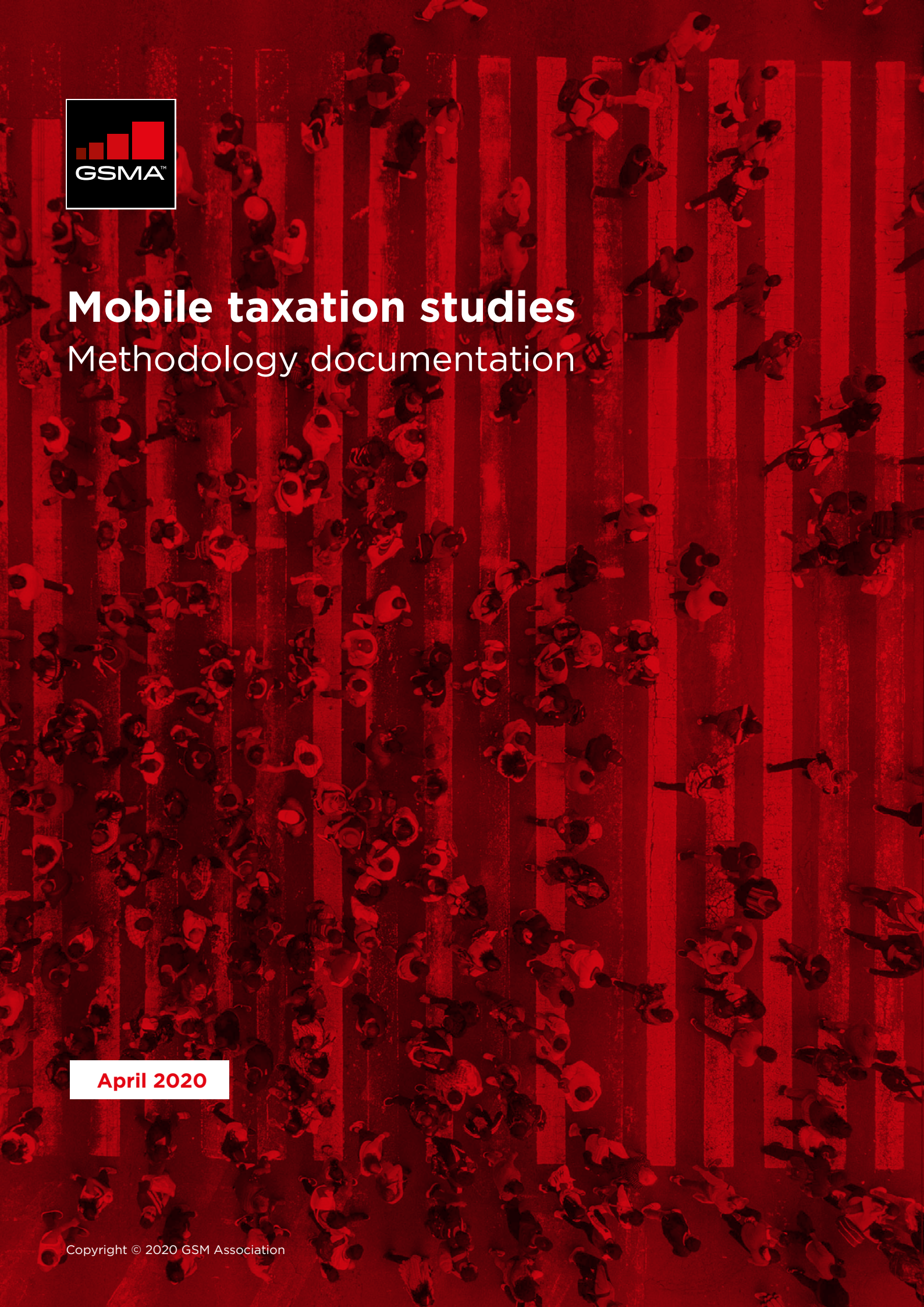


Mobile taxation studies

Methodology documentation

April 2020

About the GSMA

The GSMA represents the interests of mobile operators worldwide, uniting nearly 750 operators with more than 400 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces the industry-leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

For more information, please visit the GSMA corporate website at **gsma.com**

Follow the GSMA on Twitter: **@GSMA** and **@GSMAPolicy**

About EY

EY is a global leader in assurance, tax, transaction and advisory services. The insights and quality services we deliver help build trust and confidence in the capital markets and in economies the world over. We develop outstanding leaders who team to deliver on our promises to all of our stakeholders. In so doing, we play a critical role in building a better working world for our people, for our clients and for our communities.

EY refers to the global organization, and may refer to one or more, of the member firms of Ernst & Young Global Limited, each of which is a separate legal entity. Ernst & Young Global Limited, a UK company limited by guarantee, does not provide services to clients.

For more information about our organization, please visit **ey.com**.

Disclaimer

This report (Report) was prepared by Ernst & Young LLP for the GSM Association using information provided by the GSM Association and data from publicly available sources.

Ernst & Young LLP does not accept or assume any responsibility in respect of the Report to any readers of the Report (Third Parties), other than GSM Association. To the fullest extent permitted by law, Ernst & Young LLP will accept no liability in respect of the Report to any Third Parties. Should any Third Parties choose to rely on the Report, then they do so at their own risk.

