted and experienced (O'Hara et al. 2014). With the popularity of this feature and thus being part of many group chats at once, consumers may sometimes find such groups burdensome. However, they report enjoying following the thread of messages with close friends (Smith & Tang 2015).

Awareness and notification functions refer to the ticks the sending party sees when a message is delivered and hence read. This functionality constitutes another important added value for consumers using RIAs. Although most consumers know how to de-activate this function, they choose to leave it switched on. It has become a measure of the intensity of personal relationships: the quicker the response arrives after a message has been read, the stronger the personal bond is (Arnold & Schneider 2016). This introduces a new layer into conversations that SMS messages lack, which in turn may introduce an "additional set of concerns relating to accountabilities, moral implicatives and temporal meanings bound up in what can be perceived, interpreted and revealed through" the two blue ticks in the case of WhatsApp (O'Hara et al. 2014).

Furthermore, the notification that the chat partner is writing fulfills a function: "[…] the visibility of typing activity is seen to hint at levels of investment in the crafting of the response. Implied here is how this temporal investment is subject to social scrutiny both in terms of what the sender thinks it may reveal and what the recipient thinks it reveals. This leads to experienced or anticipated anxieties that are dealt with through a deliberate avoidance of WhatsApp in these scenarios" (O'Hara et al. 2014, 10).[12]

12 cf. Arnold et al. (2016).

Presentation of self has long been known to be relevant to consumers in the context of cell phone use (Stald 2008, Vincent 2010). RIAs provide a channel for users to enact presentation of self through emerging cultural mainstream practices such as selfies (Walker Rettberg 2016, Bosch 2011) and by sending and sharing pictures and videos of themselves. In line with Dunne et al.'s (2010) analysis of social networking sites, one can assume that these functions leverage individuals' self-esteem. Furthermore, RIAs satisfy consumers' aesthetic needs as well as their self-representation needs as the user interface of most RIAs can be tailored to one's individual needs and preferences, giving it a personal touch. For consumers, SMS messages have a pragmatic and technocratic look and feel to them. The various profile options and, above all, the profile picture that features in many RIAs enable self-representation, but they also have a social facet (Arnold & Schneider 2016).

Although the examples above represent only a small share of the functions and subtleties of human interaction, they showcase the importance of rich communication for consumers and in turn explain their preference for RIAs in situations where they want a deeper form of interaction than telephony or SMS can provide.

These findings indicate that consumers do not use RIAs simply because they want to send texts and make phone calls with no direct monetary cost. Such a narrow focus on economically optimizing consumer behavior (Fishbein & Ajzen 1975, Ghose & Han 2011) does not account for the actual origin of RIA communication behavior or the fundamental differences in usage between SMS and RIA communication channels previously described. The relevance of social factors in the adoption of innovative technologies (Glass & Li 2010) is reflected in Church and de Oliveira's (2013) finding that the adoption of WhatsApp hinges on several factors beyond cost, such as intent, community, privacy, reliability and expectation. As explained by O'Hara et al. (2014), it is necessary "to capture the quiddity of the experiences sought for and enabled by these applications [RIAs] in ways that reaches beyond economic or technological determinism and which accounts both for scale and the purpose of this use in ways that colours how that use is experienced and oriented to; how it is lived, if you like" (p. 2).

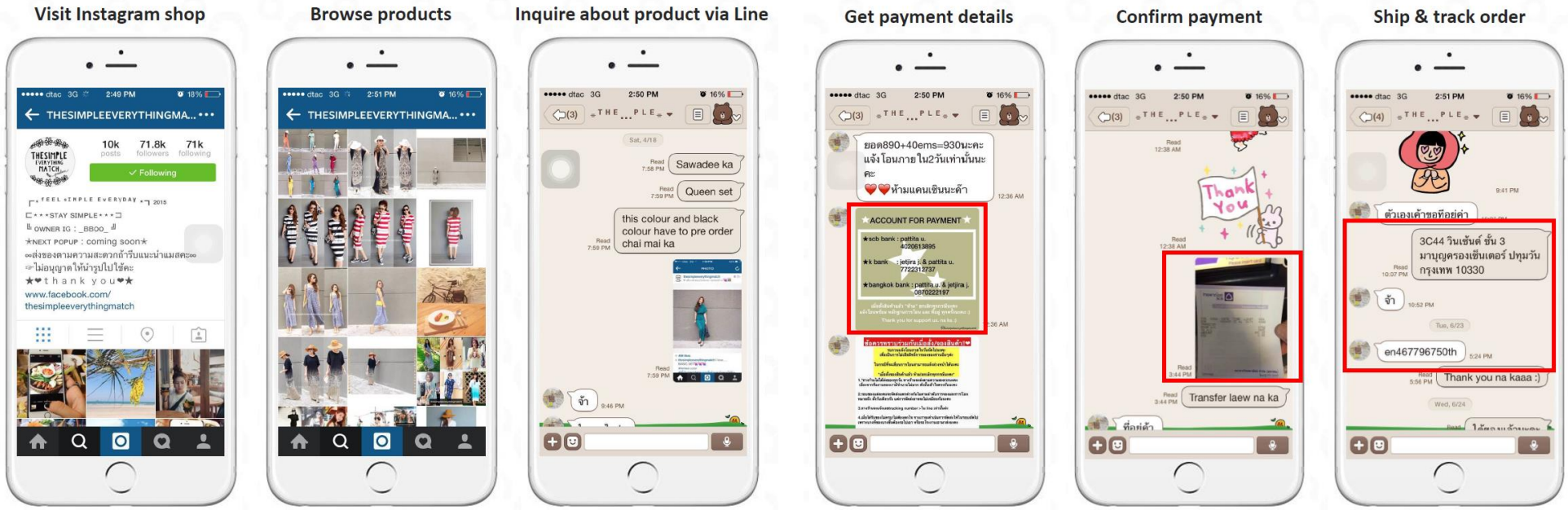
3.2 RIAs enable consumers to switch for different purposes

The vast array and low (or, generally, no) cost of RIAs and the portability of contact data mean that consumers can and do subscribe to multiple RIAs. This phenomenon is known as multi-homing, something which was not possible with network-bound Public Switched Telephone Network (PSTN) voice services. In this manner, consumers are able to reach the end users of any of these applications. RIAs also offer two other types of interoperability not found on PSTN services: interoperability across multiple devices and operating systems due to the RIAs multi-homing capabilities, and ability to add on additional services, such as purchase and payment.

RIAs are mostly made available by its providers for smartphones and/or tablets running on Apple and Android system software. In some instances RIAs are also made available for desktop computers depending on the system software. Because of the cross platform/device availability, consumers can use a particular RIA from different devices using one account. This multi-system availability is enabled by international standards and increasing number of tools which facilitate porting of software.

The following example from Thailand demonstrates how, in response to market demand, RIAs can facilitate the integration and interoperability needed to seamlessly purchase goods and services across various applications.

Figure 3-2: Example of RIA interoperability



Source: aCommerce (2015).

The concept of any-to-any connectivity is at the heart of telephony over the PSTN and mandated interoperability became essential with the growth and ownership fragmentation of the networks[13]. The original SMS services were not interoperable, as they were intended to allow operators to communicate only with customers on their network. However, the introduction of cell phones[14] created a business case for telecommunications operators to provide consumer-to-consumer texting. While a single standard (Global System for Mobile Communications, GSM) in Europe eliminated the technical hurdles to interoperability in that market, SMS were not interoperable across networks in North America until 2002 (Crowe 2002).

RIAs, even in their earliest desktop forms, have always been provided using internet protocols. The fundamental nature of the internet as a network of networks means that interoperability across (physical) telecommunications networks has never been an issue for RIAs, as it was for PSTN (Salus 1995). As long as end users are registered with the same RIA, anyone with an IAS from operator A in country X can contact anyone with an IAS from operator B in country Y.

Proposals to mandate interoperability between RIAs must be based on the assumption that there would be a consumer benefit. On the contrary, however, in the case of RIAs, the evidence shows that consumers have benefited immensely from the creation of unique protocols and closed networks that allow each RIA to offer features that differentiate its services from others in the pursuit of competitive advantage in a crowded market segment. Mandating interoperability across the various RIAs would limit the diversity of features, and constrain innovation and competition that drives it. If every rich feature has to be standardized to allow for interoperability, there is no longer any commercial incentive to innovate and create new functionalities. Furthermore, it would eliminate the current diversity of small start-up entrants, which currently thrive by finding and occupying new niches.[15] Finally, given how easy it is to develop and launch a new RIA from anywhere in the world, one should not dismiss the sheer pragmatic and cost challenge of identifying all global RIAs in order to ensure interoperability.

In addition to the economic and technological arguments, there is another interesting aspect of consumer behavior that speaks against extending interoperability obligations to RIAs. Graham, Barbato, & Perse (1993) show that consumers' communication behavior rests on adjusting the style and content of communication to the audience. Specifically, their findings support the ideas that (1) communication with weak and

13 The earliest state-owned monopoly networks were interoperable by default, as there was only one network. Prior to this time, interoperability had been relevant for international calls crossing different national operators, and the high demand and willingness to pay for such calls created a clear commercial incentive to provide this international interoperability. The need to regulate end-to-end interoperability emerged only once telephony markets were liberalized and multiple networks emerged.

14 Notably, Nokia introduced the first "texting-enabled" mobile in 1993.

15 In total, we have identified 139 RIAs in our sample, of these many target specific usage situations, such as Slack (enterprise), Disney MIX (youth and families) or Care Messenger (healthcare). Equally, we find many examples of RIAs that have emerged only within the last three years such as GekoLife, Yo, and OGO.

strong ties fulfill different psychological needs and (2) they trigger substantially different communication styles, breadth and depth. Arnold, Schneider, & Hildebrandt (2016) find further support for these findings with regard to RIAs. They draw on the concept of seamfulness of technology (Chalmers & Galani 2004). Indeed, various studies support the idea that consumers proactively use the seams between RIAs (and ECS) to stratify their social contacts according to the strength of the individual tie (Reynolds et al. 2011, Church & de Oliveira 2013, Barkhuus & Polichar 2011) and to add meaning or communicate urgency (Cramer & Jacobs 2015). Thus, blurring or even erasing the borders between RIAs would go against consumer preferences to separate the various streams of interaction in their lives.

3.3 Demand for RIAs drives demand for IAS

Although it is clear that RIAs do not simply substitute traditional telephony services and ECS, their popularity has engendered concern about the impact on the revenue of telecommunications service providers. However, the link between RIA usage and telecommunications providers' revenue is not as straightforward as it is often shown.

Using a representative survey of consumers, Arnold, Schneider, & Hildebrandt (2016) have proven that consumers who use RIAs more intensively also have upgraded their IAS subscriptions within the past two years. More specifically, the more frequently consumers use RIAs, the more likely they are to have purchased a new mobile contract with more high-speed data, likely spending more money on it.

This purchasing behavior directly reflects their usage patterns that move more and more toward constant engagement on RIAs within and outside their homes. For example, consumers who frequently use streaming (music and video) services are more likely to have upgraded their mobile and fixed IAS subscriptions within the last two years. They are also more likely to have above-average internet access speeds for their at-home internet connection as well as a 4G contract (Arnold, Schneider, & Hildebrandt 2016, Arnold, Hildebrandt, & Waldburger 2016).

This finding is further supported by analyses of mobile broadband data price developments across developed and developing countries and their impact on internet penetration in the respective countries. In contrast to expectations of typical supply and demand associations, there was no significant correlation between the two measures even when an appropriate time lag was introduced. The finding was consistent across Google broadband pricing data and ITU broadband pricing data. Since internet take-up is increasing constantly across all countries in our sample, this finding implies that applications drive consumers' inclination to purchase an IAS subscription (network complementarity with apps).

For developing countries, a similar effect is observable. Before RIAs became available, many people in rural areas could not afford to subscribe to the traditional communication services or use classic fixed and mobile termination. They were mostly occupied with subsistence farming and small-scale income-generating activities. Availability of funds for (mostly prepaid) mobile calls came only after basic housing needs such as food, children's medicine and school equipment had been met. People were also often forced to call only in the evenings due to lower calling rates or wait for people to call them back after giving them a missed call.

With the arrival of RIAs, consumers have more choices on how to structure their interaction and how to dispose their data and funds. Although consumers will still buy prepaid data bundles, the usage price of the RIA is no longer time restricted, meaning people do not need to wait until off-peak times to make a call. Also, the lower costs of RIAs (data usage only) will encourage them to communicate more often and for a longer period of time. As seen in our research, this is especially important in societies where the eldest children of families like in Kenya play the most important role in keeping the family together or for siblings of widows to contact their family for (economic) support.

Furthermore, RIAs help users to communicate about economic support and life advice, as well as enabling family to check up on the health of relatives living in rural areas and discuss everyday coordination of family life.

4 The role of RIAs in the broader digitization ecosystem

Key Findings

- RIAs play a key role in the broader digital economy.
- Interaction with consumers through RIAs creates value for local businesses.
- Advertising through RIAs enables value creation both locally and globally.
- Money transfer via RIAs can play a significant role in decreasing the cost of transactions and remittance.

4.1 RIAs acting as intermediaries for local value creation

The World Bank (2016b) acknowledges the enormous and increasing effect that digitization has on value creation around the world, including by sharply reducing transaction costs. Online intermediaries are driving innovation in this area, by enabling (potential) sellers of goods and services to access new groups of buyers, including those far beyond their local markets, and by enabling buyers to realize significant efficiency gains. RIAs are playing a key role in this new local value creation, including by acting as or supporting such intermediaries, by serving as an advertising space, and by providing a conduit for money transfers in the context of commercial transactions and remittance payments. The role that RIAs play in these newly enabled interactions varies. Among others, RIAs can be communication channels used to negotiate services of various kinds, e.g. online marketplaces or online games or they can be an intermediary themselves on which other services can be conducts, e.g. advertising (or at least data for advertisers) or money transfer.

According to economic theory, intermediaries bring together a group of suppliers with a group of consumers to facilitate transactions. The economic literature has looked at online intermediaries as two-sided or more multi-sided markets, where the provider acts as an intermediary enabling the interaction of different user groups (Evans & Noel 2005, Armstrong 2006, Evans & Schmalensee 2007). The service (i.e. transaction, exchange, comparison) is based on the behavior and usage patterns of the respective group to enable interactions, to some extent without being involved directly.

Those interactions can be characterized by so-called network effects (Katz & Shapiro 1985). Direct network effects are based on the size of the network within the same user group. It implies a network business model from an economic point of view, because it is a one-sided market (when there are no indirect network effects). An example of powerful direct network effects is the case of the voice over internet protocol (VoIP) service Microsoft Skype. The more people use this service, the more attractive it becomes. Thus, the attractiveness comes from the user base itself, directly. Indirect

network effects exist when the number of individuals from one user group increases, thereby making the service more attractive to another user group.

These indirect network effects establish strong links from different sides of the (two- or multi-sided) market, creating true intermediary characteristics in economic terms. Indirect network effects are the foundation for making intermediaries scalable from an economic perspective. An example of powerful indirect network effects is the case of online marketplaces. On the one hand, the online intermediary is more attractive for sellers when more potential consumers use the marketplace, because a growing number of consumers increases the probability of sales. On the other hand, the marketplace becomes more attractive for consumers because a growing number of sellers providing goods via the intermediary increases choice for the potential buyers.

Pricing in intermediaries follows different patterns compared to traditional business models. Online intermediary pricing policy is a function of the price elasticity of demand of the different sides of the intermediary (Armstrong 2006, Rysman 2009). The intermediary's user group with the lowest price elasticity has to pay a relatively high price and kind of subsidize the other side. This means that the side of the intermediary with a high sensitivity to price does not contribute to cover the costs of the intermediary business. The price for this side can be zero or even negative depending on the price elasticity of demand. Thus, there is an asymmetric pricing structure in most intermediary business models. Moreover, the price paid for using an intermediary service can also be in terms of attention and consumer data and does not have to be charged in monetary terms (Hildebrandt & Arnold 2016, Hagiu 2007). In order to be able to scale efficiently (reaching the critical mass), the different sides of the market for online intermediaries have to grow consistently, which is the greatest difficulty for these business models (Caillaud & Jullien 2003).

4.2 RIA intermediaries create value for local merchants

RIAs are developing a vital role by enabling small and large businesses to access their subscriber base. The previous example of the integration of Instagram and LINE (see Figure 3-2) demonstrated the benefit to consumers of this seamless integration of advertising/presentation, negotiation and purchases through the apps that they use most often. The present section aims to examine the effects that such integration has for local businesses.

It can be very difficult for Small and Medium-sized Enterprises (SMEs) to access regional, national or even international markets, and even more difficult for individuals who are producing local products.[16] RIAs can facilitate access to these markets, and

16 UNCTAD (2016) lists the top 100 multinational enterprises in transition and developing economies (ANNEX, Table 25) in the year 2014. This overview indicates that the majority of these companies would also not profit from a direct link to consumers immediately as their core business is oriented to business customers.

may even offer a more innovative way of communicating with consumers than the typical business-to-consumer communication channels, such as a call center, websites or advertising. The case studies below illustrate these effects.

Mifuko: Upped the game with messaging

Mifuko[17] uses instant messaging for their order status information system and this example shows the creation of local value in the involved Kenyan communities. It started in 2009 as a small Finnish company importing traditional Kenyan kiondo baskets, but they increased their competitiveness with messaging-based business operations.

