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STRATEGIC CONFUSOPOLY: EVIDENCE FROM THE UK MOBILE TELECOMMUNICATIONS MARKET

Ambre Nicolle, Christos Genakos & Tobias Kretschmer

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Cambridge Judge Business School author contact details are as follows:

Christos Genakos
Cambridge Judge Business School
University of Cambridge
Email: c.genakos@jbs.cam.ac.uk

Please address enquiries about the series to:

Research Manager
Cambridge Judge Business School
University of Cambridge
Trumpington Street
Cambridge CB2 1AG
Email: research-support@jbs.cam.ac.uk

Strategic Confusopoly:

Evidence from the UK mobile telecommunications market *

Ambre Nicolle† Christos Genakos‡ Tobias Kretschmer§

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Abstract

Can entire markets strategically confuse consumers to raise market prices? Using a detailed dataset covering virtually all mobile phone tariffs and their handsets in the United Kingdom between January 2010 and September 2012, we study the evolution of quality-adjusted prices and find that they increased until December 2010, even though the industry was mature, technologically homogeneous, and competitive. Upon exploring the role of several salient factors, such as differentiation and product proliferation by firms that may have affected this evolution, we argue that the primary driver is the implementation of obfuscation strategies by firms. The observed price increase is significantly correlated with the rate at which operators implemented dominated tariffs (i.e., tariffs for which there is a cheaper alternative from the same operator), indicating that firms use obfuscation strategies to reduce product transparency, thereby elevating overall prices. Importantly, the presence of dominated tariffs raises not only the prices of these contracts but also those of efficient ones, distinguishing our findings from a behavioral price discrimination strategy that would only affect inattentive consumers. Our exploratory study is one of the first to offer suggestive evidence of obfuscation as an industry-wide supply-side phenomenon.

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†LMU Munich & Mines Paris, PSL University, Centre for Industrial Economics (CERNA), i3 UMR9217 CNRS. Email: ambre.elsas-nicolle@minesparis.psl.eu

‡University of Cambridge, Cambridge Judge Business School, CEP & CEPR. Email: c.genakos@jbs.cam.ac.uk

§Corresponding author: LMU Munich, Imperial College Business School & CEPR. Email: t.kretschmer@imperial.ac.uk

1 Introduction

Do firms strategically confuse their consumers to raise prices at the industry level, and if so, how? Strategic obfuscation can take several forms, such as bundling obscure product characteristics with well-known ones to shroud the prices of individual components (Gabaix and Laibson, 2006), issuing complex product descriptions (Ellison and Ellison, 2009), or simply introducing an excessive number of nonviable products (Miravete, 2013). In a world with perfectly informed consumers, this would seem ineffective at best, and harmful at worst. Even with imperfectly informed consumers, these strategies may not be profitable if firms face a non-negligible cost of launching these products or, more generally, of implementing these strategies.

If the product or service is such that the cost of introducing new variants is low, however, the number of products may increase rapidly, and competitive imitation may be fast and complete (MacMillan et al., 1985; Piazzai and Wijnberg, 2019). If product features are new or hard to interpret, boundedly rational consumers may be unable to overcome their "comparison frictions", which may lead to suboptimal choices or simply consumer inertia ("choosing not to choose"; Iyengar and Lepper, 2000; Diehl and Poynor, 2010). Firms may use product proliferation as a way to obfuscate direct product comparisons (Blake et al., 2021), which may allow firms to raise prices unilaterally. However, can this be sustained as an industry equilibrium? Despite its theoretical appeal, few empirical studies look at obfuscation as an industry-wide strategy.

Our "forensic" analysis of the U.K. mobile telecommunication market – carefully ruling out alternative explanations such as differentiation, proliferation, or handset competition – provides novel evidence of the existence of these strategies and their impact on product prices and margins, with an ultimate impact on consumer welfare. We track prices of virtually all products offered in this market over nearly three years and observe that quality-adjusted prices rise in the early part of our sample period and decline later. We analyze the level of product differentiation and proliferation and comment on the possible existence of a collusive agreement on prices only. We conclude that none of these factors can truly explain the observed evolution. Accordingly, we turn to a less-documented aspect that could impact price, namely, the transparency of tariffs offered. Interestingly, the share of "dominated tariffs", i.e., tariffs for which there exists a better

alternative by the same firm for a given set of characteristics, follows the same pattern as the one observed for quality-adjusted prices. This suggests that, on the supply side, the level of prices and the level of obfuscation may be related to firm choices. We argue that it is highly plausible that all firms in the industry participated in a "confusopoly" (an oligopoly of firms trying to confuse consumers), in which they jointly increased the number of dominated tariffs to create a "shroud" over the most efficient (i.e., non-dominated) tariffs to raise average prices. In the latter part of the sample period, firms reduced the number of dominated tariffs, triggered by a move for transparency by the smallest operator and a push by the regulator to increase price and product transparency in the market. This period of "competition on transparency", where firms cleared their portfolio of dominated tariffs, goes along with a steady decline in prices.

We focus on an important but understudied dimension of multiproduct strategy: the degree of transparency of product offerings when products are multidimensional and product introduction is low-cost. While we cannot claim to identify the causal structure between two choice variables (price and the degree of transparency), we find strong suggestive evidence that firms indeed strategically choose the degree of transparency (or lack thereof) in their product portfolio as an obfuscation strategy to raise prices. A key insight from our analysis is that the presence of dominated tariffs raises prices across the board, including for efficient tariffs, suggesting that obfuscation affects the entire market equilibrium rather than merely extracting surplus from inattentive consumers.

This result survives a forensic search for alternative explanations such as product differentiation, product proliferation, and competition on handsets. Obfuscation, i.e., firms' actions intended to increase the complexity of their products or prices, but more generally any action that increases consumers' search costs, is most common for tariffs bundled with a (subsidized) handset. While we do not have demand-side data, we focus on the supply side of an industry with an abundance of similar products and show that multiproduct firms compete by designing their product portfolio conditional on the degree of consumer sophistication. While obfuscation has been documented in several theoretical and empirical papers, we highlight its existence at the industry level in a clearly defined market, documenting its co-occurrence with other strategies

such as product proliferation, product differentiation, and potential collusion on prices. We also connect to behavioral strategy by suggesting that consumers are boundedly rational in their use and valuation of new product characteristics and, as such, may fall victim to a "confusopoly" of firms offering a shroud of tariffs that makes understanding and comparison particularly difficult. Finally, we estimate that the total cost of obfuscation strategies for consumers was between 57m and 137m GBP in the least costly scenario or between 106m and 252m GBP in the worst case scenario.

In sum, we contribute to the study of obfuscation as a choice variable by multiproduct firms, the role of obfuscation in sustaining high industry-level prices, and more broadly, to the analysis of firm strategies in markets with boundedly rational consumers.