Ernst & Young LLP has not been instructed by its client, GSM Association, to respond to queries or requests for information from any Third Party and Ernst & Young LLP shall not respond to such queries or requests for information. Further Ernst & Young LLP is not instructed by GSM Association to update the Report for subsequent events or additional work (if any) performed by Ernst & Young LLP. Accordingly, without prejudice to the generality of the foregoing, Ernst & Young LLP accepts no responsibility to any Third Party to update the Report for such matters.

Contents

1. Overview

The GSMA and EY have prepared a series of studies of taxation and regulatory fees faced by the mobile sector in a number of countries. In each case, the analysis undertaken assesses the impact of proposed mobile sector tax and regulatory fee reforms[1] on the economy and quantifies the impact on key metrics including mobile penetration, taxation receipts and Gross Domestic Product (GDP).

This document sets out the methodology applied to estimate these impacts. The scope of this document is limited to a description of the general approach that holds across country studies; it does not provide a comprehensive methodology for individual countries. This methodology supplements the methodologies specific to each country, which are available in the annexes of the country tax studies. This document does not constitute step-by-step guidance for applying the modelling framework.

The economic modelling is undertaken in two stages, using two models:

- A model of the country mobile sector – the 'telecoms market model' – has been created to calculate changes in the mobile sector resulting from each of the tax policy scenarios. This includes the change in subscribers, usage, technology, revenues, profits, reinvestment and expanded capacity in the sector; and

- The wider economic impacts of each scenario are assessed via a Computable General Equilibrium (CGE) model,[2] namely the standard version of the Global Trade Analysis Project (GTAP) model and its associated dataset.[3] [4]

This document will be continually updated as the methodology employed develops as future studies are undertaken.

1. This document covers both tax and regulatory fee reform. For simplicity, tax – rather than tax and regulatory reform – is referred to throughout the rest of the document.
2. See Section 3.2. for the detail of the CGE modelling approach.
3. Aguiar, A., Chepeliev, M., Corong, E., McDougall, R., and D. van der Mensbrugghe, 2019. The GTAP Data Base: Version 10. Journal of Global Economic Analysis, 4(1), 1-27,
4. The GTAP model is contributed to, and widely used, by government agencies, international institutions, the sector and academia to model policy changes within countries and cross-border effects of trade policies. Some examples include the World Bank, the World Trade Organization (WTO), the Directorate General for Trade of the European Commission, the Asian Development Bank and the Organisation for Economic Co-operation and Development (OECD). See GTAP Consortium, https://www.gtap.agecon.purdue.edu/about/consortium.asp.

2. Mobile sector modelling

2.1 Design of the telecoms market model

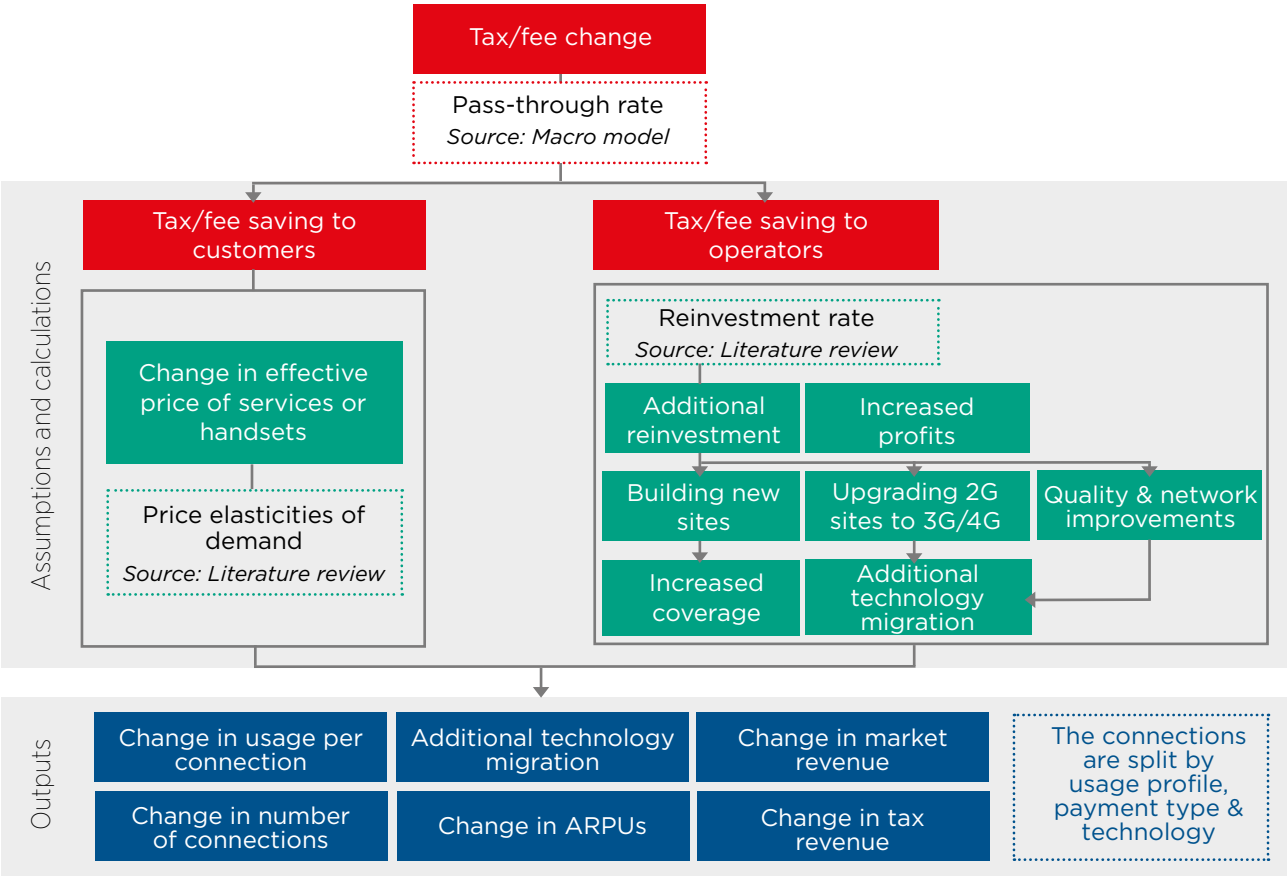
The telecoms market model covers the five-year period from the assumed calendar year of the reform and uses data from local mobile operators and the GSMA Intelligence database. The telecoms market model then calculates separate forecasts for each policy scenario.