Kiondo baskets are woven from sisal fiber and colorful plastic. They are produced by women in five Kenyan villages, providing these women with additional income to their main activity of farming. Instant messaging services (text and pictures) are used to communicate daily between Mifuko and the Kenyan women to update order status and to react if orders are missing or there are production issues. M-pesa mobile payment service is used to pay the women directly on their mobile.

In 2015, Mifuko delivered its Kenyan kiondo baskets to design stores in more than 20 EU countries.

RIAs as new customer service channels

Ongair, a small venture in central Nairobi, Kenya, enables companies to communicate with their customers via different instant messaging apps. The venture provides a management solution that aggregates messages from different services into a single interface and, therefore, allows companies to integrate applications like WhatsApp, WeChat or Facebook Messenger into their customer services. Ongair offers several price plans that are designed to meet the needs of different company sizes. Thus, businesses of all sizes can benefit from Ongair's work. The venture was launched in 2014 and now enjoys a pan-African presence and has about 800 clients in South America, India and Asia. They also recently expanded to Hong Kong.

Ongair is not the only venture in Africa focusing on this new emerging market. Several other projects are targeting companies who wish to integrate modern communication services into their businesses.[18]

17 http://www.mifuko.fi/

18 http://disrupt-africa.com/2016/04/kenyan-im-startup-ongair-opens-hong-kong-office/
http://www.pcadvisor.co.uk/feature/internet/kenyan-company-makes-business-sense-of-whatsapp-eyes-global-market-3591210/
https://qz.com/687042/a-kenyan-startup-is-revolutionizing-how-businesses-talk-to-their-customers/
http://disrupt-africa.com/2016/05/kenyas-ongair-taking-world-first-im-platform-global/

RIAs are particularly well-suited to provide access for services that entail some sort of negotiation. Instead of separating this negotiation process from the purchase of the service, various examples exist of services that have integrated the rich interaction functionality of RIAs into their own applications or online services. The case study below provides examples for this development.

Better interaction means more business

Apps like Lookup[19] in India or local delivery services like WumDrop[20] in South Africa connect customers to nearby stores. Lookup is a chat-based service connecting customers to nearby stores with the help of maps and via chat. More than 70,000 merchants were listed at the end of 2015 across the three cities of Bangalore, Delhi and Mumbai. The app WumDrop allows for collection and delivery of packages in Cape Town, Johannesburg and Pretoria. A user requests a courier, the courier comes to the agreed location to pick up the package and then the courier delivers it. The user can track them on a map and receive notifications of delivery. After delivery, the courier gets paid via mobile payment.

Finally, RIAs facilitate local trade by offering payment functionality. Around 5% of the RIAs analyzed for this study feature a payment and/or money transfer function. It can be expected that these functions will quickly increase in popularity, especially in regions where there are few or no banks available and problems in identifying individuals persist.

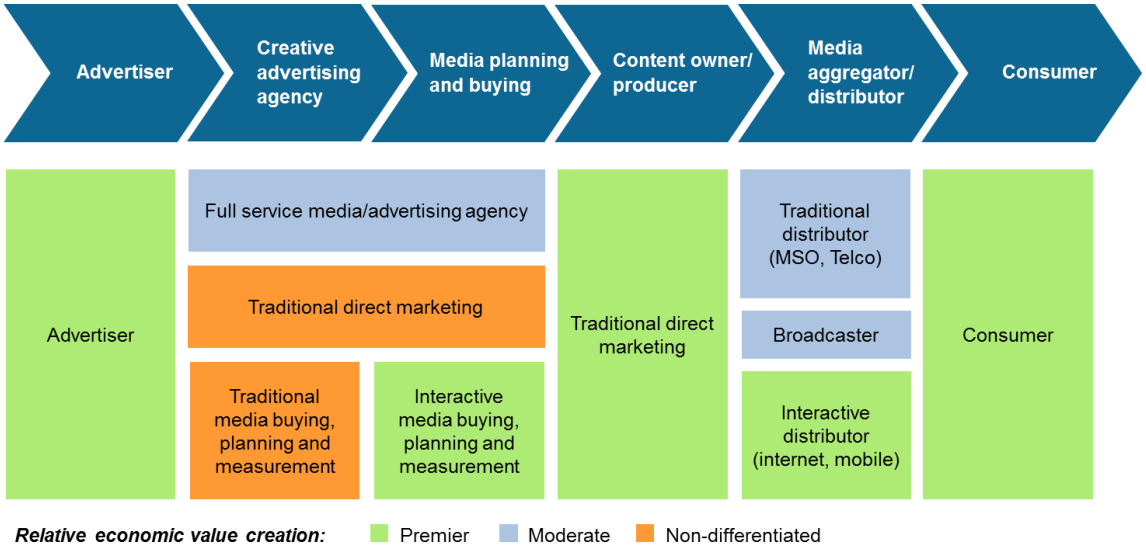
4.3 The role of RIA intermediaries in the advertising value chain

In this section, we examine the impact of advertising on local economies and how RIAs (and the companies behind them) who often use an advertising-based business model can influence local value chains. We find that these RIAs with ad-based business models are not extracting money from local economies, since their main source of revenue is advertising. Indeed, the overall effect of these ad-based businesses is actually to add wealth to local economies by creating jobs, additional income for local companies, and new opportunities even for micro companies.

To begin the analysis, Figure 4-1 provides an overview of a typical advertising value chain. The color coding illustrates the respective relative economic value created in each step of the value chain.

19 http://lookup.to/
20 https://www.wumdrop.com/

Figure 4-1: Typical advertising value chain



Source: WIK based on Berman et al. (2007).

RIA and the companies behind them are relevant participants in only a few of these stages, specifically interactive media buying, planning and measurement, and interactive distribution. Although the relative economic importance for value creation of these two stages is significant in the advertising value chain, the more important roles for local economic actors are in other parts of the chain, such as the advertisers themselves and the consumer side where the Return On Investment (ROI) is captured.

Advertisers are the companies that initiate advertising in order to market their products and services in a specific country. Although large international Fast Moving Consumer Goods (FMCG) corporations such as Procter & Gamble, L'Oréal and Unilever dominate this part of the value chain globally, a substantial share of advertising expenditure originates from within the country where the target consumers reside. SMEs and small offices/home offices (SOHOs) had little opportunity to participate in advertising on a relevant scale prior to the advent of affordable online advertising formats. Today, they can reach consumers worldwide even if their budgets are very limited. Thus, online advertising significantly lowered the barrier to entry for these companies.

Creative advertising agency and media planning and buying comprises companies that develop marketing campaigns. Although there are some multinational full service media and advertising agencies, the vast majority are SMEs serving a local market and employing local staff. Their competitive advantages include in-depth knowledge of the media and advertising landscape, an established network of key contacts, and knowledge about local culture and consumers.

While digitization has changed the business of many advertising agencies and in fact some enterprises have discontinued their contracts in order to manage their advertising directly via the interfaces that some of the large providers of online advertising space offer, many companies have entered into contract with agencies to manage their online advertising accounts. The largest part of the value that is created in this step of the value chain originates and remains in the specific country where the advertiser operates and finds its target audience with the support of local advertising agencies.

Content owners/producers are commonly linked to traditional direct marketing. This part of the value chain is almost completely organized locally. Consequently, the value created here originates and remains in the country.

Media aggregators and distributers organize advertising distribution via suitable media channels to the target audiences. This step of the value chain has indeed changed significantly due to increasing popularity of the internet as a communication and media consumption channel. To date, the impact of RIAs as such is probably marginal in this area. Many services, apps and advertisers are still experimenting in the field. The impact of the companies behind RIAs is significantly larger, but a lot of the revenue is redistributed into the local country. The advertising revenue from banner advertisements organized via major advertising networks is equally shared with (local) website owners.[21]

It is as yet unclear whether individual websites would actually be able to attract advertisers without advertising networks or if the effort (transaction cost) of acquiring the right advertisers would in fact be greater than what an individual website is able to gain from the advertisers for their audience.

The main idea behind advertising is essentially to sell products and services to the target audience. Thus, *consumers* are the step in the advertising value chain that is decisive for the ROI depending on whether they purchase advertised products or services. Online advertising has been shown to be much more effective than traditional advertising formats as it can be targeted much better to specific consumer needs, consumption situations and consumer intentions (Arnold & Schiffer 2011). Also, the terms of payment for online advertising often comprise an element of success, for example clicks on the advertisement (pay-per-click); in the event of there being no click on the advertisement, the advertiser does not have to pay for the advert even though the advertiser may still profit from the fact that relevant target audiences have seen it.

21 Notably, the price for each click and consequently the amount that can be paid to the content owner differs across countries. Commonly, European and North American countries are sorted into Tier 1, fetching the highest prices and payments. Tier 2 is the largest group. Tier 3 consists of Algeria, Central African Republic, Cuba, Equatorial Guinea, Eritrea, Iran, Korea (North), Kuwait, Libya, Madagascar, Papua New Guinea, Saudi Arabia, Somalia, Sudan, Syria, Yemen and Zimbabwe. The number of tiers and corresponding countries can change depending on the advertising network. The example reproduced here is based on Tribal Ad Network's list of countries: https://tribaladnetwork.com/blog/about-tier-1tier-2-and-tier-3-countries/

The local perspective: Germany

The top ten advertisers by total advertising spending reflect the expectations mentioned in the above as many of them represent international FMCG conglomerates. Nonetheless, there is local value creation attached to them as they commonly have production facilities as well as offices in local markets employing several thousand people. In Germany, the total investment in advertising creates 847,000 jobs. Out of these, 27% are associated directly with the production of advertisements and 12% with media distributors. The remaining 61% of jobs reside with other sectors in the German economy, indicating the large positive spillover effect of advertising.

Overall, each euro invested in advertising creates up to €7 of GDP in the German economy (Deloitte 2017). The vast majority of advertising agencies have annual turnover of €250,000 or less. This underscores the emphasis on local value creation.

Within media distribution, online advertising plays a major role. In 2015, around €1.4 billion was spent on placing advertising in online and mobile channels (ZAW 2016). A significant share of this revenue is redistributed to (local) content creators, website owners and digital media outlets. The effect of online advertising is very significant for local companies and in particular SMEs.

Arnold and Schiffer (2011) show that Google AdWords enables an ROI for German companies of €12 for each euro they spend. The effect splits into approximately €8 for online revenue and €4 for offline revenue. The latter can be attributed to the so-called Research Online Purchase Offline (ROPO) effect. Other advertising channels achieve significantly lower ROIs in Germany: billboards €2.10; TV €1.30; print €1.90.

Table 4-1: The German advertising landscape

Germany (Dec 2016)
1. Procter & Gamble
2. Ferrero
3. L'Oréal
4. Media-Saturn-Holding
5. Lidl
6. Volkswagen
7. Beiersdorf
8. Deutsche Telekom
9. Unilever
10. Vodafone

Source: WIK based on Nielsen (2017).

<€250,000 annual turnover
73%
>€250,000 annual turnover
27%

Source: WIK calculation based on Federal Statistical Office (Destatis) data (in 2014).

4.4 RIAs as intermediaries for monetary exchange

Access to banking is still an issue in many countries. Various initiatives have aimed at banking the unbanked. Among them, m-pesa[22] is probably the best-known example. It enables people to send and receive money via SMS, for example to pay bills, save money or get paid for their services. Its success in particular in Kenya is well documented (Arnold et al. 2013). As our analysis of RIAs' functions in Chapter 2 shows, currently around 5% of RIAs feature a similar functionality.

The most advanced among them appears to be WeChat, which offers its own payment function. WeChat attracts a large number of merchants seeking to sell almost all types of goods and services to WeChat's large subscriber base and benefit from the popularity of the payment function. Its attractiveness is increased by the low transaction fees (0.6%) compared to major credit card companies (2–4%).[23] Since November 2015, WeChat's payment system has also been open to merchants in 20 other countries. This offers significant potential to engage with Chinese tourists who travel more due to increasing wealth in the country.[24]

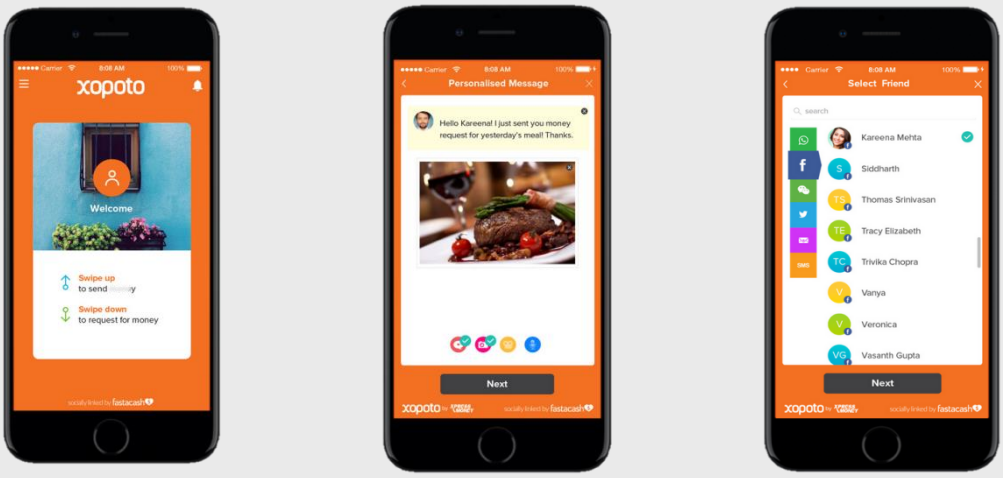
Other RIAs have similarly integrated payment functions. The case study below describes a particularly interesting example of a money transfer application that includes an enhanced chat feature to let customers exchange pictures and videos and engage socially in the context of the money transfer. This example underscores the finding from Chapter 2 that communication is at the center of human interaction.

22 https://www.mpesa.in/portal/
23 http://www.chinaluxuryadvisors.com/what-brands-should-know-as-wechat-goes-global/
24 Ibid.

XOPOTO: Interoperable social money transfer

XOPOTO[25] is a worldwide money transfer service founded by Singapore-based start-up Fastacash that works together with Xpress Money. XOPOTO is the first app to allow users to send and receive money around the world, integrating various social networks and offering rich interaction functionality so that senders and recipients can socialize.

The app can draw on the contact lists from various social networks including Facebook and Twitter as well as RIAs such as WhatsApp and WeChat. Its social functions are particularly important for expats who use the app to send money to their families at home and who appreciate the immediate feedback from their loved ones.



Transferring remittance money is one of the main usage scenarios for RIA-related money transfer, as the case study exemplifies. On average, these money transfers are significantly cheaper than via traditional systems like Western Union, Moneygram, or local banks and their international affiliates.

First, the transfer fees are significantly lower[26] and, in some cases, the service is provided for no fee for the user.[27] Second, organizing remittance via apps saves time as there is no need to drive to the local branch of a bank or a money transfer service, wait in line, or fill in forms. This efficiency enables remitters to send smaller amounts exactly when they are needed.

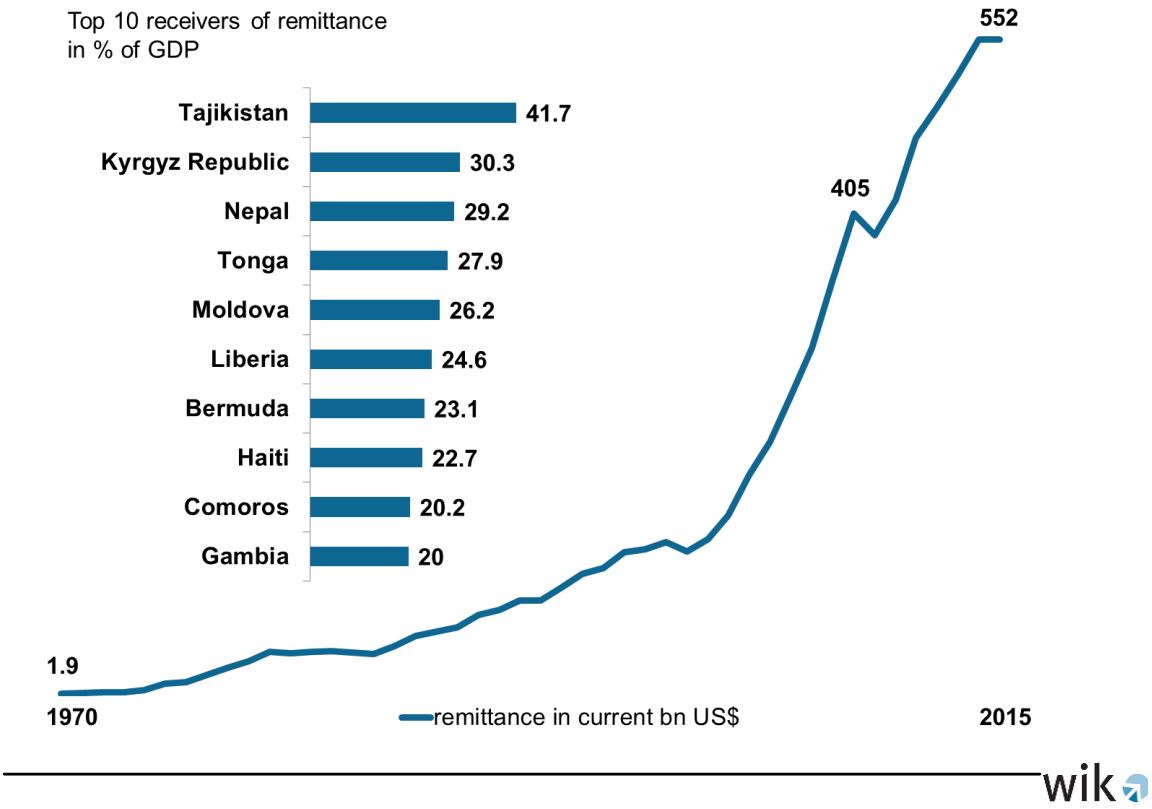
25 https://itunes.apple.com/de/app/xopoto-social-money-transfer/id1052650023?mt=8

26 In comparison, depending on the originating and destination country, traditional money transfer services collect fees up to 20% of the remitted amount (World Bank 2016a).