2 Prior work

The strategic use of obfuscation by firms, particularly in competitive and technologically homogeneous markets, has become increasingly relevant for understanding price dynamics. We explore the theoretical and empirical foundations of obfuscation strategies, examining how firms can manipulate product transparency to sustain higher prices and achieve market equilibrium, with a specific focus on mobile telecommunications markets. We will only give a snapshot of the vast literature on strategies in multiproduct markets and prior work in behavioral economics, which sheds light on boundedly rational consumers (and how firms strategically interact with them) to provide a departure point for our theoretical and empirical exploration.

Strategic decision making in multiproduct markets. Multiproduct firms navigate various strategic decisions concerning product portfolios, pricing, and differentiation to maintain competitiveness. These decisions are shaped by costs, resource allocation, competitive dynamics, consumer demand heterogeneity, and budget constraints.

Product line length. A key decision for multiproduct firms is to determine how many products or product lines to offer (Draganska and Jain, 2005; Giachetti and Dagnino, 2014; Zia and

Kuksov, 2025).[1] The size of the product portfolio plays a crucial role in competition and firm performance. Research indicates that expanding product lines can enhance consumer loyalty, allow firms to charge higher prices (Draganska and Jain, 2005), deter imitation by rivals (Piazzai and Wijnberg, 2019), or respond to competitor actions (Bayus and Putsis, 1999; Putsis and Bayus, 2001). Another strand of research focuses on resource allocation across product categories, where firms often group product line decisions based on resource reusability (Barroso and Giarratana, 2013). In telecommunication services, product lines are strategic complements, where one firm's expansion leads competitors to follow suit (Miravete, 2009). Offering many product variants, or brand proliferation, can create barriers to entry (Schmalensee, 1978). However, a large number of products does not always equate to high differentiation, as seen in the yogurt industry (Richards et al., 2013) and the smartphone industry (Fan and Yang, 2020).

Product differentiation. Firms differentiate their products through new attributes, technologies, or pricing schemes. Theory suggests that firms seek maximum differentiation from competitors to reduce price competition (D'Aspremont et al., 1979). Over time, product characteristics may diverge as demand becomes less uncertain and more heterogeneous (Corrocher and Zirulia, 2010; Koski and Kretschmer, 2007). Introducing popular product attributes can also support firm survival, as discussed in the dominant design literature (Suarez and Utterback, 1995). Market concentration and mergers can affect variety in various ways, depending on the market conditions (Berry and Waldfogel, 2001; Götz and Gugler, 2006; Sweeting, 2010). If we shift the focus to consumers, other reasons could explain why firms tend to differentiate their products. Lancaster (1990) suggests that variety within a group of products would persist if each individual consumer seeks variety in his or her own consumption (i.e., if consumers have a *love for variety*) and if different consumers are willing to purchase different variants of a product because tastes vary (i.e., if consumers are *heterogeneous* if their preferences.)

Prices. Another important product dimension that will determine its success is price. Firms positioned close to each other tend to compete intensively on price (minimal differentiation), while firms that differentiate themselves more through attributes or advertising (maximal differ-

[1] The related concept of *product line breadth* is also used in the literature, typically referring to the number of product categories.

entiation) can charge higher prices. Hotelling's (1929) model suggests that firms choose minimal differentiation to stabilize prices, a finding supported by research indicating that firms may position their products near competitors when demand is spatially concentrated (Stahl, 1982), when there are demand spillovers (Gavazza, 2011), or when consumers face search costs (Dudey, 1990). Generally, there is a trade-off between a market area effect (the increase in demand from clustering) and a substitution effect (price competition due to ease of comparison).

In mobile telecommunications markets, multiproduct firms serve diverse consumers. In most industrialized economies, the industry is mature, with uniform technology and network coverage. As innovation primarily occurs at the hardware level, competition at the retail level focuses on setting tariffs: bundles of attributes and prices within contracts. The low cost of designing new products lets firms rapidly introduce and withdraw tariffs. Given heterogeneous consumer preferences and budget constraints, firms have to balance product variety. Despite the traditional principle of offering only the minimum number of variants to serve all profitable consumers, the low cost of launching products suggests that an increasing number of minimally differentiated tariffs could emerge, each targeting specific (micro-)segments of the market.

Imperfectly rational consumers and strategic firms. The interaction between (imperfectly rational) consumers and strategic firms shapes competitive dynamics in many markets. Firms often exploit consumer cognitive biases and decision-making limitations through complex product offerings and pricing schemes, impacting consumer welfare and market outcomes.

First, consumers face search costs, which increase as product variety grows (Diamond, 1971). Firms may deliberately increase these search costs by co-locating products in attribute space (Bernhardt et al., 2022) or using obfuscation strategies to increase the time needed to learn their prices (Ellison and Wolitzky, 2012). Higher search costs, for example, can help inferior products survive (Ellison and Wolitzky, 2012).

In addition to search costs, consumers also often exhibit bounded rationality, leading to suboptimal decision-making due to cognitive limitations and biases (DellaVigna, 2009; Spiegler, 2011). These limitations are particularly pronounced in markets where products (and prices) are complex or numerous, such as mobile telecommunications. For example, prior literature

documented the existence of loss aversion (Genakos et al., 2023) and overconfidence (Grubb, 2009; Grubb and Osborne, 2015) in these markets.

Firms aware of consumers' bounded rationality often design contracts which are sometimes referred to as *exploitative contracts*, taking advantage of biases like limited attention (Spiegler, 2006) or usage uncertainty (Lambrecht et al., 2007). Complex pricing schemes (Richards et al., 2010; Gu and Wenzel, 2012), complex product descriptions (Ellison and Ellison, 2009), and shrouded product attributes (Gabaix and Laibson, 2006) reduce transparency, increase search costs and make it harder for consumers to compare offering (Ellison and Wolitzky, 2012), which ultimately allow firms to extract higher profits (Menzio, 2023). Janssen and Kasinger (2024) show theoretically that in a duopoly setting with price competition and rationally inattentive consumers, firms may converge to an obfuscation equilibrium characterized by high prices.

Firms in competitive markets may choose to increase obfuscation rather than lower prices (Spiegler, 2016), especially when they sell products with multiple attributes (Gabaix and Laibson, 2006). Competition may drive firms to increase pricing complexity, which decreases consumer welfare (Carlin, 2009). Price framing, which influences how consumers perceive prices (Chioveanu and Zhou, 2013), and complex price strategies may allow firms to sustain high profits in competitive settings. However, obfuscation does not always lead to higher prices. In some cases, it can help maintain a low-price strategy, depending on how consumers search and compare products (Wilson, 2010; Petrikaitė, 2018). Yet, it can backfire if consumers become distrustful of firms using these strategies, reducing their willingness to engage (Allender et al., 2021; Chiles, 2021; Seim et al., 2017).