The difference between the scenario forecasts and the baseline is effectively the additional impact resulting from the policy reform.[5] A schematic of this model is presented in Figure 1 below.

Figure 1

Overview of mobile sector modelling approach

Source: EY analysis



As illustrated in Figure 1, the telecoms market model captures the impact on consumer demand and operators' profits and investment resulting from mobile taxation reform. The model allows for the estimation of the additional connections, technology migration and mobile penetration generated across different usage profiles (categorised by low, medium and high-income groups), and across 2G, 3G and 4G services.[6]

5. The baseline forecast is the counterfactual scenario for which results are compared against. It is based on operators' forecasts of the market.
6. Explicitly forecasting pricing and usage of 5G technology was considered, as a modification to the current approach of considering 4G and 5G usage as a single category. However, to date, 5G has not been forecast to become a significant proportion of the mobile market in any of countries studied over the five-year modelling period. Therefore, 5G is not part of the telecom market model, as of April 2020.

2.2 Mobile market impacts

For consumers, a reduction in the tax rate leads to a decrease in the effective price of mobile services or handsets.[7]Effective prices represent the value for money achieved by subscribers, and therefore are wider ranging than pure price changes. For example, the effective price subscribers face can be said to decrease if they receive a better quality or quantity of service for the same price.

Figure 2

Effective price

The relationship between the size of the tax reduction and the related decrease in effective prices is dependent on the level of "pass-through".[8] The resulting reduction in the effective price of mobile services is modelled to have the following impacts:

- An increase in usage per connection, as lower effective prices lead to increased demand for services;
- An increase in the number of connections, as lower effective prices reduce the relative effective cost of mobile ownership which attracts new subscribers; and
- Additional technology migration, as lower effective prices for smartphones and / or cheaper data services accelerates the migration of existing subscribers from 2G services to 3G / 4G services.

For operators, the proportion of the tax reduction that is not passed through in the form of lower effective prices would either be retained as increased profit or reinvested. The decision between these two options depends on an assumption made on the reinvestment rate.[9] The following effects of additional investment are estimated using the telecoms market model:

- An increase in the number of subscribers, as the investment enables the building of new mobile sites and, hence, increased network coverage; and
- Additional technology migration, as the investment enables upgrade of 2G sites to 3G / 4G and, therefore, existing subscribers can upgrade from 2G to 3G / 4G services.

7. In some cases, such as the study of taxation of the mobile market in Kenya, the impacts of an increase in the tax rate are modelled, to demonstrate the macro-economic disbenefits that would be expected to arise.
8. The percentage of the tax / fee change which is passed through to subscribers in the form of lower effective prices. This is calculated based on the relative slope of the supply and demand curves for mobile services.
9. The percentage of the tax / fee change not passed through to subscribers which is reinvested by operators.

2.3 Key outputs

The key outputs of the telecoms market model include changes to the baseline forecast (based on the GSMA Intelligence forecast) in respect of:

- The number of connections;
- The number of unique subscribers;
- Mobile market penetration (unique subscribers and connections);[10]
- Total market revenue; and
- Sector taxation receipts.

For connections and subscribers, the model specifies market segments by usage profile (high, medium and low), technology (2G, 3G and 4G) and payment type (prepay and postpay). Therefore, the telecoms market model is run for a total of 18 categories of subscribers.

For sector taxation receipts, the calculation of the difference between the baseline forecast and each of the scenario forecasts accounts for:

- Anticipated changes to tax rates over time due to the policy change: Changes to tax rates are determined by each policy scenario modelled; and
- Forecast changes to the relevant tax bases: Changes to the tax base are driven by behavioural relationships described in Section 2.2.
- At a high level, the calculation of the change in sector taxation receipts is comprised of the following steps:
- Multiplying the tax rate by the tax base in the baseline;
- Multiplying the tax rate by the tax base for each individual scenario; and
- Calculating the difference between the two.