27 XOPOTO claims to transfer money at zero fees – this applies to selected types of money transfer (cash to card) in selected countries, e.g. UK to India (http://xpressmoney.com/xopoto/#, visited 11-05-2017).

On a global scale, the effect of these savings is potentially huge. The World Bank (2016a) estimates that US$552 billion was remitted in 2015. In some countries, the remitted amount contributes a vital share of GDP. Figure 4-2 lists the top ten receiving countries ranked by the remittance share of GDP. Although these are mostly small economies, the remittance effect on large economies is also significant. According to the World Bank (2016a), the largest remittance receivers are India (US$72 billion from around the world), China (US$64 billion from around the world) and the Philippines (US$30 billion from around the world). In these three countries, personal remittance is in fact higher than the reported total foreign investment.

Figure 4-2: Value of remittance



Source: World Bank (2016b).

5 The value of RIAs

Key Findings

- The economic impact of RIAs is a US$5.6 trillion GDP increase for each 10% increase in RIA usage (cumulative from 2000 to 2015) worldwide, with an anticipated acceleration of the impact in the later stages of the period.
- Consumer surplus from RIAs increased with a Compound Annual Growth Rate (CAGR) of 13% from 2010 to 2015 globally.
- RIAs also bridge language barriers, empower people with disabilities, extend connection services to remote areas, enhance the delivery of healthcare and education information, and contribute to the achievement of the United Nations Sustainable Development Goals.

5.1 Economic value

5.1.1 Brief literature review

There haven't been any prior economic studies on RIA estimating their (global) economic impact before, at least to the best of our knowledge. As we turn to measure the impact of RIAs on the global economy, we begin with a few selected studies of the economic literature in the fields of telecommunications and internet research because both represent our two endpoints, thus telecommunications and the full internet experience.

Roeller & Waverman (2001) provide evidence from 21 Organisation for Economic Co-operation and Development (OECD) countries over a 20-year period for a significant positive causal link between telecommunications infrastructure and economic activity. Sridhar & Sridhar (2007) investigate the relationship between telephone penetration and economic growth using data for development countries and find a robust positive impact of telecommunications penetration on economic output. With a regression on panel data of 192 countries from 1990 to 2007 using a production function with a system of simultaneous equations, Gruber & Koutroumpis (2011) find that mobile telecommunications' contribution to annual GDP growth is 0.11% for low income countries and 0.20% for high income countries. Czernich et al. (2011) estimate the effect of broadband infrastructure that enables high-speed internet on economic growth in OECD countries from 1996 to 2007 and find that a 10 percentage point increase in broadband penetration raises annual per capita growth by 0.9 to 1.5 percentage points. Farhadi, Ismail, & Fooladi (2012) find evidence for a positive relationship between growth rate of real GDP per capita and internet usage within a dynamic panel data

approach with 159 countries over the period 2000–2009. They estimate that a 1% increase in the level of internet usage compared with the previous year will increase the economic growth rate of GDP per capita by 0.09%. A study by Rafert & Mate (2017) presents findings from data covering 2012–2015 and 157 countries to estimate the relationship between WhatsApp usage and GDP with panel regressions and instrumental variables. Their results suggest that a 5 percentage point increase in WhatsApp penetration in 2015 is associated with a US$22.9 billion increase in global GDP.

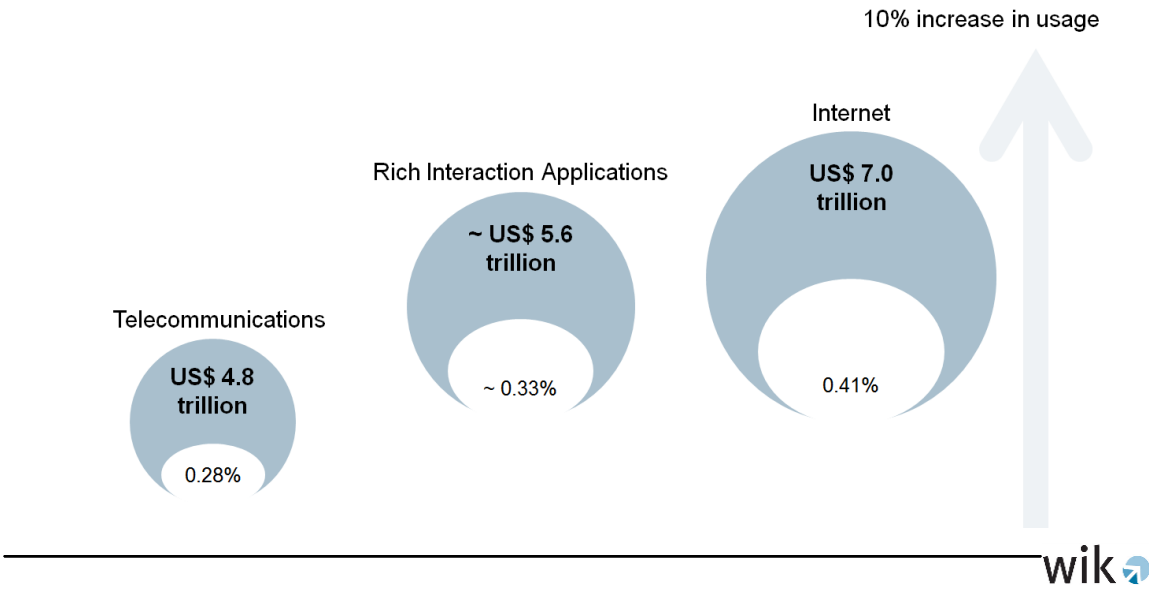
5.1.2 Impact of RIAs on GDP

Our analysis of RIAs' impact on GDP rests on our previous finding that RIAs are developing to integrate almost all of the functionalities associated with a "full internet experience". In order to calculate the impact, we applied econometric models drawing on a panel of 164 countries and 16 consecutive years (2000 to 2015) featuring more than 2,600 observations in total.

Since usage intensity of RIAs varies across countries, our analysis accounts for this by introducing a weighting factor based on the usage numbers presented in the Global Web Index data.

Our results are summarized in Figure 5-1. We find that, on average, a 10% increase in the global usage of RIAs leads to an increase in global GDP per capita by (approximately) 0.33%. This corresponds to an average global increase in GDP of US$5.6 trillion from RIAs over the 16-year period. These are conservative estimates, given that many uses and impacts of the RIAs are not captured in GDP.

Figure 5-1: Average impact of telecommunications, RIAs and the internet on global economic output from 2000 to 2015



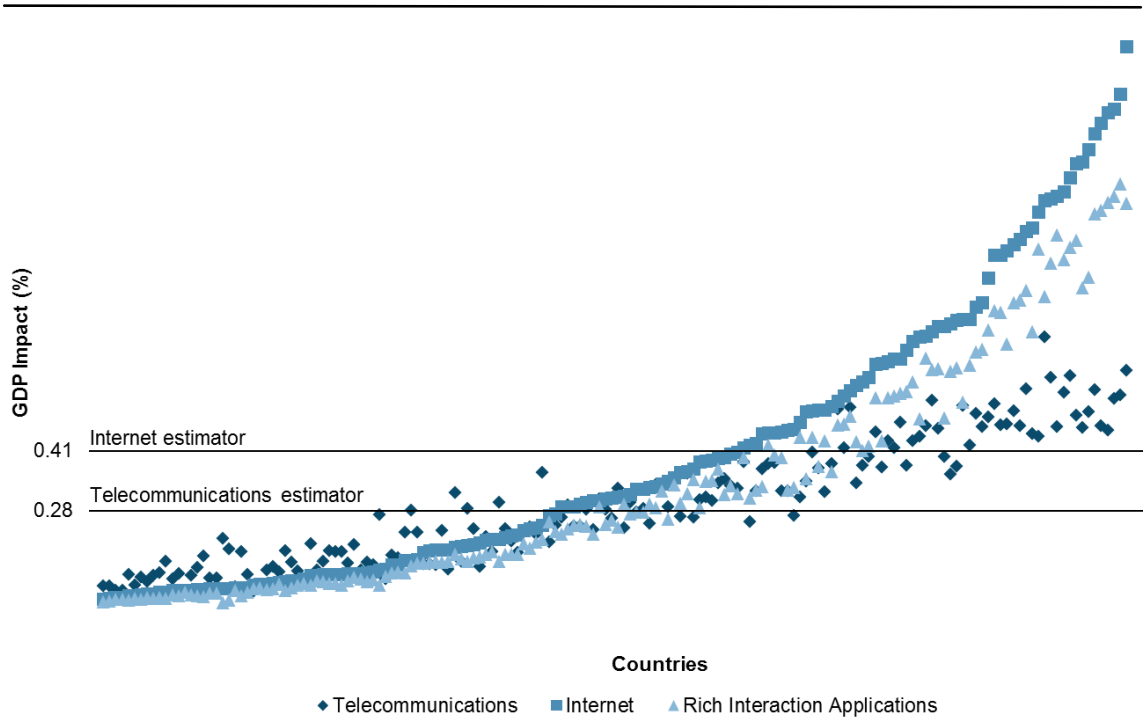
Source: WIK.

The following paragraphs provide more detailed insights into the background of the estimates presented in the above. A full description of the methodology can be found in Annex 4 of this study.

Notably, the impact of RIAs is not likely to be equal across all 164 countries over the whole period. Given the early history of RIAs as largely desktop applications, developed countries probably benefited relatively more from RIAs in line with the earlier take-up of fixed IAS. However, the benefit has spread to developing countries as RIAs have evolved into mobile applications (some with relatively low handset and bandwidth requirements) and internet penetration has begun to reach comparable levels in these countries. Hence, one would expect a lower average impact for users in less-connected countries across the 16 years observed in the present study.

Figure 5-2 illustrates these differences by depicting the GDP per capita impact of RIAs in relation to telecommunications and the “full internet” for each country covered in the panel dataset over the 16-year period. For countries located at the bottom half of the scatterplot (generally, those with lower levels of broadband penetration), an increase in internet usage and, therefore, in RIA usage has little or no impact on global GDP per capita. For countries located in the upper half of the scatterplot, an increase in internet usage and, therefore, in RIA usage has a strong impact on global GDP per capita. These include Australia, Austria, Bahrain, Canada, Costa Rica, Germany, Hungary, Kuwait, Lebanon, Macao (SAR China), Malaysia, Mexico, New Zealand, Qatar, Serbia, Slovakia, United Arab Emirates, United Kingdom, and United States.

Figure 5-2: Scatterplot of GDP impact referring to a 10% increase in telecommunications, RIAs and internet usage



Source: WIK.

Table 5-1 presents the results of the econometric estimation of the impact of telecommunications and the internet on global economic output per capita over the 16-year time span for 164 countries. The overall models as well as the individual coefficients are statistically significant in both equations. R-squared (the share of the variance in the sample that can be explained) is around 80% in both specifications. Further tests were conducted and all of them supported the robustness of the estimates shown below.

Table 5-1: Impact of telecommunications and internet usage on GDP per capita

VARIABLES	(1) Log(GDPpc)	(2) Log(GDPpc)
Log(K/L)	0.168***	0.141***
	(0.039)	(0.037)
Log(IndexTelecom)	0.028**	
	(0.013)	
Log(IndexInternet)		0.041***
		(0.008)
Constant	6.818***	7.188***
	(0.406)	(0.386)
Observations	2,616	2,607
Number of countries	164	164
R-squared	0.800	0.814

Sources: WIK based on ITU, World Bank, and Penn World Table.
Robust standard errors in parentheses. Results referring to a 1% increase in telecoms and internet usage.
*** p<0.01, ** p<0.05, * p<0.1.

Column 1 presents the results for the common logarithm of the telecom index. The estimated coefficient for the telecom index is statistically significantly different from zero at the 5% level. According to this coefficient, a 10% increase in the global level of the telecom index leads to a 0.28% increase in the level of global GDP per capita. On average, this 10% increase corresponds to an economic magnitude of about US$4.8 trillion of global GDP over the 16-year period.

Column 2 shows findings for the common logarithm of the internet index. The estimated coefficient for the internet index is statistically significant at the 1% level and reveals an even higher impact on economic output than telecommunications. The coefficient indicates that a 10% increase in the internet index results in a 0.41% increase in the level of global GDP per capita. On average, this 10% increase relates to an economic magnitude of about US$7.0 trillion of global GDP over the 16-year period.

Our findings are consistent with the economic literature that telecommunications and internet usage are positively correlated with economic output. Our results can be interpreted as conservative estimates, in particular for the internet impact on GDP, since there are several non-monetary aspects of internet functionality, such as reduced information, search and transaction costs, and further efficiency gains, such as rather large spillover effects due to time saved. These non-monetary aspects that are not considered in GDP tend to have quite a large effect in economic terms at a global level.

5.1.3 Impact of RIAs on consumer surplus

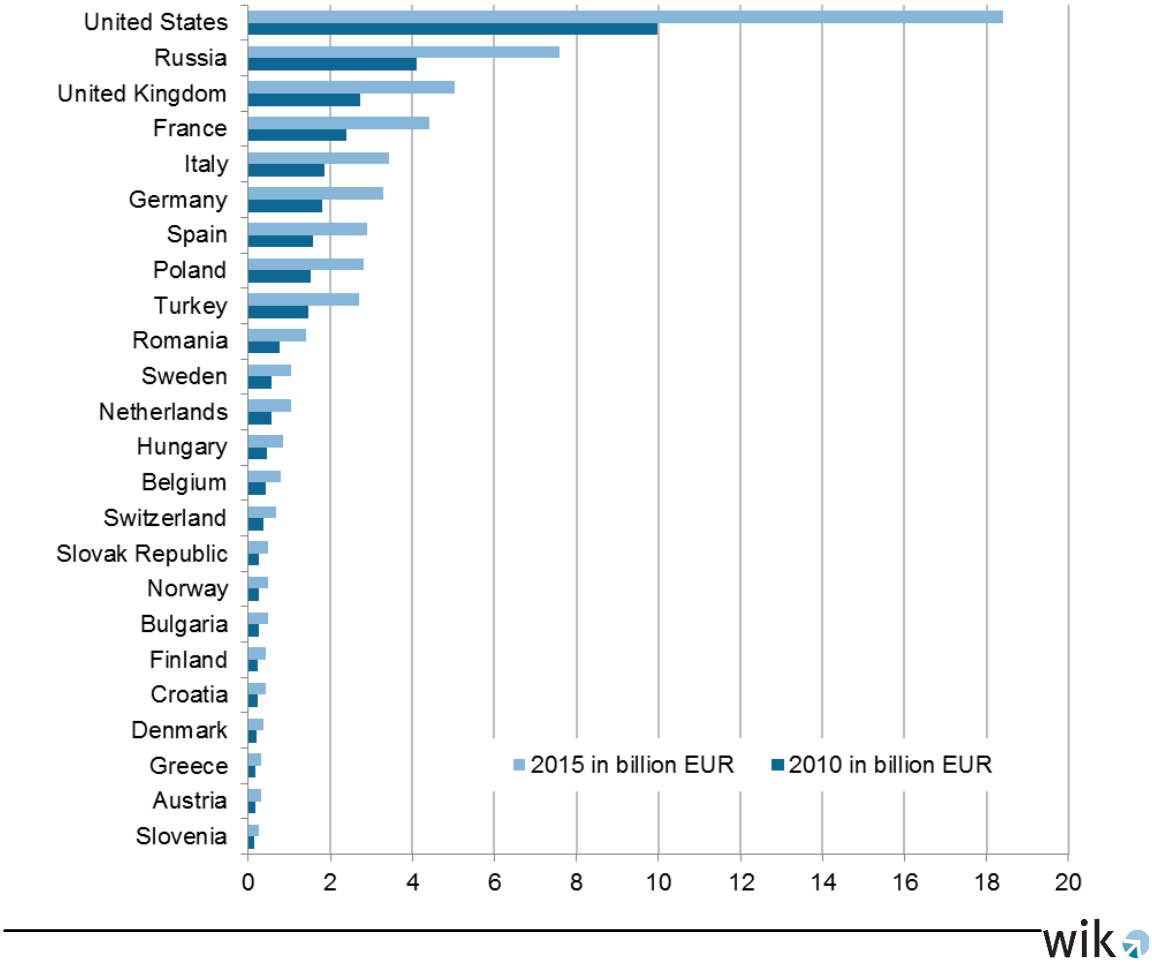
We have previously shown that RIAs offer functionality that covers about one third of all activities commonly considered to be part of a “full internet experience”. Using previous analyses of the consumer surplus, we have calculated that RIAs generate a very significant portion of consumer surplus in a range of countries for which data were available.