In mobile telecommunications markets, where products are bundles of services and devices, firms easily observe competitors and imitate offerings. The low cost of introducing new tariffs enables firms to create complex menus, confusing consumers and raising search costs (Miravete, 2013). Mobile tariffs are difficult for consumers to evaluate due to hidden attributes like subsidies, further complicating the decision-making process (Gabaix and Laibson, 2006). With the introduction of cellular data and smartphones, the number of tariffs rose significantly, reducing transparency for consumers (as in the setting studied by Ellison and Ellison, 2009). Lastly, the

bundled nature of mobile services and devices adds complexity, as (less easily observed) details like handset subsidies are often shrouded (like in the settings studied in Gabaix and Laibson, 2006 and Seim et al., 2017). Consumers are required to make difficult choices, complex calculations, which can result in suboptimal decisions and, ultimately, higher profits for operators.

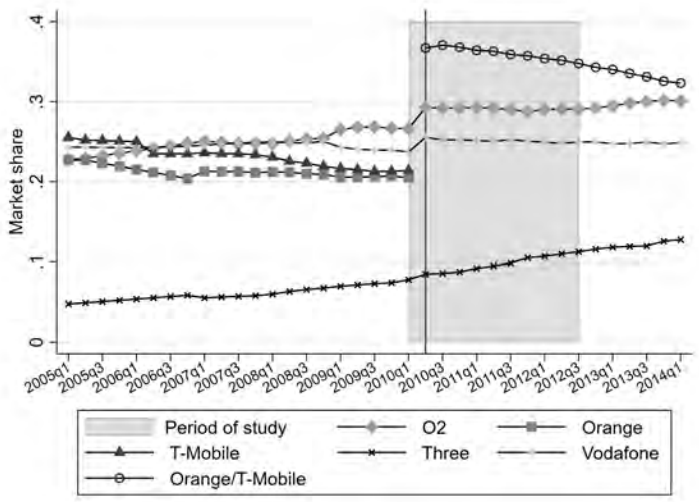
Our setting combines various features that make it particularly prone to obfuscation strategies: an oligopoly (Ellison and Wolitzky, 2012) of multiproduct firms (Spiegler, 2016) offering complex products with new and complex attributes (Gabaix and Laibson, 2006; Spiegler, 2006) facing boundedly rational consumers with search costs. This sentiment is shared by policymakers (European Commission, 2007 and 2017; Ofcom, 2018), who have repeatedly raised concerns about possible consumer harm in these markets arising from the lack of transparency of offers. We consider the industry as a whole - and shed light on how operators could have used obfuscation strategies in equilibrium, resulting in a "confusopoly".

3 Industry background

The UK mobile telecommunication market. There are four licensed Mobile Network Operators (MNOs) in the UK: Everything Everywhere (owned by British Telecom), O2 (owned by Téléfonica), Vodafone, and Three (owned by Hutchison). The Office of Communications (Ofcom) regulates the industry by controlling licensing, but otherwise, the operators are free to market their products and set prices to consumers. At the end of 2011 (halfway through our sample), there were 83 million mobile subscriptions (in a population of 63 million) and 53% of them were post-paid (i.e., monthly bill) contracts. Post-paid tariff plans are multi-dimensional. They include a monthly rental, a minimum contract term, voice, text, and data allowances, and other add-ons, and they can be paired with a device and a variety of services. The industry is mature and highly competitive. Figure 1 shows the evolution of operators' market shares since 2005, with the shaded region representing our study period.

Two industry facts are worth noting. First, Orange and T-Mobile were allowed to merge in 2010, thus consolidating the UK market from 5 to 4 main operators. The merger was announced in September 2009 and cleared by the European Commission in March 2010, resulting in the

Figure 1: Mobile operators' market share of subscribers in the UK



Note: Our period of study starts in January 2010 and ends in September 2012. The vertical line shows where the merger between Orange and T-Mobile took place. **Source**: Operators' financial reports and Ofcom.

creation of Everything Everywhere in May 2010. Although owned by the same company, Orange and T-Mobile continued operating under their own brands and kept their own shops and service centers as well as independent marketing campaigns until 2015. Thus, given our timeframe, we will look at the decisions of each of these firms separately.

Second, the introduction of 4G licenses meant that cellular data gradually became available in tariffs from late 2009 onwards.[2] However, to make full use of this option, consumers needed new mobile devices (smartphones). The evolution from two-dimensional (voice and texts) to three-dimensional tariffs (voice, texts, and data) bundled with a whole set of new phones had a profound impact on the market as the number of available options for consumers surged from 2,118 varieties in January 2010 to 12,573 in just one year.

Given the complexity of the tariffs, consumers' capacity to make informed choices became a hot policy discussion topic. Although Ofcom never intervened directly in any price setting or restricted the types of tariffs that could be offered, they supported the idea that information

[2]This coincides with the release of Apple's iPhone 3G, basically the first smartphone able to connect to the cellular network.

should let consumers make better choices because consumers are more likely to shop around when information is available. Thus, the regulator has awarded accreditation to websites that allow consumers to compare phone companies to find the lowest tariffs. In 2009, Billmonitor.com (henceforth BM), the leading UK mobile phone price-comparison site, was the first firm to receive such an award for mobile phone services. We use BM as a base to construct the most comprehensive dataset of the supply side of available mobile tariffs in the UK.

4 Data

Data set construction. We construct a novel dataset that lets us analyze in great detail the evolution of mobile tariffs together with their handset characteristics and their prices in the UK between January 2010 and September 2012. To this end, we combine three data sources. First, we have the complete list of post-paid mobile tariffs offered by mobile operators from BM.[3] We define a tariff as a combination of a network (O2, Orange, Three, T-Mobile, or Vodafone), a contract length (between 1 and 36 months), allowances of SMS, voice and data, on-net calls, mixed allowance (from zero to unlimited) and a handset (manufacturer and model), if any. For each tariff, we have the monthly price in GBP and the allowances of voice, text, data, mixed allowance (voice and SMS combined), and on-net volume of calls. The original data set consists of 3,812,523 daily observations. Once aggregated monthly, we have 204,364 observations of 53,421 unique tariffs.

We obtained this unique, highly granular data thanks to our collaboration with BM, which gave us access to this specific time period. We did not select this time period, and due to changes in company policy, we cannot access an extended time frame (before or after). Still, our nearly three years of data give a comprehensive insight into what happened at the industry level, capturing market-level trends, the gradual introduction of mobile data, and the widespread diffusion of smartphones. Finally, given the scarce availability of such detailed data at the *industry level*, our data lets us conduct detailed supply-side analyses.

The data includes two types of contracts serving different consumer segments: traditional

[3]For data availability reasons, December 2011 and January, June, and July 2012 are missing, giving us 29 months in total.

ones, where mobile services are bundled with a handset which is subsidized by the operator, and tariffs that only include mobile services, known as *SIM-only* tariffs.[4] For the latter, consumers either use a handset they already own or purchase a new or used device of their choice. For tariffs bundled with handsets, we have information on the model and the upfront cost to consumers. Our data does not include information on the actual consumption or choices of subscribers (no demand-side information). Also, we observe no local discount or shop-level variation in the prices of the contracts - we only observe official national prices advertised on operators' websites.