Refer to Section 3.1 for an explanation of the mechanism by which the potential impacts of policy reforms of total tax receipts across the whole economy (rather than sector-specific receipts) are estimated.

10. The number of unique subscribers differs from the number of connections as a unique user can have multiple connections. Both unique subscriber penetration and connections penetration are expressed as percentage shares of the country's population.

3. Macro-economic modelling

3.1 Macro-economic modelling approach

The macro-economic model builds upon the mobile sector analysis to estimate how lower taxes and effective prices feed through to the wider economy. This accounts for forward and backward linkages in the supply chain (i.e. supply chain for mobile service providers, and where mobile services are used in other sectors of the economy), the interaction between expanding businesses and a rise in household incomes and employment, and an assumed productivity gain across the economy as mobile penetration rises. This model gives an estimate of the dynamic impact on total tax receipts, allowing for all these indirect effects to work through the economy.

The macro-economic impacts are modelled in two stages:

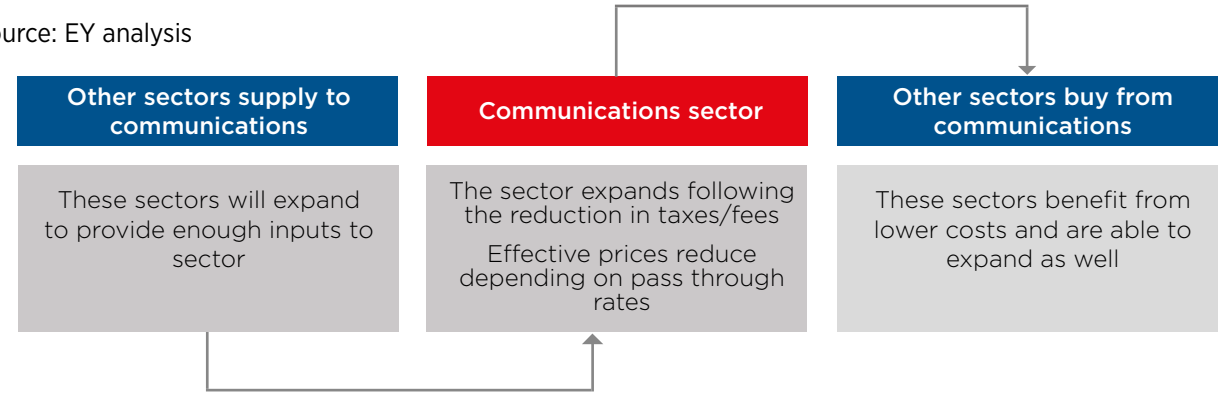
- The impact of the tax change on the sector itself and the interaction with the wider economy; and
- A boost to economy-wide productivity resulting from the increase in penetration.

The impact of the mobile sector on the wider economy starts from its supply chain linkages. Telecommunications are an important input to businesses across national economies. As lower taxes and consequent lower effective prices are passed on, many businesses will benefit and be able to expand their own outputs. Businesses that supply the mobile sector will also benefit from its expansion (see Figure 3).

Figure 3

Supply chain linkages

Source: EY analysis



The wider interactions in the economy lead to a virtuous circle of economic expansion:

- The forward and backward linkages from the mobile sector lead to expansion in several related sectors, and this in turn creates more expenditure circulating in the economy;
- The mobile communications sector will see increased investment, as it is now relatively more profitable than in the baseline;
- Overall household incomes will expand, leading to more spending in the wider economy and an increase in aggregate savings to fund investment;

- A larger economy requires more investment to complement the expansion in employment and to support the larger capital stock, which will see growth in construction and in sectors making investment goods; and
- The economy is modelled to be constrained by available resources (workers, capital), so some sectors must contract to make way for the expanding sectors.

These linkage and interaction effects will be reinforced by an increase in productivity in the economy, due to the rise in penetration of the mobile sector. This in turn leads to a further expansion in output, incomes and expenditure in the economy.