According to a study by McKinsey (2010), free internet-based services account for about 80% of total consumer surplus associated with the internet. The McKinsey report calculates that total consumer surplus from online-advertising-based services increased from €101.3 billion in 2010 to €186.64 billion in 2015 for Europe and the USA. This corresponds to a CAGR of about 13% (McKinsey 2010). With market research techniques and a conjoint analysis based on a total of 3,360 online interviews in Europe and the USA, they find a similar shape and size of the demand curve in different countries, allowing us to extrapolate these patterns to other markets. Since most RIAs are either advertising-based or free of charge, it is plausible to assume a similar structure for the demand curve for RIAs.

Consumer surplus is calculated by analyzing the difference between the willingness to pay for a given quantity of a good by the consumer relative to the market price being paid for a given quantity of that good. In addition, consumer surplus can arise due to better quality, decreasing prices and time saved. We calculate this difference based on the results of the conjoint analysis capturing the value of free and advertising-based services to consumers and calculate the share of the functions of these services that are covered by RIAs.

Figure 5-3 presents the results for the consumer surplus from RIAs in 2015 compared to 2010 for selected countries. The consumer surplus associated with RIAs in the USA increased from €9.9 billion in 2010 to €18.39 billion in 2015 and is leading the list of the countries analyzed. Slovenia is at the bottom end of the countries analyzed; their consumer surplus from RIAs increased from €0.13 billion in 2010 to €0.26 billion within the same period.

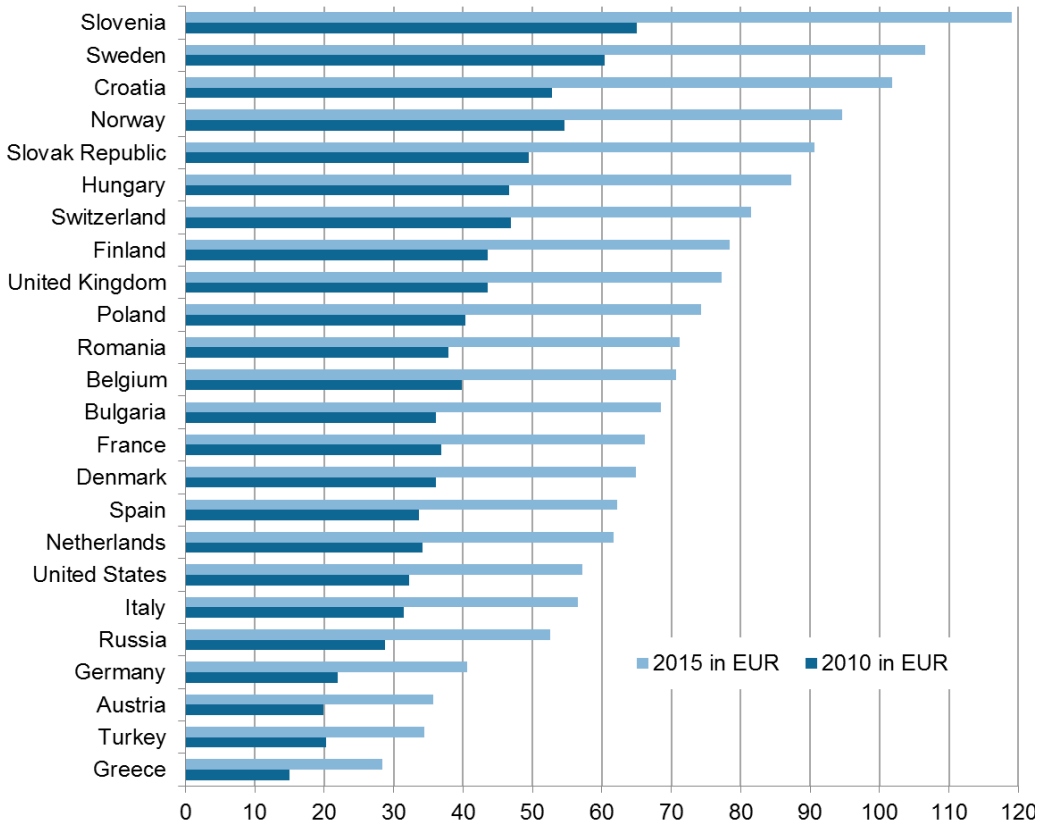
Figure 5-3: Consumer surplus from RIAs in selected countries in 2010 and 2015



Source: WIK.

Figure 5-4 below shows the results for the consumer surplus per capita from RIAs in 2015 compared to 2010 for the same selection of countries. In contrast to the results for the absolute consumer surplus from RIAs, the consumer surplus per capita associated with RIAs in Slovenia increased from €65 in 2010 to €119 in 2015 and is leading the list of the countries analyzed. In comparison, the consumer surplus per capita from RIAs in the USA increased from €32 in 2010 to €57 in 2015. Not surprisingly, there is a different allocation of consumer surplus per capita across countries in comparison to the absolute consumer surplus ranking.

Figure 5-4: Consumer surplus per capita from RIAs in selected countries in 2010 and 2015



Source: WIK.

Overall, our consumer surplus results can also be interpreted as conservative calculations. The consumer surplus of RIAs tends to be higher: First, most RIAs are application-based and there is increasing global popularity of mobile devices such as smartphones, tablets and wearables. Second, RIAs provide means for users to publish, share and consume content within a group acting as multipliers. Third, RIAs endow social interactions with the speed, scale and economics of the internet, thus making them powerful enablers of value creation.

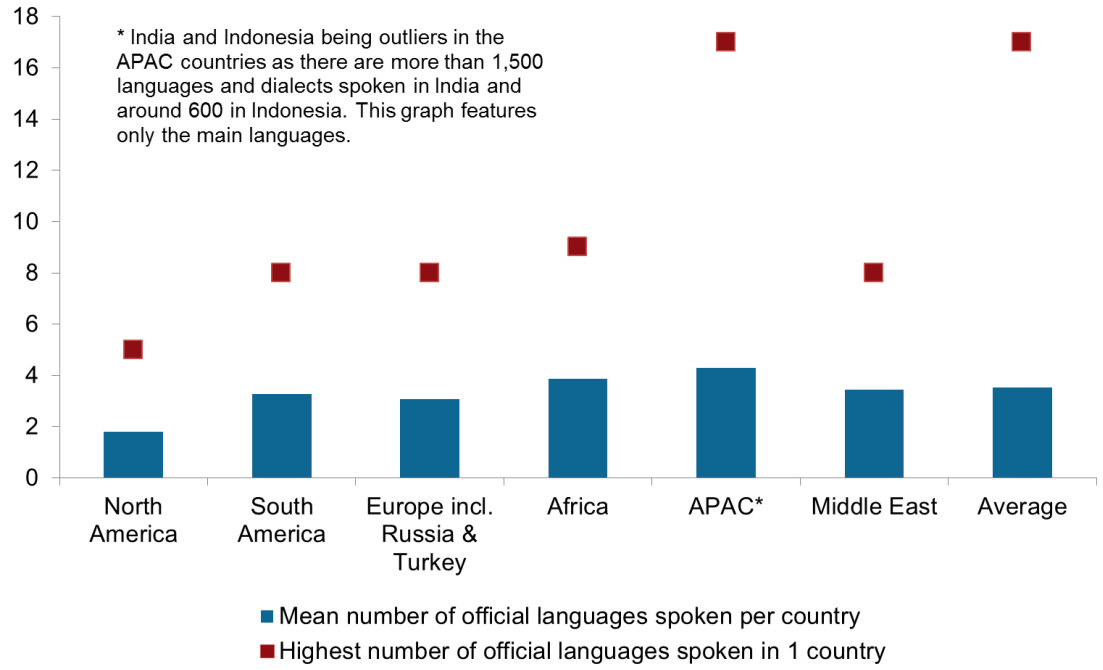
5.2 Societal value

5.2.1 RIAs can help to bridge communication gaps

To understand each other, a common language is essential. On average, 3.5 languages are spoken in each country, so it is not surprising to find language gaps in the middle of many international relations and business encounters (see Figure 5-5). RIAs offer smart

translation tools in real time and, in many cases, at no cost to help bridge these gaps. The most prominent example is probably the Skype real-time translation feature. This feature was introduced in 2014 and was limited to Skype-to-Skype calls until December 2016. Today, it can also be used for calls to mobile and fixed lines. The system currently translates nine languages: English, Spanish, French, German, Chinese (Mandarin), Italian, Portuguese (Brazilian), Arabic and Russian.

Figure 5-5: Number of languages spoken in each country across world regions



Source: WIK based on infoplease.com.[28]

People with disabilities may experience a different set of gaps in their efforts to communicate. There is an increasing trend among individuals with communication disabilities to use standard commercial devices (Bornman et al. 2016). Standard commercial technologies such as touchscreens and speech recognition are playing an increasingly important role in supporting people with specific access needs, in many cases replacing the more expensive Augmentative and Alternative Communication (AAC) technology previously used for these purposes (Raja 2016). Alper and Haller (2017) have found that mainstream technologies are comparatively more powerful, compact, and have a longer battery life, which is essential for communicating without having to stop and recharge a device, as is often the case with specialized AAC devices. However, it should also be noted that in Bornman et al.'s (2016) study, negative perceptions of mainstream devices also resonated with participants. Despite adaptions to the mobile devices, participants identified frustrations using them, like

28 https://www.infoplease.com/world/countries-world/languages-spoken-each-country-world

having difficulty entering a lot of text (30%), and having difficulty reading something on their device because the screen was either too small or the screen reader could not read the text aloud (17%).

There have been dedicated developments, such as 3D touchscreens and cell phones that can be turned on by voice command or manipulated with head movements like the Sesame phone,[29] but RIAs are also doing a lot of work to provide equal access for everyone. An app called Ava[30] translates spoken language into written language displayed in the app on the smartphone of a person who is deaf or hard of hearing. Another app called Five[31] allows users to use sign language (existing or new) and send the message to friends in Five or connect with Facebook Messenger.

Bornman et al. (2016) also found that 40% of the studied population used one or two apps on their wireless devices, with the most popular being social networking apps; 67% of the individuals have a profile on Facebook, Twitter and/or LinkedIn and 43% visit these sites several times a day. This is in line with other studies, like Caron and Light (2016) and Light and McNaughton (2014), which suggest that social media via networked mobile technologies give individuals with significant communication disabilities opportunities to increase, maintain, or improve their own communication in everyday contexts. Indeed, RIAs can also play a crucial role in this respect. For instance, the Australian app hireup[32] enables rich interaction between people with disabilities and potential professional care workers. The app facilitates socializing before the actual interaction commences. Thus, common interests can be explored, resulting in an improved matching process for care workers and people with disabilities.

RIAs also offer solutions for communication with elderly individuals who are likely to be less technology savvy. An application called Care Messenger allows RIA users to communicate with elderly relatives through their TV sets.

Communication and caring go hand in hand

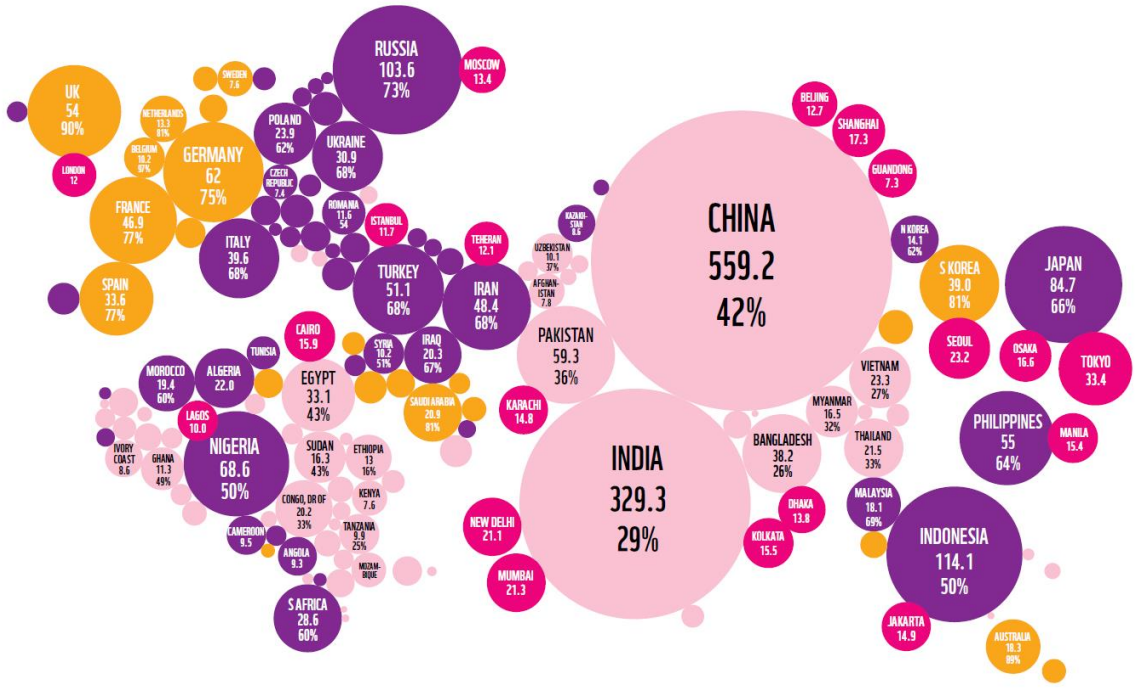
Care Messenger[33] in the UK enables people to communicate via SMS or app on mobile devices to anybody with a TV screen. The message is displayed on the TV screen and the receiving person can send a simple response using their familiar television remote control. This helps enable communication with elderly people, who often are not familiar with tablets or smartphones but do know how to operate the TV, which is switched on for most of the day.

29 http://sesame-enable.com/phone/
30 https://dwww.ava.me
31 http://www.health24.com/Medical/Hearing-management/News/18-year-old-creates-first-sign-language-messaging-app-20160202
32 https://hireup.com.au/#/about
33 http://www.caremessenger.co.uk/viewcaremessenger.html

5.2.2 RIAs facilitate the maintenance of close relationships over long distances

Urbanization is one of the primary drivers of geographic dispersal of families. The United Nations expect that two out of three people will live in urban areas by 2050 (cf. WWF 2012). In fact, urbanization has already had a significant impact on the way people live (see Figure 5-6) and it is accelerating rapidly. According to the African Development Bank Group, Africa has experienced the highest urban growth during the last two decades at 3.5% per year, and this rate of growth is expected to continue until 2050. [34] Typically, it is a husband or children who move to large cities to earn money in better-paying jobs than they would have been able to attain in their villages. However, keeping in touch with family, friends and other loved ones can be challenging and expensive.

Figure 5-6: Urbanization in selected countries in Europe, Africa and Asia



This figure shows the number of people living in cities in selected countries in 2010, together with the percentage of the population in countries with large urban populations.

Source: WWF (2012).

In Kenya, Oduor et al. (2014) examined the communication practices of family members who communicate both within and between rural, suburban and urban settings. In urban areas, communication options were facilitated by higher incomes and education, as well as the availability of fixed internet access and mobile telecommunications services. In

34 https://www.afdb.org/en/blogs/afdb-championing-inclusive-growth-across-africa/post/urbanization-in-africa-10143/

more rural areas, however, RIAs are necessary to bridge the digital divide by offering a new communication option to individuals who otherwise have limited access to telecommunications services and little knowledge about computers.

RIAs also facilitate communication in more specific situations where an individual is not geographically close to their friends and family. This is typical for aid workers who engage in international projects as well as soldiers who may spend months in remote areas with poor infrastructure. Again, the rich interactions that RIAs enable is well-suited to helping these individuals maintain close ties even over great distances. This capability was recognized by the United Nations High Commissioner for Refugees (UNHCR) and Skype when they developed a special version to connect families (see case study).

Remote but still connected thanks to RIAs

UNHCR staff often work in remote "hardship" locations to provide support to people who have to flee from their home country, for example because of war and natural disasters. The UNHCR staff may therefore be separated from their families and friends for months at a time, sometimes at very short notice, and have limited or occasionally no opportunities for communication. To address staff isolation and stress, for the sake of staff well-being but also to ensure staff productivity and, ultimately, the quality of UNHCR's operational response, a cooperation was started in 2009 between UNHCR, the Government of Luxembourg and communications software provider Skype.

Funded by the Government of Luxembourg, Skype started developing a customized version to provide free or low-cost voice and video calls over the internet that worked on low bandwidth connectivity. This was important considering the limited availability of connectivity in the remote areas but also to address continuity of other UNHCR business applications, integration with UNHCR's firewalls and other security aspects.

By August 2011, Skype had been rolled out in 118 hardship locations in United Nations compounds across Asia, the Middle East, Africa, Oceania and Europe, benefiting 3,068 members of UNHCR staff. Since the end of 2011, the special Skype version has been provided to all UNHCR's hardship locations.

People working for UNHCR state that the availability of Skype during their assignments is very important for keeping daily contact with their family and staying involved in the family's daily routine.