We complement this data with information from GSMArena that provides detailed handset characteristics (dimensions, weight, camera quality, date of release, CPU, GPU, etc). When comparing the prices of different tariffs, this information lets us control for the quality evolution of handsets in detail. Finally, we merge this data with information from IDC on the list price (and sales) of each handset model. This information is needed to calculate the implicit handset subsidy and to compare tariff (bundled with a handset) prices more accurately. Our final sample comprises 184,560 observations from 51,414 unique tariffs, of which 419 are SIM-only.

Note that the tariff price we use in our analyses is the list price for a given mobile plan. This price corresponds to the minimum price that consumers will pay on a monthly basis. In reality, consumers may face a higher monthly bill due to extra costs related to the use of special numbers and international roaming, or due to usage beyond their allowances. The price of additional SMS, minutes, or data (often called out-of-bundle rates) varies across operators. We do not observe these prices in our dataset, so the price we consider in our analyses is a lower bound or the most conservative estimate of the final tariff invoice for any given consumer.

Prices and characteristics of products. We define mobile tariff prices (in GBP) as a combination of monthly allowances of SMS, data, on-net, and off-net calls[5] and mixed allowances,[6] bundled with a handset (if the tariff is not a SIM-only contract), offered by a given operator. All contracts are post-paid, so that consumers pay the tariff price at the end of the month. We

[4] In 2010, Ofcom reported that SIM-only contracts accounted "for more than one in five new pay-monthly connections". Nowadays, SIM-only subscribers represent about 39% of the market in the UK (Ofcom, 2021).

[5] This corresponds to the voice allowance for calls on the operator's network (on-net) or on the other networks (off-net). Often, the allowance is not split between on-net and off-net.

[6] Mixed allowances combine texts and calls.

Table 1: Descriptive statistics on combinations of tariff and handset

Variable	Mean	Std. Dev.	Min.	Max.
Tariff price	32.98	13.77	0	125
Handset cost	39.03	75.64	0	649.99
Amount of subsidy	191.7	100.76	0	650
Contract length	20.82	3.87	1	36
SIM-only tariff (0/1)	0.02	0.13	0	1
Voice allowance	651.45	624.51	0	3,000
SMS allowance	291.84	823.89	0	5,000
Data allowance	258.13	380.89	0	3,072
On-net voice allowance	52.54	503.52	0	5,000
Mixed allowance	7.85	94.15	0	3,875
Unlimited voice (0/1)	0.04	0.2	0	1
Unlimited SMS (0/1)	0.56	0.5	0	1
Unlimited data (0/1)	0.17	0.38	0	1
Unlimited on-net voice (0/1)	0.12	0.33	0	1
Dominated tariff (0/1)	0.15	0.36	0	1
N		184,560		

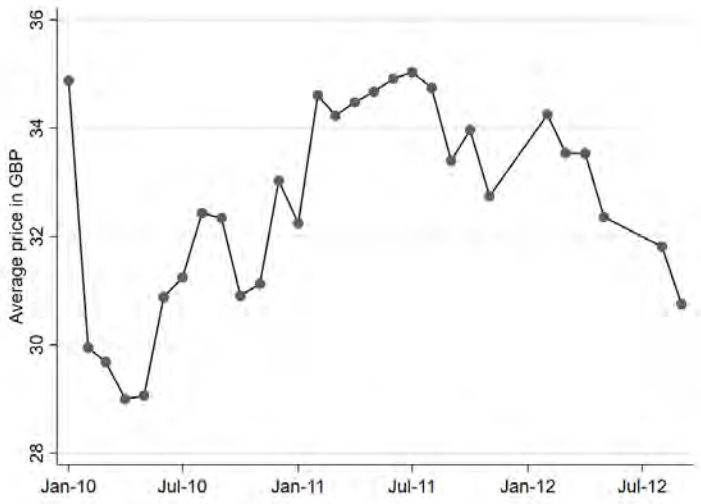
Notes: These statistics are computed for all tariffs. 71% of tariffs are associated with a zero handset cost, meaning that they are fully subsidized by the operator or that the tariff is SIM-only. Indeed, SIM-only tariffs are, by design, not associated with any handset - thus a zero handset cost. Dominated tariffs in this table are defined using our primary (*cost-conscious*) definition.

observe the introduction and withdrawal of tariffs, as well as their price evolution over time.

Table 1 presents descriptive statistics of the prices and characteristics of tariffs (combined with various handsets). On average, a tariff costs 33 GBP (monthly charge), and the handset 39 GBP (one-off charge). We observe two types of tariffs serving two segments of consumers: tariffs associated with a handset (about 99.8% of observations) and SIM-only tariffs.

Table B.1, presented in Appendix B, shows characteristics and prices of tariffs across operators. Three offers the cheapest tariffs on average (about 23 GBP), while Vodafone charges 39.5 GBP. Table B.2 shows that the modal contract length for SIM-only tariffs is 1 month (57%), followed by 12 months (37%). With handsets, most contracts are 24 months (53%) or 18 months (45%). A correlation matrix of our main variables is presented in Appendix B in Table B.3.

Figure 2: Evolution of average prices of tariffs



5 Descriptive evidence

The mobile telecommunications market is characterized by fast technological evolution at the upstream manufacturing level and a high degree of technological homogeneity among the competing mobile operators, who all have access to the same handsets. Price dynamics are crucial in this industry, serving as both a primary determinant of consumer choice and a performance metric for operators, who offer essentially identical technological products. Figure 2 presents the evolution of average prices over the period. We observe a clear inverse U-shaped pattern with prices increasing until summer 2011, followed by a steady decline.[7]

The first and most natural explanation for this pattern would be changes in the differentiation of products. Over the focal period, smartphone usage was taking off, and operators introduced a new dimension in their tariffs, namely mobile broadband, typically offered as an allowance of 500MB, 1GB, etc, or, more rarely, in a flat rate. Operators might increase the differentiation of their products to cater to different, still evolving needs, or simply to experiment, given the low cost of introducing new bundles. Smartphone diffusion also drove consumers to adopt new handsets. If some (highly valued) handsets were exclusive to some operators, a price

[7]The first month of our period of observations is characterized by a higher average price. This month's price distribution displays a notable irregularity, specifically a tail of exceptionally high tariffs not seen subsequently. Looking at the tariffs offered that month, we observe that the higher average price is driven by a number of tariffs with fully subsidized handsets and unlimited data (about 120) - tariffs which are quickly churned.

increase would be expected. Indeed, while the products are technologically homogeneous, they are differentiated in several dimensions (allowances, handsets) as they are offered in bundles freely designed by operators. Figure A.1 presented in Appendix A offers a simple illustration of the positioning of products in the attribute space - and how it changed over the focal period.