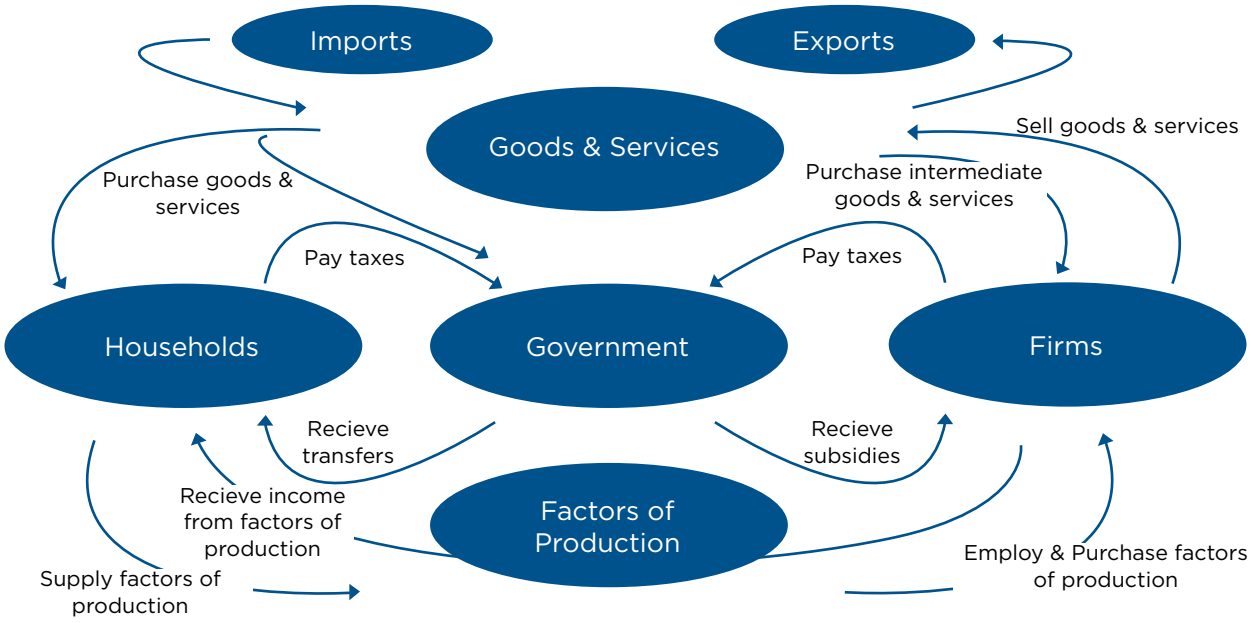
3.2 The CGE model

CGE models reproduce the structure of the whole economy by mapping all existing economic transactions among diverse economic agents (e.g. households, firms). They are large-scale numerical models that simulate the core economic interactions in the economy and replicate the circular flow of the economy (see Figure 4). They are based on the economic theory of general equilibrium; i.e. that supply and demand for goods, services and factors of production in the economy must be balanced. Economic relationships in CGE models are based on theory and empirical evidence from the academic literature. The prices of goods, services and factors of production adjust until all markets clear, that is, until they are simultaneously in equilibrium.

Figure 4

Circular flow of the economy

Source: Adapted from Burfisher, Mary (2011) Introduction to Computable General Equilibrium Models



Central to CGE modelling is the choice of closure rules. This refers to the specification of endogenous (those determined by the model) and exogenous (those determined externally). In the standard GTAP model prices, quantities of all non-endowment commodities (e.g. produced and traded commodities) and regional incomes are endogenous variables, while policy variables, technical change variables and population are exogenous to the model.[11] This standard closure is amendable with a wide range of alternative options available depending on modelling assumptions adopted.

11. Hertel, T.W. (ed.), (1997), Global Trade Analysis: Modelling and Applications, Cambridge University Press.

3.3 Scenario modelling

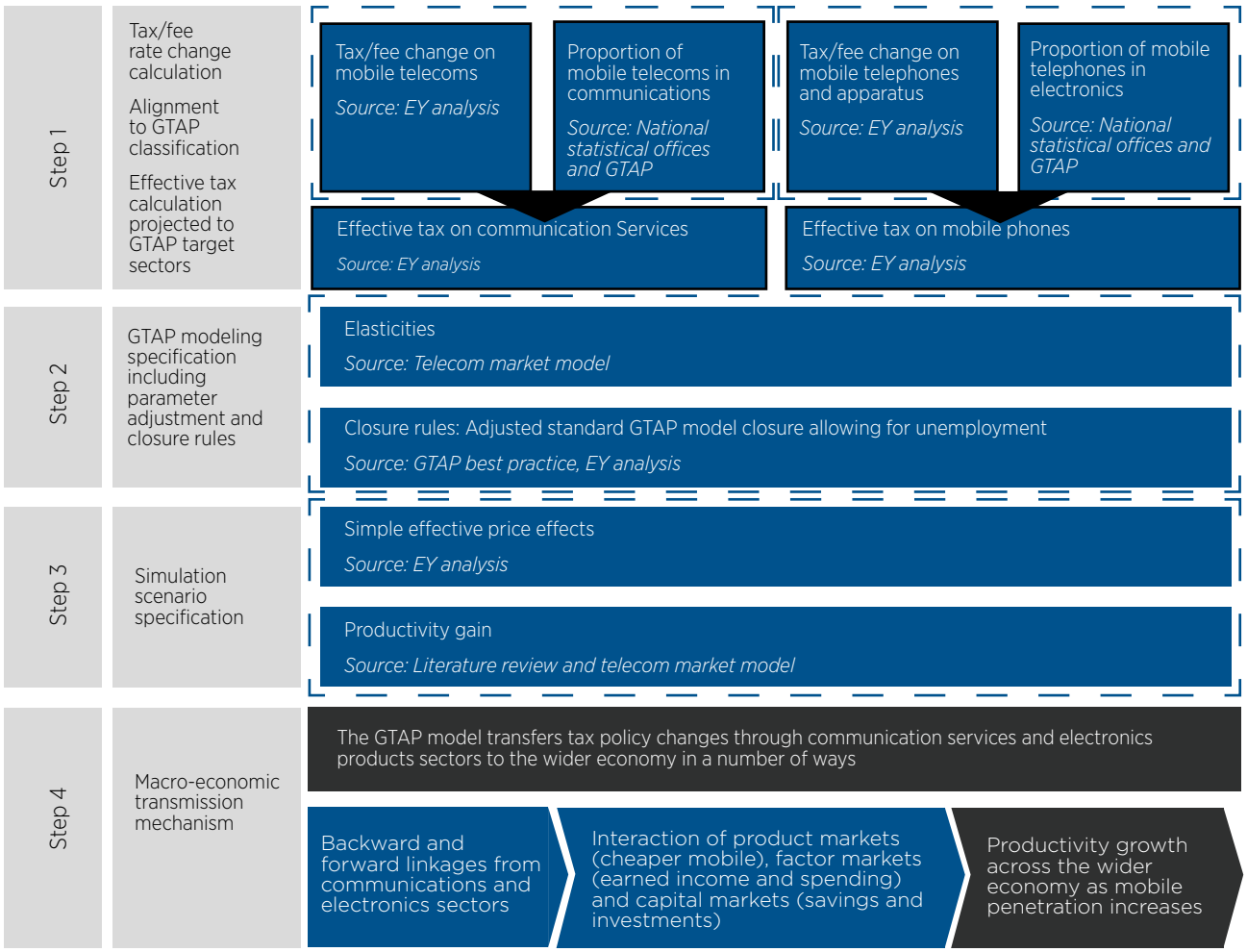
The CGE model is used to conduct tax policy simulations and hence assess the impacts of detailed policy scenarios on the wider economy. The approach is as follows:

- First, the effective tax on Communication Services (which includes mobile services) is calculated;[12]
- Second, GTAP model parameters (e.g. price elasticities of demand) and closure rules (e.g. related to employment assumptions) are adjusted to ensure better alignment with the mobile telecoms market and broader characteristics of a specific economy;
- Third, simulation scenarios are run that account for the direct effect of taxes and tariffs on prices and a productivity improvement from any increase in mobile penetration (see Figure 5); and

Figure 5

Supply chain linkages

Source: EY analysis



12. All taxes affecting the production and consumption of mobile services and mobile phones (e.g. turnover, excise, VAT) are combined to estimate the effective (compound) tax rates on final and intermediate consumption of goods and services.

3.4 The impact of changes in tax policy on pricing

Mobile taxation policy changes may be fully or partially passed through to effective consumer prices for mobile goods and services. The extent of pass-through depends on specific market factors (e.g. the extent of competition), the nature of the taxes modelled (e.g. whether they are based on consumption, production etc.) and is likely to vary by sector and country.

In these studies, the extent to which tax changes are passed onto consumers is derived from the macro-economic modelling in GTAP and specifically for each country. The GTAP model calculates the communication sector-specific medium-to-long-run change in relative effective prices of intermediate and final goods after a change in taxation. This calculation is based on relationships derived for each country that are incorporated in the GTAP model, and which are based on Input-Output tables from national statistics and other empirical data on the economy. In the GTAP model, tax reform scenarios are modelled as a percentage change in the overall taxation burden on consumption and/or production in the sector.

Therefore, the change in effective price in any country is determined by the specific market conditions in the communications sector and the relationships in the wider economy of that country, as these are reflected in the underlying data (demand and supply flows) and parameters (elasticities and other estimated coefficients) of the economy under analysis. Specifically, the extent of pass-through is determined by the assumed elasticity of both demand and supply in the market.[13] The elasticity of supply depends on the competitive environment and degree of market power within the industry, and reflects the profitability, input costs and usage of natural resources in production. The elasticity of demand is determined by consumer preferences and will vary depending on the underlying behavioural relationships in the economy.

13. For instance, if we assume that supply is perfectly elastic, then consumers will absorb the full tax reduction in the form of lower effective prices.

4. Key assumptions

The assumptions underlying the mobile sector and macro-economic modelling for these studies are based on an extensive literature review and are presented in more detail below.

4.1 Price elasticity of demand

The impact of effective price changes on the consumption of mobile services is captured via estimates of the price elasticity of demand (PED), which measures the change in quantity demanded following a change in price.

A literature review has been conducted (covering around 30 studies), as a basis for establishing a set of assumptions on the PED.

For purposes of these studies, we define three sets of PEDs:

- Mobile usage elasticities which relate to the change in usage per connection following a change in effective price;
- Mobile ownership elasticities which relate to the change in number of connections following a change in the effective price of services and handsets; and
- Technology migration elasticities which relate to the migration from 2G to 3G / 4G services following a change in the price of data, and a change in the effective price of handsets.

All elasticities in these studies are further varied by income groups of subscribers (low, middle and high).