RIAs have also played an important role in connecting family members to individuals who are caught up in extreme events, including when they are unsure of their safety and well-being. RIAs offer quick help due to their availability, ease of use and rich communication. For instance, WhatsApp played a crucial role in reuniting families after the tragic train crash near Pukhrayan in the Indian district of Kanpur in November 2016. Injured people, including many children, were rushed to hospitals wherever capacity and required expertise were available. This meant that families, friends and relatives were separated from each other without knowing where their friends or relatives were or whether they had survived at all. The situation was further complicated by the fact that many of the hospitalized people were either unconscious or not able to speak due to shock.

In the meantime, people looking for their relatives and friends were going from one hospital to another searching for more information. Doctors started taking pictures of hospitalized clients accompanied with their name if available and the hospital they were in. These photos were then shared with doctors in the surrounding hospitals via WhatsApp group chats and this enabled a much quicker reunion of families.

5.2.3 Impact of RIAs on health in developed and developing countries

RIAs can be useful for improving health outcomes in developing countries. RIAs provide medical information through text and especially through pictures and videos, helping to overcome the obstacles to good health outcomes created by poor medical infrastructure, low literacy rates and even traditional beliefs that might endanger health.

RIAs are particularly well-suited to overcoming information gaps in situations where low literacy levels and diverse local languages render textual information provision difficult. While there are many dedicated information apps,[35] general purpose RIAs can also play a more informal role and indeed lower the threshold to engage with professionals about potentially embarrassing topics around reproductive medicine or HIV/AIDS.

For instance, a WhatsApp group providing this kind of forum for exchange in Kenya has been very successful.[36] These groups can provide continuous social support or an immediate communication channel that can be used to gather detailed information at very little effort or cost, including for those who might not be otherwise inclined or able to join a support group or call a helpline. The below case study on WhatsApp's role during the Ebola crisis illustrates this characteristic and its effect.

35 For instance, Smart Health App is an information app intended for the whole African continent and is already available in seven countries (Tanzania, Nigeria, Kenya, South Africa, Angola, Ghana and Senegal). The app provides accurate information on HIV/AIDS, tuberculosis and malaria in English, French, Portuguese and Swahili.

36 250 young people talk about HIV on WhatsApp group (Source: http://www.keycorrespondents.org/2016/05/20/whatsapp-in-kenya-real-time-messaging-about-hiv/).

WhatsApp in the fight against Ebola

During the Ebola crisis in 2014–15, the BBC set up a subscriber-based WhatsApp service that allowed content from the World Health Organization (WHO), the Centers for Disease Control and Prevention, and the United Nations Children's Fund (UNICEF) to be posted as images, text and audio.[37] The service became immensely popular; in total, 20,000 people subscribed, of which 15,000 lived in Sierra Leone, making it the most widely used RIA during a global health emergency.

According to the BBC, a big part of the success came from being “low tech”, i.e. a system that is already installed on many devices and is straightforward to use while not requiring too many resources. Thus, people from remote and quarantined areas could access life-saving information from an app they already used. The images and audio messages were particularly useful for users with low levels of literacy. It also provided a platform for people to post their questions about routes of transmission and share stories of local solutions. Furthermore, there were many questions and myths going around regarding Ebola and these were answered with objective and trustworthy content via the chat group.

A second facet of health information provision is the education of health workers. While professional health workers receive a significant amount of formal training and gain on-the-job experience and insight from colleagues, Community Health Workers (CHWs) usually cannot profit from the same level of support. CHWs in Kenya are supported by the use of chat services as a supervisory tool. A six-month study in the Kibera and Makueni districts showed that with minimal training, 41 CHWs and their supervisors could use mobile instant messaging to support supervision, professional development and team building.

Rich content was a key component of the communication among CHWs and their supervisors, as 23% of all posts contained pictures or other media. The communication was used to support: (1) quality assurance, (2) communication and information, or (3) a supportive environment (Henry et al. 2016).

Independent from whether one lives in a developing or developed country, getting accurate information immediately when it counts can save lives. While SMS and voice services already provide crucial help, there is a role to play for RIAs, with their ability to include rich communication and integrate innovative algorithms. The case study of Artificial Intelligence (AI) integration in RIAs highlights this role.

37 https://www.devex.com/news/beware-of-the-pokemon-the-not-so-augmented-reality-of-digital-health-and-development-88456

AI: A natural extension of health applications

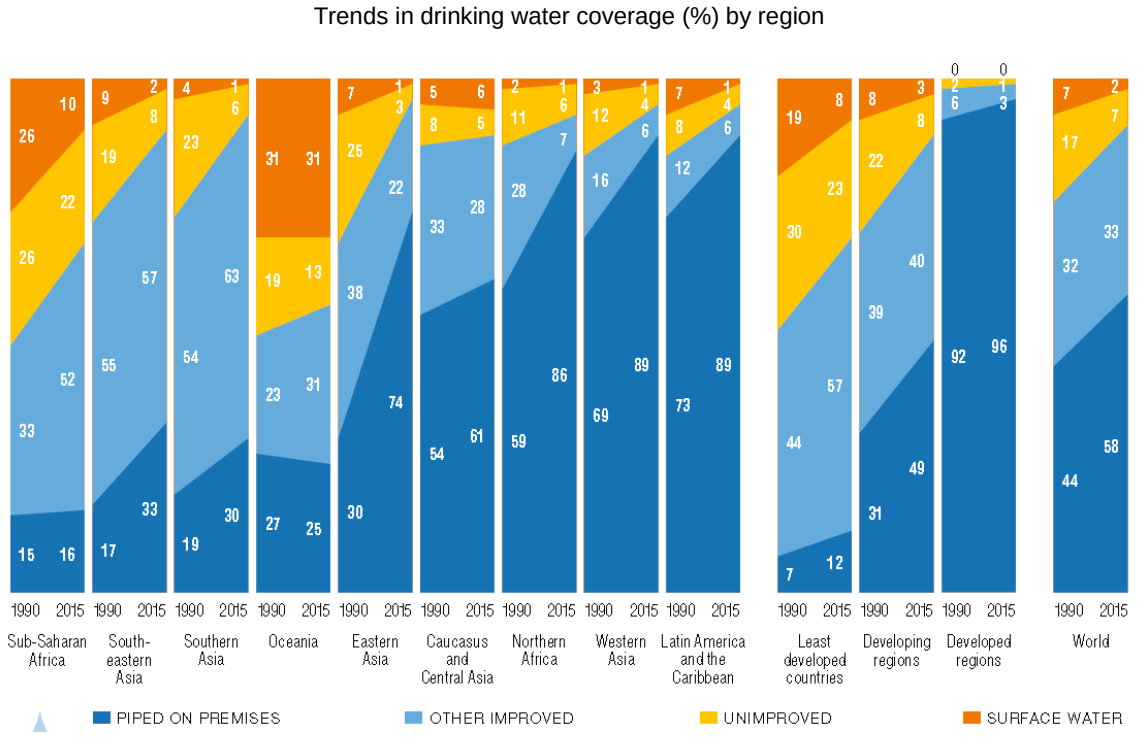
Birth asphyxia is one of the top three causes of infant mortality in Africa, causing the death of about 1.2 million infants and severe life-long disabilities such as cerebral palsy, deafness and paralysis. If asphyxia can be detected early enough, the babies' lives might be saved according to the United Nations. Ubenwa[38] is an app for parents with a newborn; by using the app to record the crying of their newborn baby, it is possible to detect whether the baby has birth asphyxia. This very cost-effective and quick method is realized by AI's automatic comparison of amplitude and frequency patterns of the crying with database recordings of babies born without birth asphyxia.

Adults can also profit from AI support through Your.MD,[39] an app promoted as a personal health assistant that is available for users on global messenger platforms such as Slack, Telegram and Facebook Messenger. Your.MD claims that it has become the number one health app in over 40 countries, including India, the Philippines and Nigeria, since its launch in November 2015.

Finally, RIAs can also support the delivery of basic health needs such as clean water supply. Although significant progress has been made on water supply (see Figure 5-7), in many areas it is only intermittent and sometimes not clean enough to drink. Information about when water is available or alerts when the water may not be drinkable are crucial, as this can help avoid wasting time waiting for water or walking to another more remote water supply. Apps such as Waattr can provide exactly this type of information.

38 http://ubenwa.com/
39 http://www.your.md/

Figure 5-7: Understanding water supply worldwide



Achievement of drinking water target from Millennium Development Goals (MDG)

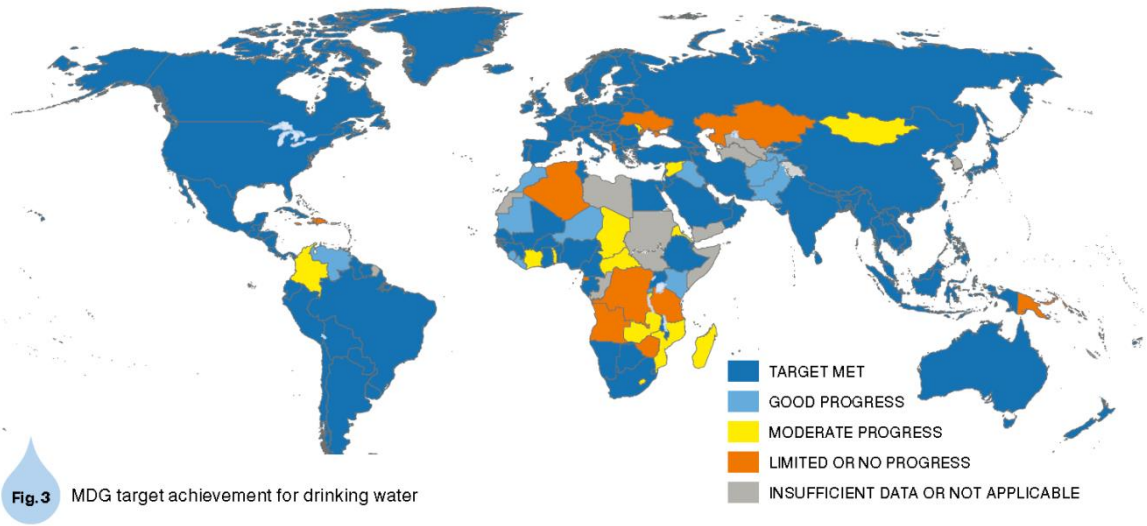


Fig. 3 MDG target achievement for drinking water

Source: WHO & UNICEF (2015).

Every drop counts

In 2010, the United Nations University indicated that more people own a cell phone in India than have access to a toilet. This shocking finding raised international awareness of the poor infrastructure conditions in developing and emerging countries.

While the information by the WHO and UNICEF presented in Figure 5-7 shows some improvement, the situation is still difficult for many people living in India. Water supply there is intermittent and sometimes of poor quality. This is due to a predominantly manual system of valves in the Indian cities, which makes water supply unpredictable. Thus, information about when good clean water is available is crucial. The smartphone app Waattr[40] and related SMS program NextDrop allow users to find and share information about water quality and supply with the local community that is provided by the people operating the valves.

Integrating this system into an RIA could further empower the crowdsourcing approach with pictures and videos of leaks or other faults in the system. This additional information may improve the overall quality of the infrastructure as early intervention could reduce maintenance costs. Furthermore, picture analysis algorithms could help people to evaluate the quality of the water that they receive.

5.2.4 Connecting people without the internet

RIAs that enable *ad hoc* networks are an essential asset for disaster relief operations that commonly have to deal with unfavorable environmental conditions including intermittent or unavailable broadband access. For instance, FireChat was used in the Chennai floods in India in 2015. Then, around 23,000 new users were registered in the most affected areas alone. Given that traditional networks were no longer available, independent communication was of essential importance to the people.[41]

FireChat has also been part of an earthquake simulation in the Philippines. The so-called Shake Drill simulated an earthquake of 7.2 magnitude. The simulation showed that with FireChat, alerts reached 80% more people than without it.[42] The United Nations (2014) estimated that in 2014, the majority (56%) of cities with more than 300,000 inhabitants were at high risk of exposure to at least one of the six natural hazards (cyclones, floods, droughts, earthquakes, landslides and volcano eruptions). At the time, this equaled 1.4 billion people at risk (Gu et al. 2015). With ongoing

40 http://www.npr.org/sections/goatsandsoda/2015/08/29/434649468/no-more-standing-by-the-spigot-messaging-app-alerts-water-availability

41 http://economictimes.indiatimes.com/tech/internet/firechat-alerts-to-help-people-communicate-without-mobile-networks/articleshow/52346969.cms

42 FireChat case study on the company website: https://www.opengarden.com/case-studies.html

urbanization and increasing risk of natural disasters due to climate change, this figure has been increasing.

Table 5-2 provides an overview of FireChat and another exemplary RIA, Jott, featuring this type of functionality. Notably, the examples below illustrate that broadband-independent RIAs are equally popular in areas with and without a high level of broadband quality. While in developing countries and under severe conditions they can provide otherwise non-existent connectivity, in developed countries, these services are well-suited for large events and similar occasions when mobile networks have difficulty coping with demand.

Table 5-2: Two examples of RIAs with ad hoc network functionality

FireChat
Beyond its benefits for disaster relief, FireChat has become more popular for day-to-day usage as well. In particular, consumers appreciate its reliability during large sports events, concerts or other occasions when cellular networks usually underperform or do not perform at all. It is estimated that currently around 6 million people use this app; around 1.5 million of them live in India. Technologically, FireChat builds on a self-constructed and self-healing mesh network. The company assumes that when 5% of a city's population use the app, messages can be delivered. It has also become known for supporting democratic inclusion in countries. Examples include the pro-democracy marches in Hong Kong, resistance fighters in Iraq, and the "sunflower" movement in Taiwan.
Jott
Jott is particularly popular with tweens and teens in the USA and Canada. In 2015, the company reported 500,000 monthly active users. The app users tend to refrain from using their data plans to save money. Since the typical user group spends a lot of time in close proximity, i.e. in school, the network quality is usually good. It may also be assumed that pupils appreciate the privacy that the app guarantees since the WiFi network at their school may either block other RIAs altogether or monitor the traffic somehow.

Source: WIK based on various press articles, official descriptions of the apps on app stores and company websites.

5.2.5 Impact of RIAs on education

Education is a key enabler of economic progress (e.g. Shaw & Allison 1999). Consequently, improving the success and impact of education is one of the top priorities in both developed and developing countries. Communication is a fundamental requirement of knowledge transfer and thus plays an important role in education. However, there are various situations when direct face-to-face communication is not possible, either because pupils live in remote areas or when the learning is to be extended beyond the classroom. This is where RIAs can play an important role.

The most common application is to distribute educational material. However, RIAs are also used to improve the overall interaction process between teachers, parents and pupils. To this end, various specialized RIAs, so-called classroom communication apps, exist. These are messaging apps, like Tamo[43] and Diaryium[44] in Lithuania, Juggl[45] in South Africa, and Teno[46] and Arch – The Way[47] in India, all of which connect teachers with students and their parents. In general, the classroom apps enable teachers to broadcast messages, images, videos, tabular schedules and files to the entire class or receive feedback from the students and parents. Participants have to sign up via an app to connect in a secure manner. These apps support critical aspects of communication between schools, students and parents, like controlled distribution of data and filtering of information that might harm children.

Some of these classroom apps, like the Lithuanian app Diaryium, go even further by adding administrative functions for schools like diaries, class attendance and reporting. Besides these specialized RIAs, mainstream RIAs are often used to achieve similar results. In many developing countries, mainstream RIAs play the main role since specialized services are rarely available. The following case study demonstrates this point.

43 https://itunes.apple.com/lt/app/tamo-ismaniems/id1014073211?mt=8
44 https://www.linkedin.com/company/diaryium-mano-dienynas
45 http://www.getjuggl.com/, used by hundreds of schools in South Africa.
46 https://tenoapp.com/
47 https://yourstory.com/2016/01/arch-the-way/

Telling the story of education success: RIAs in teaching

In India, two development organizations, VSO and Pratham, developed a training plan[48] to improve reading and writing skills for children in the rural district of Bundi. For seven weeks, teachers received a daily language lesson plan via SMS and WhatsApp. The plans became more complex as the weeks went by, and in the latter stages of the pilot, WhatsApp was used to deliver audio and song-based teaching aids, and to provide a forum for educators' discussions.

The results were impressive: after seven weeks, 63% of the children at participating schools were able to correctly read words and sentences compared to 35% at the beginning of the seven-week program. This is significantly higher than results at other schools (an increase from 35% to 42%) that did not participate in the learning program. In addition, the learning program is very cost-effective at just 10 Indian rupees per child, which is only 1.4 euro cents.

However, WhatsApp and other mainstream RIAs are also used in developed countries in order to improve learning performance and socializing outside the classroom. For instance, Bansal and Joshi (2014) observed student-teacher interaction via WhatsApp for 40 days and found that students found learning through WhatsApp very interesting and educationally useful and their social interactivity increased. However, the converging of private and classroom lives was not considered positive by all participants, in particular students who already had a family.

Insights gathered from students and teachers at the Open University in Indonesia show that Facebook and WhatsApp groups have the potential to be used as complementary online tools for English courses; however, participation of teachers and administrators in the online groups is crucial for the potential to be realized (Susilo 2014). Bouhnik and Deshen (2014) explored the use of WhatsApp as a classroom communication tool between teaching faculty and high school students. Participants mentioned technical advantages (such as simplicity, low cost and availability), educational advantages (such as the creation of a pleasant environment and easier acquaintance with other students), and academic advantages (such as accessibility of learning material, teacher availability and learning after class hours), but they also mentioned challenges (such as not all students had a smartphone, and teachers were overwhelmed by irrelevant messages and also expected to be available 24/7).