To understand the evolution of differentiation of tariffs on their most salient characteristics (allowances of text, voice, and data), we construct a differentiation measure capturing the average pairwise distances between all products available in a given month. More precisely, we compute the Euclidean distance between the characteristics of all pairs of tariffs available on the market each month. Three key dimensions are considered: voice, SMS, and data allowances.[8] By averaging the pairwise distances for each month, we can see in Figure 3 how the level of differentiation – the average distance between products – at the industry level evolves over time. We observe a sharp decline in the differentiation measure over the relevant period.[9] Theoretically, we would expect prices and differentiation to evolve in the same direction. Hence, the price decline in the second part of the observation period could be explained by the overall decline in product differentiation. Still, what happens in the first half of the period remains a puzzle.

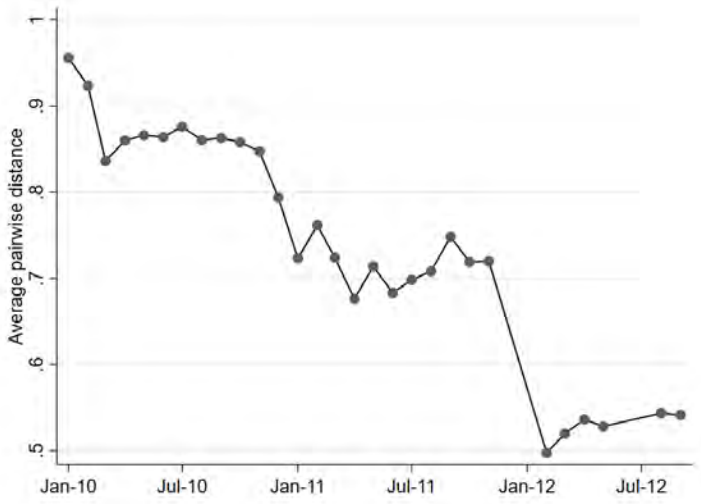
Another important dimension of tariffs offered by firms in this industry is the handset. Although over the period we study, there are no exclusivity agreements between operators and smartphone manufacturers, some handsets were *de facto* exclusive to some operators. If these handsets were highly valued by consumers, this might explain price increases as the operators would gain market power through exclusive access to these phones. For each period, therefore, we compute the share of exclusive handsets sold by just one operator.[10] Figure 4 shows no major change regarding the prominence of *de facto* handset exclusivities over the period. In Section 7.2.1, we describe these exclusivities and the overall demand they receive in more detail. The bottom line is that the most popular brands are sold by all brands, and that most of the popular, highly-demanded models are sold by at least two operators.

[8] We describe this computation in detail in Appendix A, Section A.1. Some descriptive statistics are presented in this section in Table A.1.

[9] Figure A.2, also in Appendix A, provides a more detailed view of the evolution of pairwise distances. It also shows that differentiation is steadily declining both at the between-operator level (i.e., different operators' portfolios become more similar over time) and the within-operator level (i.e., a single operator's portfolio contains fewer different products over time).

[10] Most of these phones are branded with the operator's name.

Figure 3: Evolution of the average pairwise distance between tariffs

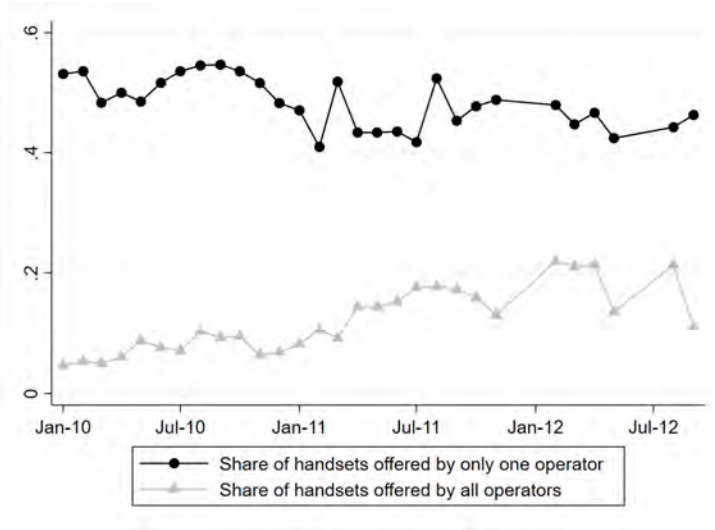


Another possible source of differentiation could be the quality of phones included in contracts. As handset list prices[11] can be a proxy for quality, we study the average prices of phones offered by operators over time. Figure B.1, presented in Appendix B, shows an increase in the average list price over time - but the trend is the same for all operators. This observation renders the idea that one of the firms would strongly differentiate its catalog by focusing on lower or upper-quality handsets unlikely. Overall, the differentiation of tariffs does not appear to be the driving force behind the observed pattern of average prices.

Another important feature is the product line length of our firms. Theoretically, an increasing number of products, potentially resulting from proliferation strategies of operators, could drive up prices. Given the low cost of introducing new tariffs for mobile operators, such a strategy would seem plausible. Also, the level of differentiation could theoretically stay the same - and even decline, as in our case - with a growing number of products occupying the same product space. We monitor the evolution of the number of tariffs (typically a combination of handset and mobile services) available in the market. Figure 5 shows the evolution of the number of products. The number of tariffs increases steadily, reaching a peak in January 2011, and then steadily declines. Increasing the number of products would make sense in a period of increased differentiation of products (or firms exploring). However, we have seen before that differentiation

[11] List prices are the "official prices" of the handsets, absent any subsidies by the mobile operator.

Figure 4: Evolution of the share of exclusive phones offered with tariffs



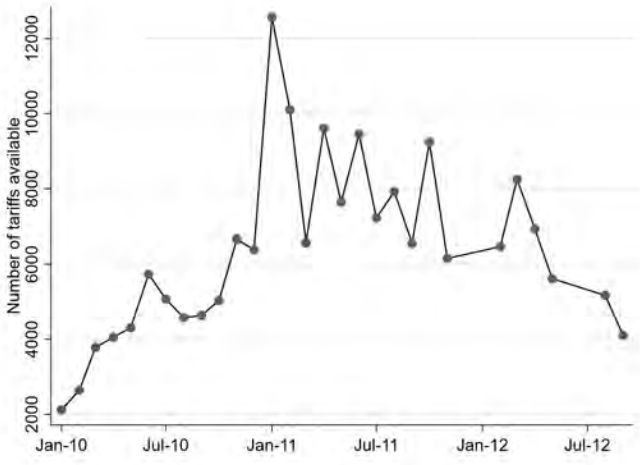
Note: Shares are computed based on the number of handsets observed in a given month across all operators' catalogs.

has not increased. The puzzle remains unanswered.