To establish relevant price elasticities, we use a set of studies pertaining to countries of a similar income bracket (as classified by the World Bank).[14]

The following price elasticities of demand are assumed in the studies:

Table 1

Price elasticities of demand

	Usage		Ownership		Technology migration	
	Data	Voice	Services	Handsets	Data	Handsets
Low-Income Countries	-1.11	-0.84	-0.90	-1.30	-0.32	-0.47
Middle-Income Countries	-1.10	-0.83	-0.85	-0.99	-0.32	-0.37
High-Income Countries	-0.82	-0.63	-0.65	-0.76	-0.24	-0.28

14. World Bank (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups)=

4.2 Reinvestment rate

The exact reinvestment rate depends on a range of factors, including the cash flow of a specific company. In the modelling, it is assumed that operators re-invest 60% of the portion of the tax reduction that they retain (i.e. the proportion that is not passed onto subscribers). The remaining 40% is retained as increased profit. This assumption is based on a review of previous studies of the economic impacts of mobile taxation reforms.[15]

Reinvestment can be targeted at expanding the network or improving the capacity of the existing network. The extent to which investment is targeted at expanding the network is determined on a country-by-country basis,[16] primarily by considering the extent to which network coverage is prevalent at the time of modelling.

4.3 Total factor productivity impact

The benefits of mobile connectivity – and how they translate to the macro economy – have been widely studied in the literature. The effects of mobile connectivity on the economy are largely delivered through their impact on productivity, one of the main measures being total factor productivity (TFP). [17]

The assumption of the extent to which a change in unique subscriber penetration leads to a change in total factor productivity is determined on a country-by-country basis. In each case, the value is based on a review of the literature, and with reference to previous studies conducted by the GSMA. The impact is adjusted to account for the extent of the development of the network infrastructure and penetration rates observed in the country.

In these studies, the shock to TFP is modelled as a change in the productivity of all primary factors (of equal proportions) in the economy. This productivity change enters as a variable into the constant elasticity of substitution (CES) value-added production function.[18] The TFP shock works in the model as the sum of two effects:

- By reducing production costs which are passed on to consumers through lower effective prices, which in turn leads to higher demand and production levels (the output effect); and
- By reducing the demand for primary factors, for a given output level (productivity effect).

15. See, for example, Gilchrist and Himmelberg (1995): "Evidence on the role of cash flow for investment" and Katz (2012): "Assessment of the economic impact of taxation on communications investment in the United States".
16. In all cases in which an assumption has been made on a country-by-country basis, the information is available in the methodology appendix of each country study.
17. TFP is a measure for how efficiently an economy uses inputs during its production process.
18. The factor substitution effect is zero, as the productivity of all factors changes in the same proportions.

4.4 Effective pass-through rates

The effective pass-through rate is the percentage of the tax or fee change which is passed through to subscribers in the form of lower effective prices. As outlined in Section 2.2, effective price reductions are wider in scope than pure price reductions and can reflect improved value for money for subscribers. Effective pass-through rates do not imply a one-for-one reduction in headline prices from lower taxation.

As described in Section 3.4 above, the level of effective pass-through is been based on the results of macro-economic modelling in GTAP, on a country-by-country basis.

Since these rates reflect changes in effective prices that take place over the medium- to long-run as a transition to a new equilibrium state of the economy following a shock such as a change in taxation, they would not only capture the immediate price decisions of mobile operators, but would also include reallocation of resources (due to changes in relative prices/costs) and effects of improved productivity on average costs.

To account for the medium-to-long-run nature of the pass-through rate derived from GTAP, the telecoms market model uses a phased effective pass-through rate using the proportions shown in Table 2 below.

Table 2

Evolution of effective pass-through rates[19]

	Year 1	Year 2	Year 3	Year 4	Year 5
% of ultimate effective pass-through applied	85%	92.5%	100%	100%	100%

19. If the effective pass-through rate determined by GTAP for a given country was 50% for example, the pass-through rate applied in the year of the policy ("Year 1") would be 85% of 50% (i.e. 42.5%); in Year 2 would be 92.5% of 50% (i.e. 46.25%); and in Years 3 to 5 would be the full 50%.

4.5 Timing of macro-economic impacts

The standard GTAP model seeks to calculate differences in key economic variables between different possible states of the economy – a baseline case and a policy scenario – at a fixed point in time. This means that the standard model is a comparative static model and does not model year-by-year changes to the new equilibrium.

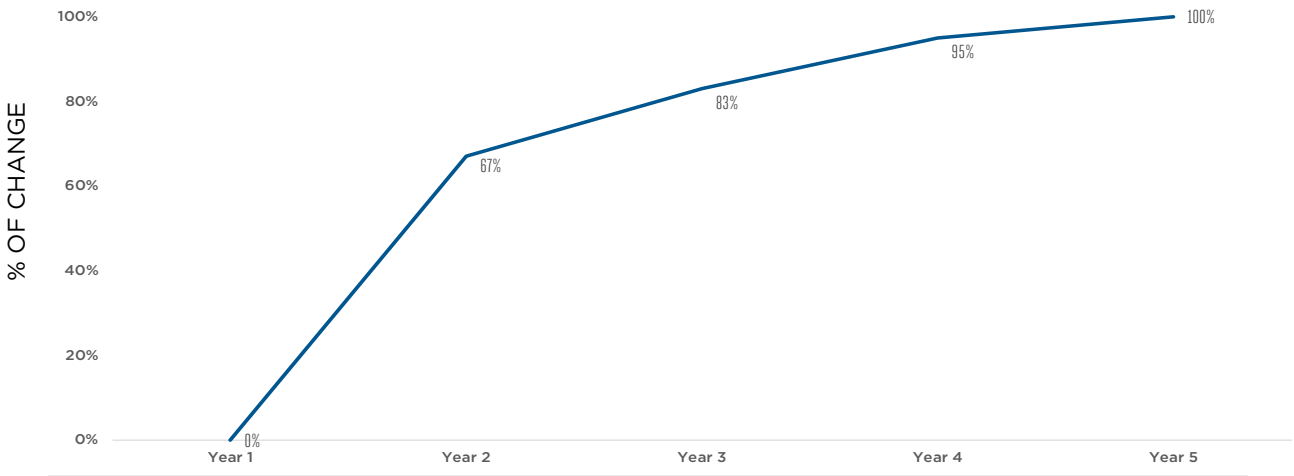
The CGE literature on the dynamic impacts of tax policy on a country's GDP suggests that the transition to a new equilibrium takes on average 5-10 years, with the annual impact on GDP increasing at a diminishing rate.[20]