In sum, these current and nascent uses of RIAs point to the many socioeconomic benefits to be unlocked by fostering the development of these applications and tools to enable richer and more accessible interaction in an ever greater set of situations and for an ever greater group of individuals and businesses.

48 See for full report, https://www.vsointernational.org/sites/default/files/sms_report_final_v1_4.pdf

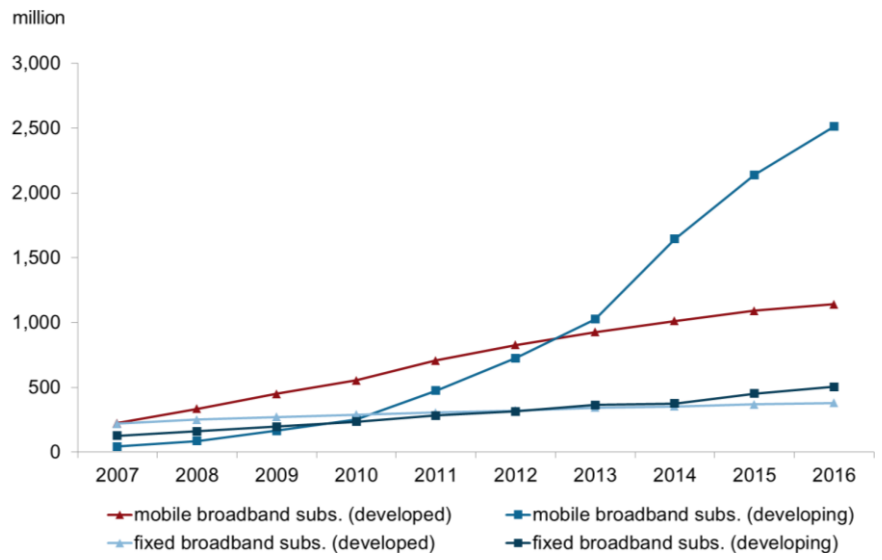
6 RIAs: An outlook

The present study is, to our knowledge, the first to explore the socioeconomic impact of RIAs. It found that the rapid uptake of RIAs is driven by consumer and business demand for the key features— rich, multi-sided interaction tools — as well as integration with activities such as advertising and purchasing. RIAs are evolving to allow consumers to engage in a full suite of online services and vendors. This implies that their socioeconomic impact is somewhere between that of simple connectivity and a "full internet experience". Our econometric analysis has shown that RIAs are having the most pronounced positive economic impact in OECD and other countries that have significant internet connectivity, while the impact is only beginning to be realized in developing countries as mobile broadband deployment increases.

Although some RIAs no longer rely on broadband internet access in order to support in-community connection, it is still critical for most applications to have an internet connection with sufficient bandwidth and run on a smartphone or at least a feature phone that can run a light version of an RIA. Thus, socioeconomic value will be greatest in the context where devices and IAS are available and affordable in developed and developing countries.

ITU and other stakeholders regularly take stock of the worldwide number of internet users. Recently, there has been substantial progress as regards connecting the unconnected, as the ITU statistics show in Figure 6-1. Across both developed and developing countries, there has been a continuous increase in IAS take-up, mostly driven by mobile broadband subscriptions. However, the rate at which new people are connected barely keeps up with the worldwide population growth.

Figure 6-1: Internet access in developed and developing countries



Source: ITU (2017).

Furthermore, the Inclusive Internet Index provides a comprehensive presentation of the current state of development. The Index assesses different factors, namely affordability, availability, relevance, and readiness, as regards their ability to form an enabling environment for the adoption of the internet in 75 countries and ranks them accordingly. Table 6-1 shows the rankings of the 75 countries considered in the measurement of the Inclusive Internet Index.

Table 6-1: Inclusive Internet Index

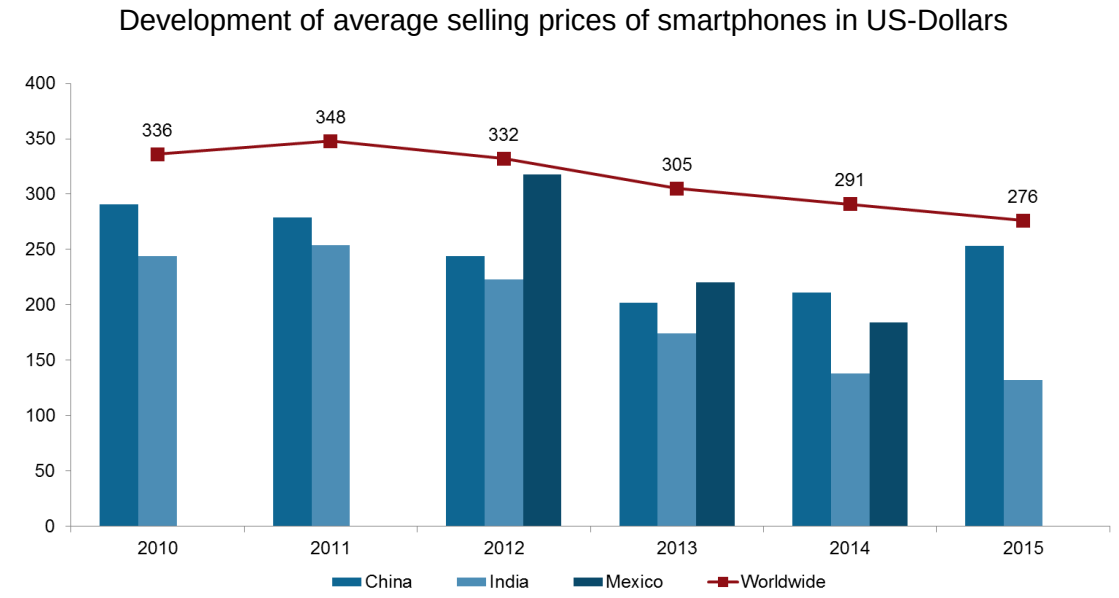
Rank	Country	Inclusive Internet Index
1	Singapore	90.3
1	Sweden	90.3
3	United States	88.2
4	United Kingdom	88
5	Japan	87.9
6	South Korea	86.9
7	France	86.6
8	Canada	85.2
8	Netherlands	85.2
10	Italy	84.7
11	Australia	83.9
12	Germany	83.8
13	Poland	82.7
14	Spain	81.1
15	Russia	80.2
16	Taiwan	79.7
17	Romania	79.4
18	Brazil	78
19	Chile	77.6
20	Argentina	76.2
21	Malaysia	75.8
22	Ukraine	73.8
23	Thailand	72.6
24	Oman	72.3
25	Kazakhstan	72.2
26	Colombia	71.9
27	South Africa	71
28	Saudi Arabia	70.6
29	China	69.7
30	Mexico	69.6
31	Turkey	68.3
32	Vietnam	67.9
33	Peru	66.3
34	Morocco	65.6
35	Indonesia	65.4
36	India	64.4
37	Egypt	64.3
38	Iran	63.9
39	Mongolia	63.6
40	El Salvador	63.4
41	Sri Lanka	62.5
42	Venezuela	60.7
43	Philippines	59.8
44	Maldives	59.7
45	Nigeria	59.4
46	Bangladesh	57.8
47	Uzbekistan	56.7
48	Seychelles	56.2
49	Ghana	56.1
50	Guatemala	55.3
51	Kenya	55.2
52	Algeria	53
53	Pakistan	50.7
54	Myanmar	50.6
55	Cambodia	50.2
56	Nepal	49.1
57	Tanzania	48.5
58	Senegal	46.7
59	Angola	46.3
60	Côte d'Ivoire	45.9
61	Cameroon	45.6
62	Sudan	45
63	Rwanda	44.3
64	Uganda	43.8
65	Mozambique	43.3
66	Yemen	42
67	Burkina Faso	40.2
68	Zambia	39.4
69	Ethiopia	37.2
70	Malawi	32.3
71	Madagascar	30.7
72	Mali	29.7
73	Liberia	28.8
74	Niger	26.9
75	Congo (DRC)	24.1

Source: Inclusive Internet Index (2017). Developed countries are highlighted in blue and developing countries are highlighted in green.

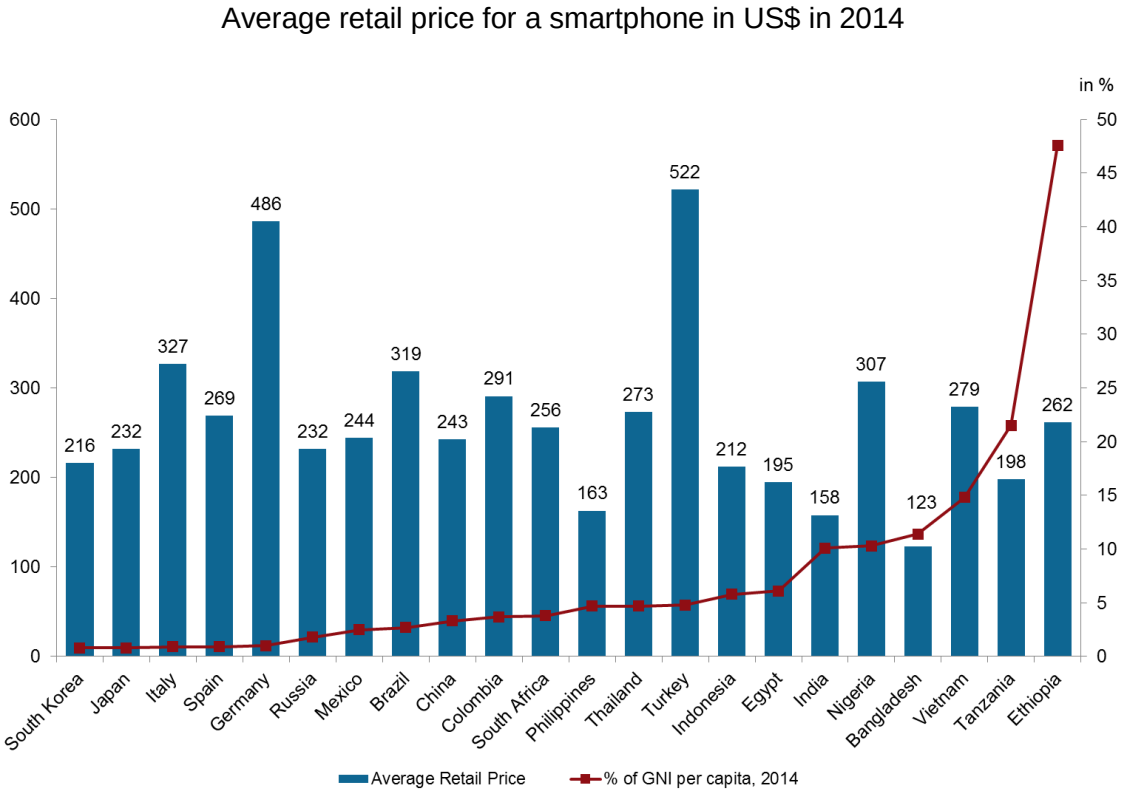
Concerning the necessary devices, price information shows that smartphones are becoming more affordable. As illustrated in the following figures, the average selling price for smartphones dropped in India and Mexico. In China, with the sharply increasing wealth among urban populations, the amount that is spent on the average smartphone rose again in 2015, while worldwide average prices continued to fall. Low-end smartphones can be bought, for example in Nigeria, for as little as US$50. Nonetheless, in some developing countries, a smartphone remains almost unattainable for the average consumer. The prime examples of this are Ethiopia and Tanzania, but also in India the average retail price of a smartphone equaled around 10–45% of per capita yearly income (in 2014). In developed countries, a smartphone retails for 1% or less of per capita yearly income (World Bank 2016b).

Despite the relatively high average price of a smartphone in India, the country shows the highest growth rate of smartphone ownership compared to 31 other developed and developing countries (Figure 6-2, Figure 6-3). Smartphone ownership is still growing quickly in most markets; many developed countries also exhibit double-digit growth rates. South Korea has got the lowest CAGR of the analyzed countries (Figure 6-3). This indicates a saturating market and is in line with other broadband- and Information and Communication Technology (ICT-)related statistics for the country.

Figure 6-2: Smartphone prices around the world

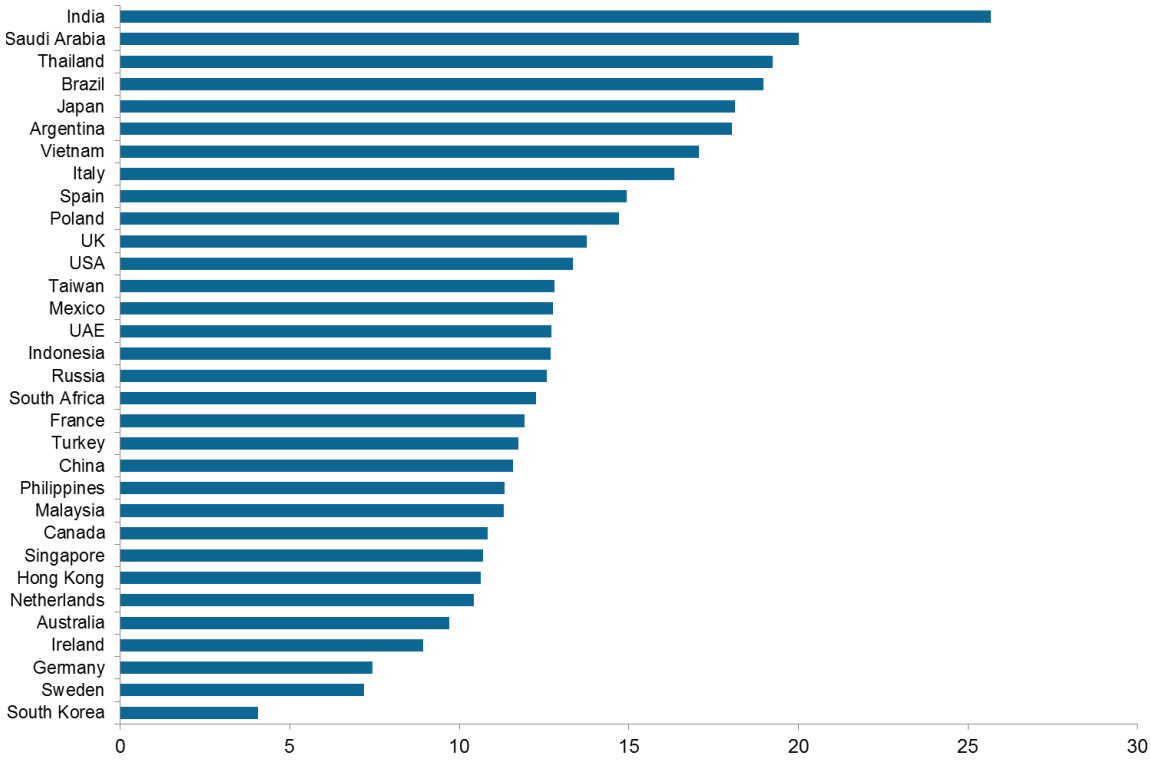


Source: GSM (2016), country overview: Mexico, IDC (2016). Average selling price of a smartphone in China and India, Statista (2015), global average selling price of smartphones.



Source: Strategy analytics, World Bank, McKinsey, Euromonitor (partly cf. KPCB).

Figure 6-3: CAGR (in %) of smartphone ownership



Source: WIK (2017) based on Global Web Index (2017); CAGR in % from Q3/2014 to Q3/2016.

As these developments continue, RIAs will soon reach not only developed countries and urban areas in the developing world with significant penetration, but also rural and potentially even remote areas, where their impact is likely to be the greatest.

Even today, the people living in these areas rely mostly on subsistence farming and are vulnerable to bad weather conditions and limited knowledge about the crops, technology, current market prices or how to potentially evolve their farming efforts. Various ICT for Development (ICT4D) initiatives have addressed these issues with a wide range of mostly SMS-based information services. Examples of such initiatives include but are not limited to WeFarm,[49] M-Farm[50] in Kenya, Agronet[51] and Tambero[52] in Colombia, M-Agri[53] in Mexico, or Digital Green.[54] Their main functions are information distribution regarding best agriculture practices and pesticide usage as well as providing access to local markets.

49 http://www.huffingtonpost.com/pierce-nahigyan/how-wefarm-connects-small_b_9294688.html
50 https://www.mfarm.co.ke/
51 http://www.agronet.gov.co/Paginas/default.aspx
52 https://www.tambero.com/users/signup?locale=en_US&src=webensl1
53 http://www.gsma.com/latinamerica/magri-mexico
54 https://www.digitalgreen.org/about/

As Zhang et al. (2016) demonstrate, the availability of interactive and rich information applications and capabilities has a strong positive effect on the economic and social well-being of farmers in rural areas in developing countries. With increasing connectivity even in rural areas and better affordability of data plans, ICT4D initiatives can also benefit from significant additional functionality offered by RIAs.