Prior literature shows that firms can strategically use obfuscation to increase their prices, even in a competitive industry. Spiegler (2011) highlighted that complex products are particularly prone to obfuscation because individuals cannot compare easily. Obfuscation strategies come hand in hand with the proliferation of products, which would be in line with what we observed before. How, then, can we identify obfuscation strategies in our setting? We define "dominated tariffs" and look at their prevalence over the period studied. To do so, (i) for a given combination of attributes, we identify the cheapest option by an operator - we call this the "efficient" tariff, and (ii) we code as "dominated" all other tariffs by the operator offering the same combination of attributes (plus potentially other characteristics that are not the focus) at a higher price. We detail our computation in Appendix A, in Section A.2. Figure 6 reflects the inverse U-shape we already observed for prices.

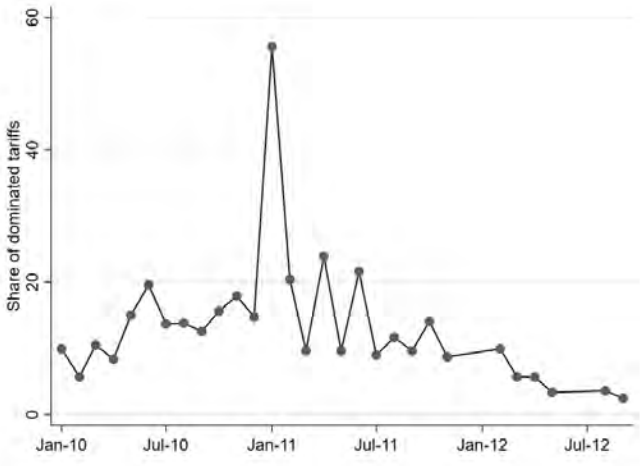
Our descriptive analysis calls for further investigation. Next, we use a regression framework to control for confounding factors, such as variations in product quality, and explore additional alternative explanations for the observed pattern.

Figure 5: Evolution of the number of products (combinations tariffs+handsets)



Note: All tariffs are represented on this figure (tariffs with handsets and SIM-only contracts).

Figure 6: Evolution of the share of dominated tariffs



6 Econometric analysis

Our measures of prices and dominated tariffs are affected by a host of factors, including product, firm, and market characteristics. We first construct price, obfuscation, and differentiation indices by regressing our measures separately on a set of controls to retrieve the *residual variation over time* for our three choice variables. We then explore their interdependencies by regressing the price index on obfuscation and differentiation and a full set of controls, including tariff and handset characteristics.

6.1 Price index

We first run a hedonic price regression, following a long literature starting with Griliches (1961) to extract quality-adjusted prices while controlling for various tariff characteristics:

$$Price_{it} = \alpha + \beta X_{it} + \sum_{t}^{T} \delta_t D_t + \varepsilon_{it}, \tag{1}$$

where $Price_{it}$ denotes the list price in GBP of tariff i available in year-month t. The vector of tariff characteristics X_{it} includes: (i) contract length (ii) unlimited voice dummy (iii) voice allowance (iv) unlimited SMS dummy (v) SMS allowance (vi) unlimited data dummy (vii) data allowance (viii) mixed allowance (voice and SMS), (ix) amount of subsidy associated with the handset and (x) mobile operator dummies. D_t are year-month dummies capturing industry-level shocks over the period. The normally distributed error term is denoted by ε_{it}. The estimated coefficients δ_t of the year-month dummies represent the quality-adjusted price index.

6.2 Differentiation index

We measure the level of differentiation of tariffs in the market by computing the Euclidean distance between each tariff pair, i.e., between characteristics of tariff i and j, available on the market in a given month t.[12] Using these pairwise distances, as for price and obfuscation, we compute a differentiation index as follows:

[12] We detail the computation in the Appendix A, in Section A.1.

$$Distance_{ijt} = a + X_{ijt}b + \sum_{t}^{T} \gamma_t D_t + \varepsilon_{ijt}. \quad (2)$$

In this dyad-level equation, $Distance_{ijt}$ denotes the Euclidean distance between tariff i and tariff j in month t. The coefficients (a,b,γ_t) are estimated using ordinary least squares (OLS). The vector of pairwise characteristics X_{ijt} includes a dummy for each combination of operators (within and across operator fixed effects) and for each combination of segments (within and across segments). The normally distributed error term is denoted by ε_{it}. The estimated coefficients γ_t of the year-month dummy variables d_T represent the product differentiation index, which captures the overall level of differentiation of products at the industry level in each month.

6.3 Obfuscation index

In a similar fashion, we calculate the obfuscation index by estimating the following regression:

$$Dominated_{it} = \mu + \sigma_1 Operator_i + \sigma_2 Simonly_i + \sum_{t}^{T} \theta_t D_t + \epsilon_{it}, \quad (3)$$

where $Dominated_{it}$ is a dummy variable with value 1 if tariff i is dominated in year-month t,[13] $Operator_i$ captures mobile operators fixed effects, $Simonly_i$ is a dummy coded 1 if i is a SIM-only tariff (i.e., not associated with a handset), and D_t are year-month dummies. The coefficients $(\mu, \sigma_1, \sigma_2, \theta_t)$ are estimated using OLS and alternatively a logistic regression. The coefficients θ_t of the year-month dummies capture how the likelihood of observing a dominated tariff can be explained by the month it is observed in, controlling for time-invariant elements such as operator fixed effects, and constitute our time-varying obfuscation index. This index captures the monthly level of obfuscation of products available in the focal market.

[13] We detail our definitions in Appendix A, Section A.2. We also provide several examples.