Using this evidence from the literature, we have formed assumptions on the transition path between the baseline case and the policy change. We assumed that 67% of the steady state impact is felt in the year after the policy is implemented ("Year 2"), 83% in Year 3, 95% in Year 4 and 100% in Year 5. The productivity effects are assumed to come into effect from Year 1. The assumed path is illustrated in Figure 6 below.

Figure 6

Time path for the transition to the new equilibrium

Source: EY analysis



20. See, for example, HMRC (2014) The Dynamic Effects of Fuel Duty Reductions; HMRC (2013) The Dynamic Effects of Corporation Tax; and Giesecke and Nhi (2009) Modelling Value-Added Tax in the Presence of Multiproduction and Differentiated Exemptions.

4.6 Closure rules in the macro-economic model

To account for country-specific labour market conditions, a specific closure rule is applied in GTAP in relation to employment and wages where necessary. The standard approach in CGE models is to assume that the supply of labour is fixed, and hence an increase in the demand for labour results in an increase in wages and prices, rather than employment. However, in some countries, it can be observed that there is some significant unemployment in a section of the workforce (e.g. medium-skilled workers in the Turkey study).[21]

Therefore, the modelling approach allows for employment to increase amongst categories of labour where required, on a country-by-country basis.

4.7 Labour mobility assumptions in the macro-economic model

Labour mobility describes the ease with which labour resources can move between sectors of the economy. In a standard CGE model (such as GTAP), the labour market is assumed to be fully flexible, such that employees can readily switch between different sectors and roles.

Full labour mobility is a valid assumption over the long-term. However, perfect mobility of workers between industries may not be achievable over the five-year horizon in countries where labour market flexibility is low as a starting point. The full labour mobility assumption ignores short-to-medium term barriers to switching in a labour market – e.g. skills or geography mismatches between supply and demand for labour.

The World Economic Forum's (WEF) annual Global Competitiveness Survey[22] calculates a metric measuring labour market flexibility, which can be used as a proxy to adjust the labour mobility assumption down from 100%, to more accurately reflect limited short-to-medium run labour market flexibility.

To reflect the varied degree of labour market flexibility and the limited labour mobility in some countries, an adjustment to the mobility of labour in the GTAP model is made. Limiting the labour market mobility in GTAP recognises the difficulty of moving labour resources from lower-skilled to higher-skilled jobs in countries with low labour market efficiency.

In the Global Competitiveness Survey, labour market flexibility is measured on a 0-100 scale, where 100 represents a perfectly flexible labour market. Based on the analysis of the Global Competitiveness Report, the following matrix correlating the WEF labour market flexibility scores with labour mobility adjustments has been developed, to approximate for the differences in labour market flexibility between countries.

21. Unemployment by education level, ILOSTAT labour force survey.
22. The Global Competitiveness Report 2018, World Economic Forum http://www3.weforum.org/docs/GCR2018/05FullReport/TheGlobalCompetitivenessReport2018.pdf

Table 3

Labour mobility adjustment matrix

Source: World Economic Forum, EY analysis

Score Range	Labour mobility assumption in GTAP
.>70	100%
55-70	75%
<55	50%

This approach is taken in favour of a 'one-for-one' approach (i.e. setting the labour market flexibility in GTAP at 40% for a county with a labour market flexibility score of 40) because the labour market flexibility scores are interpreted as an indicative guide of differences between countries, rather than a scientific assessment of flexibility.

4.8 Mobile sector as a proportion of the telecommunications sector

As the GTAP macro-economic model has no mobile sector as a separate industry, the share of the mobile sub-sector has been calculated based on data from GTAP and the GSMA. The rest of the communications sector includes:

- Postal and courier services;
- Publishing activities;
- Motion picture, video and television production, sound recording and music publishing activities;
- Programming and broadcasting activities;
- Computer programming, consultancy and related activities; and
- Information service activities.

The proportion of the telecommunications sector comprised of the mobile is estimated on a country-by-country basis.

To download the report
please visit the GSMA website at
www.gsma.com/mobile-taxation-studies-methodology-documentation

GSMA HEAD OFFICE
Floor 2
The Walbrook Building
25 Walbrook
London EC4N 8AF
United Kingdom
Tel: +44 (0)20 7356 0600
Fax: +44 (0)20 7356 0601