A final issue found throughout the study is that as RIAs rapidly expand their functionality in response to consumer demand, other online services are similarly responding to the demand for rich communication tools by incorporating them into their own applications. The next evolutionary step appears to be speech interfaces. Given the rapid progression of speech recognition and AI, these systems are expected to see significant take-up within the next couple of years. Initial applications can already be seen today, especially in areas where speech interaction has a clear advantage, such as interacting with various functions and potentially external services that a modern connected car offers.

As speech interfaces become mainstream applications, it is likely that the economic impact of RIAs will accelerate. So long as RIAs are given room to innovate and evolve, we are only just beginning to reap the economic and social gains they may deliver.

Annex 1: Case studies categorized by country

A-1.1 Hong Kong, Taiwan, Iraq

FireChat

FireChat gained some prominence during 2014 when protesters identified it as a useful tool to circumvent the censorship of authorities. Examples include the pro-democracy marches in Hong Kong, resistance fighters in Iraq, and the “sunflower” movement in Taiwan. Today, the app has become more popular for day-to-day usage as well. In particular, consumers appreciate its reliability during large sports events, concerts or other occasions when cellular networks usually underperform or do not perform at all. It is estimated that currently around 6 million people use this app, with around 1.5 million users in India. Technologically, FireChat builds on a self-constructed and self-healing mesh network. The company assumes that when 5% of a city’s population uses the app, messages can be delivered.

A-1.2 USA, Canada

Jott

Jott is particularly popular with tweens and teens in the USA and Canada. In 2015, the company reported having 500,000 monthly active users. The app users tend to refrain from using their data plans to save money. Since the typical user group spends a lot of time in close proximity, i.e. in school, the network quality is usually good. It may also be assumed that pupils appreciate the privacy that the app guarantees since the WiFi network at their school may either block other RIAs altogether or monitor the traffic somehow.

A-1.3 Philippines

FireChat

FireChat has been used as part of an earthquake simulation in the Philippines. The so-called Shake Drill simulated an earthquake of 7.2 magnitude. The simulation showed that with FireChat, alerts reached 80% more people than without it.

A-1.4 India

FireChat

FireChat was used in the Chennai floods in India in 2015. Then, around 23,000 new users were registered in the most affected areas alone. Given that traditional networks were no longer available, independent communication was of essential importance to the people. [55]

55 http://economictimes.indiatimes.com/tech/internet/firechat-alerts-to-help-people-communicate-without-mobile-networks/articleshow/52346969.cms

WhatsApp reuniting family after tragedy

WhatsApp played a crucial role in reuniting families after the tragic train crash near Pukhrayan in the Indian district of Kanpur in November 2016. Injured people, including many children, were rushed to hospitals wherever capacity and required expertise were available. This meant that families, friends and relatives were separated from each other without knowing where their friends or relatives were or whether they had survived at all. The situation was further complicated by the fact that many of the hospitalized people were either unconscious or not able to speak due to shock.

In the meantime, people looking for their relatives and friends were going from one hospital to another searching for more information. Doctors took pictures of hospitalized clients accompanied with their name if available and the hospital they were in. These photos were then shared with doctors in the surrounding hospitals via WhatsApp group chats and this enabled a much quicker reunion of families.

Every drop counts

In 2010, the United Nations University indicated that more people own a cell phone in India than have access to a toilet. This shocking finding raised international awareness of the poor infrastructure conditions in developing and emerging countries. While the information by the WHO and UNICEF presented in Figure 5-7 shows some improvement, the situation is still difficult for many people living in India.

Water supply is intermittent and sometimes of poor quality. This is due to a predominantly manual system of valves in the Indian cities and this makes water supply unpredictable. Thus, information about when good clean water is available is crucial. The smartphone app Waattr and related SMS program NextDrop allow users to find and share information about water quality and supply with the local community that is provided by the people operating the valves. The interactive nature of the app enables crowdsourced input to check this information.

Integrating this system into an RIA could further empower the crowdsourcing approach with pictures and videos of leaks or other faults in the system. This additional function may improve the overall quality of the infrastructure as early intervention could reduce maintenance cost. Furthermore, picture analysis algorithms could help people to evaluate the quality of the water that they receive.

Better learning at minimal costs with help of RIAs

In India, two development organizations, VSO and Pratham, developed a training plan[56] to improve reading and writing skills for children in the rural district of Bundi. For seven weeks, teachers received a daily language lesson plan via SMS and WhatsApp. The plans became more complex throughout the seven weeks and in the latter stages of the pilot, WhatsApp was used to deliver audio and song-based teaching aids, and to provide a forum for educators' discussions. The results were astonishing; after seven weeks, 63% of the children at participating schools were able to correctly read words

56 See for full report, https://www.vsointernational.org/sites/default/files/sms_report_final_v1_4.pdf

and sentences compared to 35% at the beginning of the seven-week program. This is significantly higher than other schools that did not participate in the learning program (an increase from 35% to 42% in the same time period). In addition, the learning program is very cost-effective at just 10 Indian rupees per child, which is only 1.4 euro cents.

A-1.5 Kenya

Role of RIAs in keeping the family together

With the arrival of RIAs, people are given alternatives to the traditional voice and text services, which also have a different cost structure. It is most likely that users will still buy prepaid data bundles, but the usage price of the RIA is no longer time dependent, so instead of waiting for off-peak times, people can communicate when required. Also, the lower costs of the RIA (data usage only) will encourage users to communicate more often and for a longer period of time. This is especially important for the eldest children of families in Kenya who play the most important role in keeping the family together or for siblings of widows to contact their family for (economic) support. Furthermore, RIAs help users to communicate about economic support and life advice, as well as enabling the family to check up on the health of relatives living in rural areas and discuss everyday coordination of family life.

Mifuko: Upped the game with messaging

The example of Mifuko[57] shows the use of instant messaging as an order status information system and the creation of local value in the involved Kenyan communities. It started in 2009 as a small Finnish company importing traditional Kenyan kiondo baskets, but it intensified the game with messaging-based business operations.

Kiondo baskets are woven from sisal fiber and colorful plastic. They are produced by women in five Kenyan villages, providing the women with additional income beside their main activity of farming. Instant messaging services (text and pictures) are used to communicate daily between Mifuko and the Kenyan women to update order status and to react if orders are missing or there are production issues. M-pesa mobile payment service is used to pay the women directly on their mobile.

In 2015, Mifuko delivered its Kenyan kiondo baskets to design stores in more than 20 EU countries.

RIAs as new customer service channels

Ongair, a small venture in central Nairobi, Kenya, enables companies to communicate with their customers via different instant messaging apps. The venture provides a management solution that aggregates messages from different services into a single interface and, therefore, allows companies to integrate applications like WhatsApp, WeChat or Facebook Messenger into their customer services. Ongair offers several

57 http://www.mifuko.fi/

price plans that are designed to meet the needs of different company sizes. Thus, businesses of all sizes can benefit from Ongair's work. The venture was launched in 2014 and now enjoys a pan-African presence and has about 800 clients in South America, India and Asia. They also recently expanded to Hong Kong.

Ongair is not the only venture in Africa focusing on this new emerging market. Several ventures are targeting companies who wish to integrate modern communication services into their businesses.

RIAs reducing the digital divide

In Kenya, a study[58] examined the communication practices of family members who communicate both within and between rural, suburban and urban settings. The study shows that RIAs reduced the "digital divide" within Kenya. Before RIAs, in rural areas, a large number of participants did not have knowledge about computers or had limited access to telecommunications services. By contrast, in the urban areas, more people had higher incomes and better access to education, and they also had fixed internet access and mobile telecom services.

Lowering the threshold regarding diseases

RIAs can play a more informal role and indeed lower the threshold to engage with professionals about potentially embarrassing topics. For instance, a WhatsApp group providing this kind of exchange in Kenya has been very successful.[59] While such groups can provide continuous social support for people, one of the benefits of RIAs is their ability to offer an immediate communication channel to potentially large groups of people and provide them with rich interactive information, and also make users part of the information-gathering process.

Community Health Workers supported by RIAs

CHWs in Kenya are supported by the use of chat services as a supervisory tool. A six-month study in the Kibera and Makueni districts showed that with minimal training, 41 CHWs and their supervisors could use mobile instant messaging to support supervision, professional development and team building. Photos were a key component of the communication as 23% of all posts contained photos or other media. The communication was used to support: (1) quality assurance, (2) communication and information, or (3) a supportive environment (Henry et al. 2016).

Independent from whether one lives in a developing or developed country, getting accurate information immediately when it counts can save lives. While SMS and voice services already provide crucial help, there is a role to play for RIAs with their ability to include rich communication and integrate innovative algorithms.

58 Conference paper published in 2014, http://clab.iat.sfu.ca/pubs/Oduor-KenyaFamily-CHI.pdf

59 250 young people talk about HIV on WhatsApp group (Source: http://www.keycorrespondents.org/2016/05/20/whatsapp-in-kenya-real-time-messaging-about-hiv/).

A-1.6 South Africa

Better communication means more business

Examples are apps that connect customers to nearby stores like Lookup[60] in India or local delivery services like WumDrop[61] in South Africa. Lookup is a chat-based intermediary connecting customers to nearby stores with the help of maps and via chat. More than 70,000 merchants were listed at the end of 2015 across the three cities of Bangalore, Delhi and Mumbai. The app WumDrop allows for collection and delivery of packages in Cape Town, Johannesburg and Pretoria. A user requests a courier, the courier comes to the agreed location and picks up the package and then delivers it. The user can track the courier on a map and receive notifications of delivery. After delivery, the courier gets paid via mobile.

Augmentative and Alternative Communication technology

A study in South Africa (Bornman et al. 2016) compares its findings from 30 individuals with communication disabilities with other international studies on the use of special AAC technology. One of the findings is that all participants, despite their limited education, unemployment and low economic status, used mainstream wireless devices. This confirmed the finding by Alper and Haller (2017) that mainstream technologies are comparatively more powerful, compact and have a longer battery life, which is essential for communicating without worrying about recharging a device, as is often the case with specialized AAC devices.

Furthermore, more than 40% of the participants used one or two apps on their wireless devices with the most popular being social networking apps; 67% of the individuals have a profile on Facebook, Twitter and/or LinkedIn and 43% visit these sites several times a day.

A-1.7 Sub-Saharan Africa

WhatsApp in the fight against Ebola

During the Ebola crisis in 2014–15, the BBC set up a subscriber-based WhatsApp service that allowed content from the WHO, the Centers for Disease Control and Prevention, and UNICEF to be posted as images, text and audio.[62] The service became immensely popular; in total, 20,000 people subscribed, of which 15,000 lived in Sierra Leone, making it the most use of a chat app during a global health emergency.

According to the BBC, a big part of the success came from being “low tech”, i.e. a system that is already installed on many devices and is straightforward to use while not requiring too many resources. Thus, people from remote and quarantined areas could access life-saving information from an app they already used. The images and audio

60 http://lookup.to/
61 https://www.wumdrop.com/
62 https://www.devex.com/news/beware-of-the-pokemon-the-not-so-augmented-reality-of-digital-health-and-development-88456

messages were particularly useful for users with low levels of literacy and they were able to access the content on basic handsets. It also provided a service for people to post their questions about routes of transmission and share stories about local solutions. Furthermore, many questions and myths going around regarding Ebola were answered with objective and trustworthy content.

Artificial Intelligence: A natural extension of health applications

Birth asphyxia is one of the top three causes of infant mortality in Africa, causing the death of about 1.2 million infants and severe life-long disabilities such as cerebral palsy, deafness and paralysis. If asphyxia can be detected early enough, the babies' lives might be saved according to the United Nations. Ubenwa[63] is an app for parents with a newborn; by using the app to record the crying of their newborn baby, it is possible to detect whether the baby has birth asphyxia. This very cost-effective and quick method is realized using AI's automatic comparison of amplitude and frequency patterns of the crying with database recordings of babies not born with birth asphyxia.

A-1.8 China

WeChat

One of the most advanced RIAs currently available is WeChat. This RIA offers various services beyond payment and can be considered not far from the full set of functionality that one would expect to use on the internet. Thus, it is not surprising that it attracts a significant number of merchants who use the RIA to sell almost all types of goods and services or benefit from the popularity of the payment function for their local businesses. Its attractiveness is increased by the low transaction fees (0.6%) compared to major credit card companies (2–4%).[64] Since November 2015, WeChat payment system has been open to merchants in 20 countries. This offers significant potential to engage with Chinese tourists who travel more due to increasing wealth in the country.[65]

A-1.9 Worldwide

XOPOTO: interoperable social money transfer (based in Singapore)

XOPOTO[66] is a worldwide money transfer service founded by Singapore-based start-up Fastacash that works together with Xpress Money. XOPOTO is the first app to allow users to send and receive money around the world by integrating various social networks and offering rich communication functionality so that senders and recipients can socialize.

The app can draw on the contact lists from various social networks including Facebook and Twitter as well as RIAs such as WhatsApp and WeChat. Its social functions are

63 http://ubenwa.com/
64 http://www.chinaluxuryadvisors.com/what-brands-should-know-as-wechat-goes-global/
65 Ibid.
66 https://itunes.apple.com/de/app/xopoto-social-money-transfer/id1052650023?mt=8

particularly important for expats who use the app to send money to their families at home and who appreciate the immediate feedback from their loved ones. Transferring remittance money is one of the main usage scenarios for money transfer in RIAs. On average, money transfer via RIAs is significantly cheaper than via traditional systems like Western Union, Moneygram or local banks and their international affiliates. First and foremost, the fees for transfers are significantly lower. XOPOTO even claims to transfer money for free.

Communication made easy for people with disabilities (based in San Francisco)

For people with disabilities, functionality can bear even more importance as the RIAs enable social interaction with everyone, whether they share their disability and way of communicating or not. Overcoming these frontiers is where new apps like Ava[67] and Five[68] come in. Ava translates spoken language into written language displayed in an app on the smartphone to support people who are deaf or hard of hearing. The app Five allows users to use sign language (existing or new) and send messages to friends in Five or connected with Facebook Messenger. These kinds of RIAs help to integrate people with disabilities into society.

Keeping contact with family and friends for UNHCR aid workers

UNHCR staff often work in remote "hardship" locations to provide support to people who have to flee from their home country, for example because of war and natural disasters. UNHCR staff may therefore be separated from their families and friends for months at a time, sometimes at very short notice, and have limited or occasionally no opportunities for communication. To address staff isolation and stress, for the sake of staff well-being but also to ensure staff productivity and, ultimately, the quality of UNHCR's operational response, a cooperation was started in 2009 between UNHCR, the Government of Luxembourg and communications software provider Skype.

Funded by the Government of Luxembourg, Skype started developing a customized version to provide free or low-cost voice and video calls over the internet that worked on low bandwidth connectivity. This was important considering the limited availability of connectivity in the remote areas but also to address continuity of other UNHCR business applications, integration with UNHCR's firewalls and other security aspects.

By August 2011, Skype had been rolled out in 118 hardship locations in United Nations compounds across Asia, the Middle East, Africa, Oceania and Europe, benefiting 3,068 members of UNHCR staff. By the end of 2011, the special Skype version was provided to all UNHCR's hardship locations.

People working for UNHCR state that the availability of Skype during their assignments is very important for keeping daily contact and staying involved in the daily routine of their family members far away.

67 https://www.ava.me
68 http://www.health24.com/Medical/Hearing-management/News/18-year-old-creates-first-sign-language-messaging-app-20160202

A-1.10 Australia

Communication between people with disabilities and professional care workers

In line with other studies like Caron and Light (2016) and Light and McNaughton (2014), social media via networked mobile technologies give individuals with significant communication disabilities opportunities to increase, maintain, or improve their own communication in everyday contexts. RIAs can also play a crucial role in this respect. For instance, the Australian app hireup[69] enables rich communication between people with disabilities and potential professional care workers. The app facilitates socializing before the actual interaction commences, meaning that common interests can be explored, resulting in an improved matching process for care workers and people with disabilities.

A-1.11 UK

Communication and caring go hand in hand

Care Messenger[70] in the UK enables people to communicate via SMS or app on mobile devices to anyone with a TV. The message is displayed on the TV screen and the receiving person can send a simple response using their familiar television remote control. This enables communication with elderly people, who often are not familiar with tablets or smartphones but do know how to operate the TV, which is switched on for most of the day meaning people are usually reachable.