7 Main results

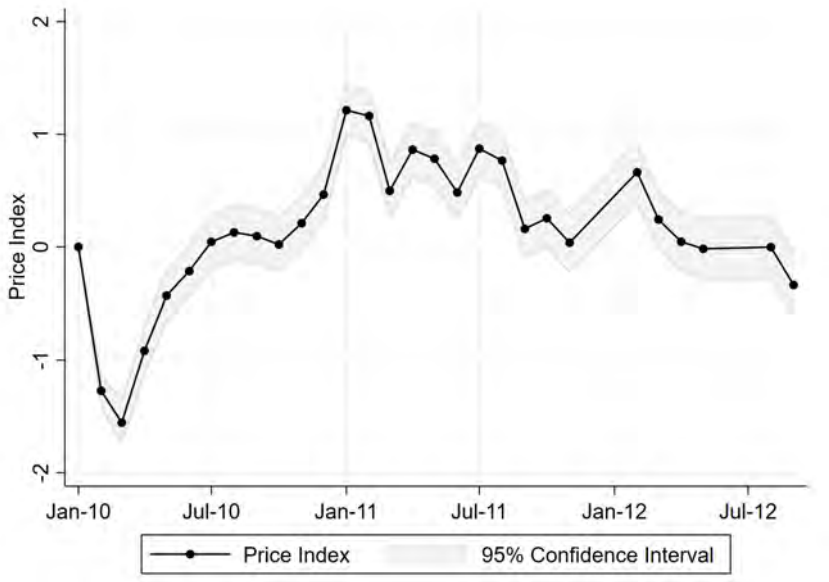
7.1 Indices

Quality-adjusted price index. Estimates of the price index regression (Equation 1) are reported in Table B.4. Using O2 tariffs as a base, we can see that tariffs offered by Three, for example, are 9.3 GBP cheaper ceteris paribus. We also see that compared to a "standard" 24-month contract, shorter commitment periods are associated with higher prices. This corresponds to the discounts offered by operators to consumers who agree to be locked-in. On average, unlimited voice costs 34.6 GBP per month, unlimited SMS 0.34 GBP, and unlimited data 3.12 GBP.[14] Further, different brands of phones are associated with different implicit prices. For example, a tariff bundled with an iPhone will be 3.52 GBP more expensive compared to the same tariff bundled with a Samsung phone. Figure 7 shows the coefficients of the quality-adjusted price index (captured by year-month dummies). Even after controlling for all characteristics, we still observe the inverse U-shape outlined in the previous section.

Differentiation index. Estimation results from the product differentiation index regression (Equation 2) are in Table B.5. This regression includes dyad fixed-effects that capture the distance within and between products offered by operators, with the base category being the distance between O2's products. We obtain positive and significant coefficients for T-mobile, meaning that compared to O2, T-mobile's products are more dissimilar to each other. Conversely, Vodafone's products tend to be more similar to each other. Further, operators are positioned in a specific way vis-à-vis each other, and this is stable over time, as suggested by the significant estimates for the "between-operator fixed effect" coefficients. Some operators position their products particularly far apart from each other. For example, the average distance between products of O2 and T-mobile (0.51) or products from Orange and T-mobile (0.32) is clearly higher than the average distance within products in operators' portfolios. Hence, operators do not occupy exactly the same space, and that is true over the period we observe. Figure 8 plots the product differentiation index over time obtained from our estimation. After con-

[14] These values vary over time – but their average prices are pooled in the estimates for month dummies. These correspond to January 2010 values.

Figure 7: (Quality-adjusted) price index



Note: The coefficients presented in this figure correspond to the year-month dummies included in Equation (1). Both the coefficients and their confidence intervals are obtained from the regression reported in Table B.4.

trolling for time-persistent differences within and across firms, we still observe a clear decline. Superimposing the two indices, the puzzle remains. Indeed, we find that there is no significant correlation (correlation coefficient is -0.26 (not significant at 1%). Therefore, differentiation does not seem to drive the quality-adjusted price evolution observed over the period.

Obfuscation index. The results of our "dominated tariffs" regressions (Equation 3) are presented in Table B.6, where we use a linear probability model in Column 1 and a logit model in Column 2. Results indicate that, compared to O2, tariffs by Orange are less likely to be dominated, while tariffs introduced by Three, T-Mobile, and Vodafone are more likely to be dominated. Further, SIM-only tariffs are less likely to be dominated, not surprisingly given the limited number of attributes they usually include. In particular, these tariffs do not include the handset subsidy dimension, which often renders a tariff dominated. Hence, we expect tariffs with handsets to be dominated more often. Figure 10 plots the obfuscation index obtained in Column 2, i.e., the coefficients for the year-month indicators reported in Table B.6. Again,

Figure 8: Differentiation index

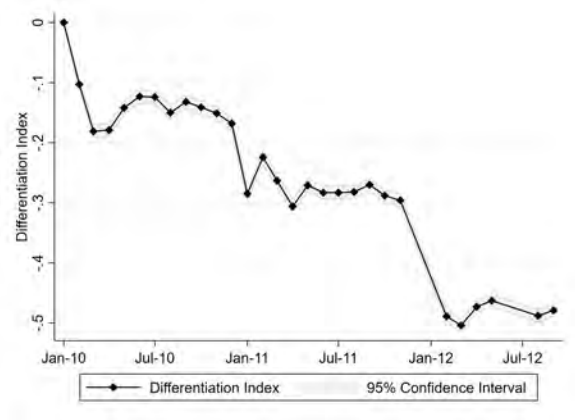
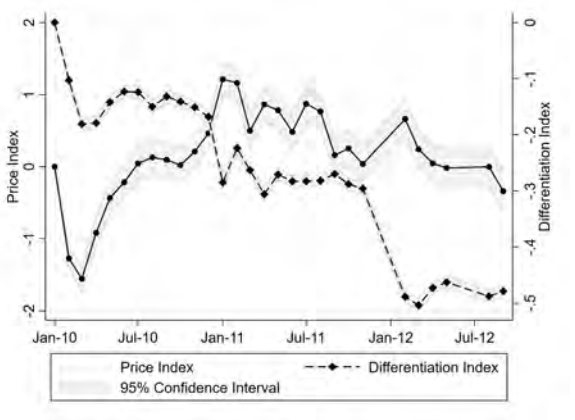


Figure 9: Price and differentiation indices



Notes: Coefficients and confidence intervals presented on Figure 8 are obtained with the regression shown in Table B.5. The correlation coefficient obtained for the price and differentiation indices (presented in Figure 9) is -0.25, insignificant at 5%.

the shape closely resembles the price evolution documented earlier (both average prices and quality-adjusted price index). Figure 11 visually highlights the close correlation over time.

So, what do we conclude at this stage? At first glance, we observe a steady decline in the product differentiation index over time that contradicts the evolution of prices: standard theory would predict that as products get closer to each other in attribute space, that should lead to a steady reduction in quality-adjusted prices. Conversely, the obfuscation index and the time series for the quality-adjusted price index in Figure 11 have very similar shapes and are highly correlated (Pearson's correlation coefficient is 0.48, significant at 1%): Both increase until the beginning of 2011 and then decline. We believe that this co-movement is not by chance and that prices and obfuscation may be part of the same process. The initial increase in dominated tariffs by all mobile operators could simply be the competitive equilibrium outcome at that time. As Gabaix and Laibson (2006) suggest, introducing "shrouded" attributes, or more generally, making it difficult for consumers to pick their optimal product among a multitude of options, can be optimal for competing oligopolists. The subsequent decrease in dominated tariffs from 2011 onward suggests that something triggered a breakdown of this equilibrium.