69 https://hireup.com.au/#/about
70 http://www.caremessenger.co.uk/viewcaremessenger.html

Annex 2: Alphabetical list of RIAs analyzed for this study

2go
Air Chat
AireTalk
Airplane Messenger
Alien chat
AV by AOL
Avaamo
Badoo
BlackBerry Messenger
BeepTool
BeeTalk
Bleep
Blend
BM Chat
Briar
Bridgefy
Care Messenger
Charge Messenger
Chat
Chat offline
ChatCall
Chatscene
Coco
Confide
Cryptocat
Disney MIX
Dust
Ekiga
Facebook Messenger
Facetime
Fire Message
FireChat
Fleep
Flock
Flows
fring
GeckoLife
GiggleMail
Glide
Google Hangouts
GroupMe
HeyTell
Hi
Hike Messenger
HipChat
Hipe
Hood
Howfar
ICQ
iMessage
imo
Instagram
invi
Jaxtr Mobile
JioChat
Jongla
Jott
JusTalk
KakaoTalk
Kids in Touch
Kik
KingsChat
KodaChat
LIFELine
Lookup
Loud-Hailer
Maaii
Maily
Mara Online
Meet4U
MeetMe
Mico
migme
Monster Messenger
mysms
NearPeer
n-gage
Nimbuzz
OfflineChat
OGO
Omlet Chat
ooVoo
Pelichat
Pinch
pinger
PLAYMessenger
QQ
Rawr
react
Reel
Rounds
Rush
Saya
Sendboo
Signal
Silent Phone
SIMSme
Skype
Slack
Snapchat
SOMA
surespot messenger
Talkatone
Talkray
Talkshow
Tango
Telegram
Telepathy
TextMe
textPlus
The Serval Mesh
Threema
Tinder
Tinychat
Tox
Trillian
Twnel Messenger
UppTalk
Viber
Vk.com Messenger
VMC Next Messenger
vobee
Vojer
Voxer
Waplog
Wave “Off The Grid” Chat
WeChat
WhatsApp
Wickr
Wire
Yahoo! Messenger
YeeCall
Yik Yak
Yo
Zalo
Zipt
ZombieChat

Annex 3: Alphabetical list of countries used for the econometric analysis

Albania
Algeria
Angola
Argentina
Armenia
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Bosnia & Herzegovina
Botswana
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cabo Verde
Cambodia
Cameroon
Canada
Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo
Costa Rica
Croatia
Cyprus
Czech Republic
Côte d'Ivoire
Congo
Denmark
Djibouti
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Gambia
Georgia
Germany
Ghana
Greece
Guatemala
Guinea
Guinea-Bissau
Haiti
Honduras
Hong Kong (SAR China)
Hungary
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kuwait
Kyrgyzstan
Lao
Latvia
Lebanon
Lesotho
Liberia
Lithuania
Luxembourg
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Mauritania
Mauritius
Mexico
Mongolia
Macao (SAR China)
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
Netherlands
New Zealand
Nicaragua
NigerNigeria
Norway
Oman
Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Republic of Moldova
Romania
Russian Federation
Rwanda
Saint Lucia
São Tomé & Principe
Saudi Arabia
Senegal
Serbia
Sierra Leone
Singapore
Slovakia
Slovenia
South Africa
Spain
Sri Lanka
St.Vincent & Grenadines
Sudan
Suriname
Swaziland
Sweden
Switzerland
Republic of Macedonia
Tanzania
Tajikistan
Thailand
Togo
Trinidad & Tobago
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
United Arab Emirates
United Kingdom
United States
Uruguay
Uzbekistan
Venezuela
Vietnam
Yemen
Zambia
Zimbabwe

Annex 4: Methodology for the estimation of the global economic impact of RIAs

In order to be able to estimate the impact of RIAs on GDP, we have to estimate the two endpoints, namely the impact of telecommunications (voice and text functionality) on GDP and the impact of the "full internet experience" (overall functionality) on GDP. In the second step, we approximate the impact of RIAs, which is assumed to range between these two endpoints (for results, see Chapter 5).

For the estimation of the impact of telecommunications and the internet on GDP, we use the World Development Indicators database of the World Bank for macroeconomic data such as the purchasing-power-parity-adjusted (PPP-adjusted) GDP per capita (GDPpc) and labor (L) and the Penn World Table data for the PPP-adjusted capital stock (K). ITU data of five indicators are used for the construction of two indices: an index for telecommunications and an index for internet usage.[71] For the indicators selected for the construction of our two indices, the normalization of the data is based on the recommendations of the ITU. Normalization of the data is necessary before any aggregation can be made to ensure the data set uses the same unit of measurement. The weighting of the indicators is also based on the ITU recommendations to construct both indices.

The telecom index covers indicators that provide an indication of the available telecom infrastructure and individuals' access to basic telecommunications services.[72] The internet index covers indicators that capture internet usage.[73] Overall, the ITU obtained the data by countries through national household surveys that are either provided directly to ITU by national statistical offices, or obtained by ITU through its own research. There are certain data limits to some indicators, insofar as estimates have to be calculated by ITU for many developing countries which do not yet collect ICT household statistics.

Our panel data set covers 164 countries with a time span from 2000 to 2015. We use an aggregate production function framework (Cobb–Douglas setting) that captures the effects of the inputs—capital, labor, and telecommunications or the internet (see equation 1)—on the output measure GDP:

$$GDP_{jt} = f\left(K_{jt}, L_{jt}, Telecom_{jt}/Internet_{jt}, t\right) \quad (1)$$

71 The ITU ICT Development Index is a composite index (based on 11 indicators) designed to be global and reflect changes taking place in countries at different levels of ICT development. It therefore relies on a limited set of data that can be established with reasonable confidence in countries at all levels of development.

72 Indicators used for the telecom index are the following: fixed-telephone subscriptions per 100 inhabitants; mobile-cellular telephone subscriptions per 100 inhabitants.

73 Indicators used for the internet index are the following: percentage of individuals using the internet; fixed-broadband subscriptions per 100 inhabitants; active mobile-broadband subscriptions per 100 inhabitants.

Thus, we relate national aggregate economic activity to the stock of capital *K* and the stock of labor *L* as the two main production/input factors and a *Telecom* index or an *Internet* index (see equation 2) as well as an exogenous time trend *t*. Therefore, we have the PPP-adjusted GDP per capita as a function of the capital/labor ratio (K/L) and an index for telecoms or an index for internet usage (based on the ITU indicators).

The econometric model is a fixed-effects (FE) specification with a Cobb–Douglas production function framework (logarithmic scale) to estimate the effect of several inputs (capital, labor, and telecommunications or internet) on the output measure (GDP per capita). Our econometric model is the following:

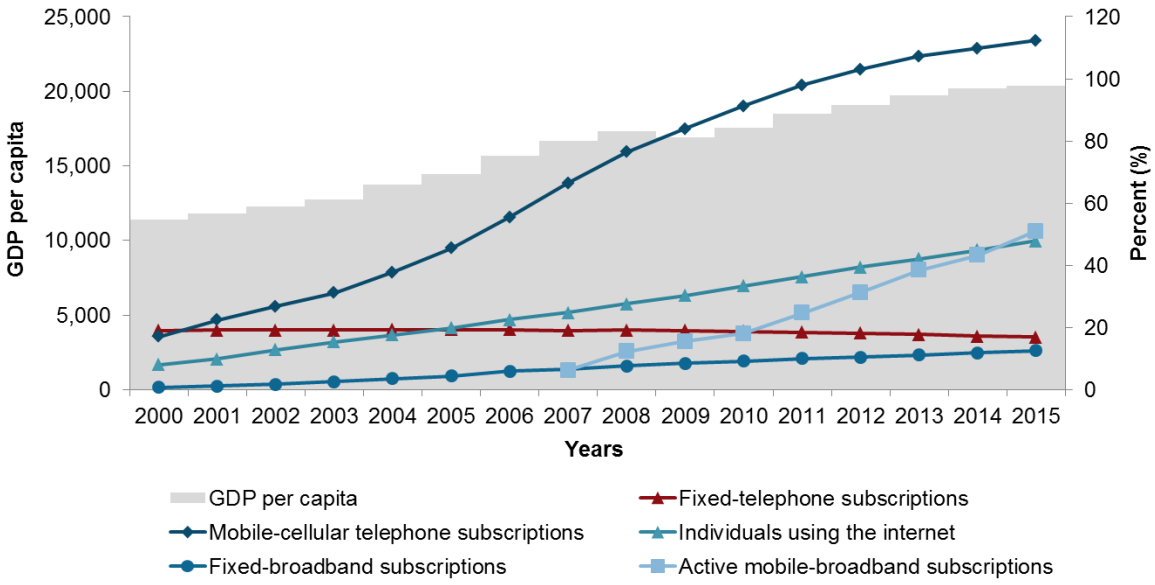
$$\log\left(GDPpc_{jt}\right) = \beta_0 + \beta_1 \log\left(K_{jt}/L_{jt}\right) + \beta_2 \log(Index_{jt}) + \alpha_j + \gamma_t + \varepsilon_{jt} \quad (2)$$

In equation 2, $\log(GDPpc_{jt})$ is the dependent variable referring to the PPP-adjusted level of GDP per capita (common logarithm of economic output) for country *j* in year *t*. β_0, β_1 and β_2 are the parameters to be estimated. The independent variables are $\log(K_{jt}/L_{jt})$ as the common logarithm of the PPP-adjusted capital/labor ratio for country *j* in year *t* and $\log(Index_{jt})$, which refers to either the logarithmic telecom index or the logarithmic internet index for country *j* in year *t*. α_j are country FE removing time-invariant effects out of the 164 countries *j* in this sample and γ_t are time FE controlling for macroeconomic changes in the sample period 2000–2015. Last but not least, ε_{jt} is the residual for country *j* in year *t* consisting of unobserved effects. Robust standard errors are clustered at the country level. The unit of observation is the country year.

The empirical method is based on a linear panel FE model that enables analysis of causal relationships under relatively weak assumptions. FE models estimate average deviations from the mean. Taking the common logarithm of the dependent variable $GDPpc_{jt}$ and the independent variables (K_{jt}/L_{jt}) and $Index_{jt}$ means focusing on an elasticity analysis. The key assumptions are that unobservables are time-invariant and that all controls are exogenous with respect to the outcome and hence uncorrelated with the residual ε_{jt}. Here, γ_t stands for a set of time dummies and α_j is a vector of country binary variables. Coefficient β_2 is the parameter of interest and measures the elasticity of $GDPpc_{jt}$ to variation in the level of the respective $Index_{jt}$ for either telecom or internet usage. Thus, our specification uses the variation from differences across country-specific economic activity with respect to developments in the respective index. The model may be subject to endogeneity bias, that is, while telecom/internet usage may cause GDP per capita growth, the reverse may also be true. Since there are strong positive network externalities from telecommunications and the internet, the first effect strongly dominates the other one according to the economic literature. Thus, we can refrain from identifying the causal relationship. To account for several methodological issues, we conducted several tests on our model specification. The results are qualitatively similar to those reported in Table 5-1.

Figure A-4-1 displays the global GDP per capita for each year along with the development of the five ITU indicators incorporated in our two indices over the sample period 2000–2015.

Figure A-4-1: Global developments in telecommunications and the internet sector

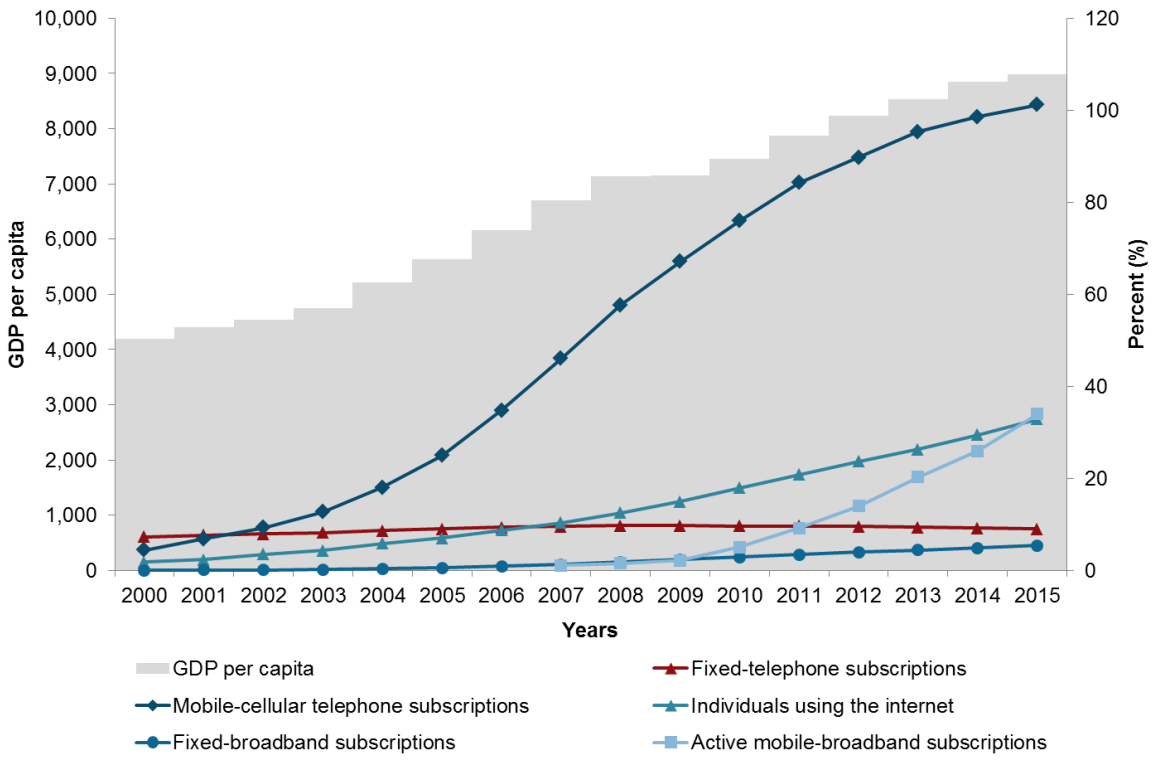


Source: WIK.

The purpose of Figure A-4-1 is to show that we experience different rates of GDP growth and volatility in telecommunications and internet usage with respect to the different indicators. Using country FE and time FE in the analysis, the main contribution comes from global shocks with diverse impacts on the different countries. Thus, the figure illustrates the identifying variation we are going to use in the estimation procedure. It indicates that it should be possible to draw inference from these data patterns.

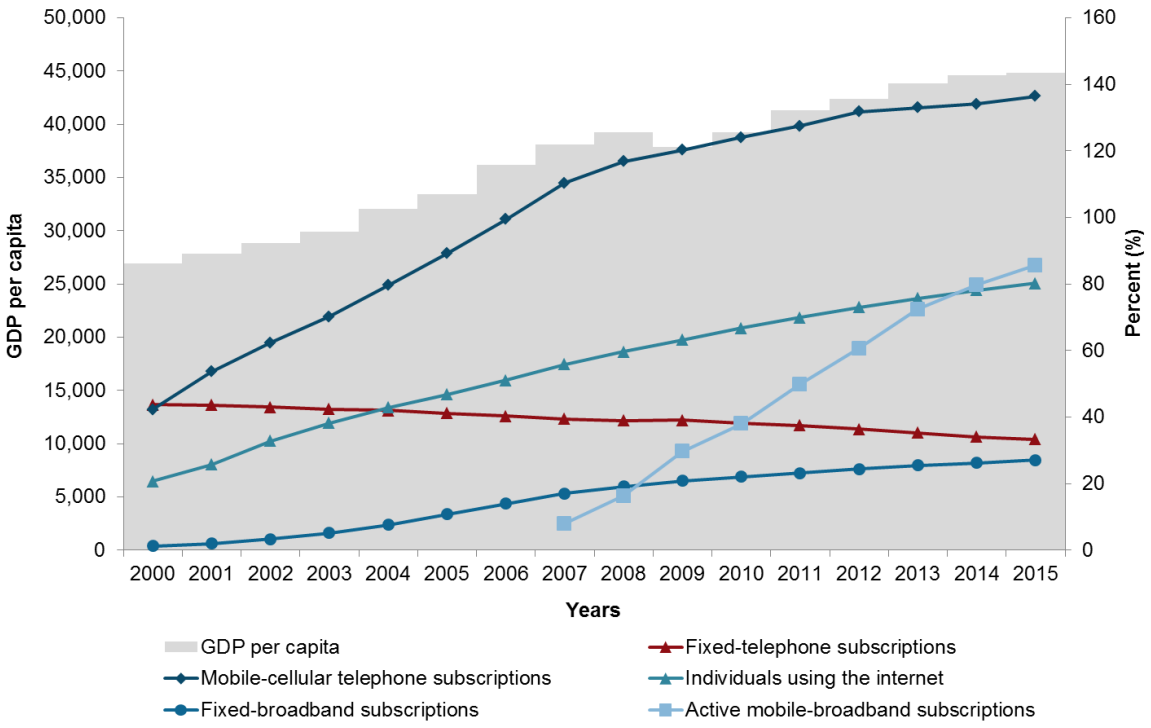
The global average impact of these technologies neglects the differences at the micro-level. Thus, looking at the difference between developing and developed countries reveals more insights about the relative economic impact of RIAs. The following two figures show the development of the indicators, in the first figure for developing countries and in the second figure for developed countries.

Figure A-4-2: Developments in telecommunications and the internet sector in developing countries



Source: WIK.

Figure A-4-3: Developments in telecommunications and the internet sector in developed countries



Source: WIK.

In both figures, the increasing trend in the indicators “individuals using the internet”, “mobile-cellular telephone subscriptions” and “active mobile broadband subscriptions” is apparent. Mobile internet usage and rich internet applications are on the rise in both developing and developed countries. In contrast, fixed telephone subscriptions and fixed broadband subscriptions are losing impact in relative terms. Moreover, they stagnate in developing countries in recent years, therefore supporting the important role of economic development in mobile broadband infrastructure. As a result, there is a higher relative value creation of adding new users and further encouraging the adoption of RIAs for developing countries in economic terms than for developed countries. This implies that the potential of RIAs to transform the economy is many times greater in developing countries than in developed countries.

Since RIAs act as intermediaries that evolve continuously by incorporating more (new) functions that provide economic value, they will finally converge to the “full internet experience”, and therefore the impact of RIAs on economic activity will continue to increase in the future.

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