Anecdotal evidence corroborates this narrative. By 2010, evidence was mounting that consumers in the UK could save money by switching their utility (electricity, gas, or telephone)

Figure 10: Obfuscation index

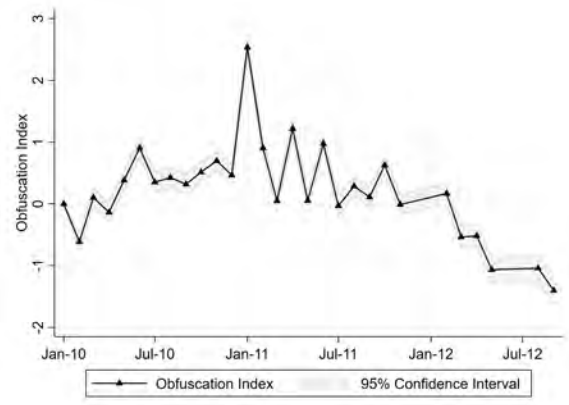
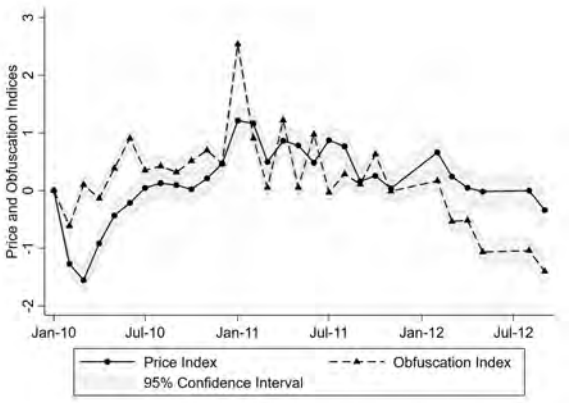


Figure 11: Price and obfuscation indices



Notes: Coefficients and confidence intervals presented on Figure 10 are obtained with the regression shown in Table B.6. The correlation coefficient obtained for the Price and Differentiation Indices (presented in Figure 11) is 0.48, significant at 1%.

supplier. The main concern was that the complexity of tariffs and options available was inhibiting consumers' ability to make the right choices. The regulator for telecommunications (Ofcom), although never intervening directly in any price setting or restricting the types of tariffs that could be offered, strongly supported the idea of making tariff information available so that consumers could calculate savings and make switching easier.[15] The UK government also pushed the "midata" clause into law in 2013 (Halpern, 2015), which required companies to print a QR code on their bills that summarized subscriber details, usage patterns and their current tariff in a machine-readable form, essentially giving access to these data to switching sites and other intermediaries to act on consumers' behalf. Hence, there was growing suspicion from the regulator and the government that a "confusopoly" had been operating in that period, and a belief that this phenomenon was inhibiting the efficient operation of the telecommunications market.

Around the same time, the market also started to respond to these growing concerns. Three, the last operator to enter, and consequently the smallest, introduced a new range of simplified

[15]Genakos et al., (2023) study consumer switching behavior during the same period and show that personalized expert advice facilitates switching, but it is only part of the story and possibly a minor one, as people respond to other behavioral incentives as well.

tariffs and advertised heavily how transparent and simple they were. Specifically, the introduction of the tariff named "The One Plan" by Three around December 2010 may have marked the end of the "confusopoly" period. As Figure 1 shows, the market share of Three steadily increased over time at the expense of Orange and T-Mobile – which, incidentally, were the operators using dominated tariffs most extensively. Hence, the last entrant, Three, behaves differently from the rest of the incumbent players, both in terms of pricing and in terms of tariff clarity, and may have triggered a breakdown of the confusopoly. Interestingly, Bourreau et al. (2021) show that the entry of Free in the French mobile market disrupted tacit collusion, as all three incumbents simultaneously launched low-cost "fighting brands" with SIM-only tariffs – without bundled handsets or long-term commitments – closely matching Free's disruptive offers. Similarly, in our setting, the "move" of a maverick player appears to have destabilized established strategic obfuscation practices and triggered a shift toward greater tariff transparency.

7.2 Additional insights

The following section provides additional insights into the drivers of our findings. In addition to considering alternative explanations – such as merger effects, collusion, and product differentiation – we examine the dynamics of tariff lifecycles and offer preliminary evidence that obfuscation affects not only dominated but also efficient tariffs.

7.2.1 Other factors influencing prices

Impact of the merger. An alternative explanation for the pattern we observe is that the Orange/T-Mobile merger led to increased market concentration, which led to higher prices despite declining product differentiation. While appealing at first glance, this argument is incomplete. First, it is not clear why firms would use obfuscation strategies if competitive pressure was declining due to the merger. Second, it seems counterintuitive that firms will become less differentiated in a market occupied by fewer players. Third, the likely merger effect cannot explain what triggered the second phase of falling prices. Fourth, existing evidence on this particular merger does not support the narrative of a price increase. Indeed, a report by

the European Commission (2017) discusses the Orange/T-Mobile case and assesses the impact of the merger on prices and investments. Using mobile expenditures for different baskets and a difference in difference estimation framework with a group of control countries, the report finds that prices *fell* between 2 and 18% after the merger.

Collusion. Another potential narrative is the existence of a tacit collusive agreement among firms in this market. This market has a number of characteristics that theoretically make it prone to collusion: it is a tight oligopoly with high barriers to entry and product offerings that are highly visible across competitors. Overt collusion on prices would be unlikely, however, given the industry's high visibility and tight regulatory oversight. Firms could instead rely on product proliferation to make it more difficult for consumers to compare prices and quality, thereby softening competition. Along these lines, Hoernig (2002) develops a model in which the proliferation of (efficient) tariffs creates confusion among consumers with limited search capabilities and, in turn, sustains collusion in an imperfectly competitive setting.[16] Although this mechanism is plausible, it cannot fully account for the patterns we observe. In particular, our analysis shows that what mattered was not only the extent of tariff proliferation, but also the nature of the products introduced, with a share of them being dominated.

Obfuscation, the introduction of a shroud of dominated tariffs by all firms in the first part of our data, could be the outcome of firms imitating each other or firms acquiring a mutual understanding that this strategy would be jointly more profitable (tacit collusion). All firms obfuscating make it more difficult for customers to compare and switch providers, which softens competition and leads to higher prices. Is the industry obfuscation equilibrium due to unilateral decisions or coordinated action? Answering this question would require much more detailed inside information of the kind only competition authorities can collect. However, we use our price and obfuscation indices as time series to conduct vector autoregressions and test for Granger causality to explore this possibility to the extent possible with our data. Results are in Tables B.7 and B.8 and show that price increase and obfuscation arise *simultaneously* and do not *cause*

[16] In Hoernig's framework, proliferation and high prices co-occur but can serve different purposes: firms may collude tacitly on maintaining a high average price level while competing for market share through complex menus of tariffs.

each other. In other words, there seems to be no sequence at play, i.e., firms do not obfuscate and *then* raise their prices or the other way round. We conclude, therefore, that obfuscation and price increases are part of a joint strategic process.

Heterogeneous consumer tastes and product variety. One could argue that the price increase we document in this paper is simply explained by the increased variety and differentiation of products responding to consumer tastes. Put differently, the demand side, i.e., changes in preferences, could be the sole driver of our empirical observations rather than a deliberate strategy of firms aiming at confusing them. We believe that this is a plausible argument that is not borne out in our data, however, for several reasons. First, we know that product differentiation in terms of the main tariff attributes (voice, text, and data) has steadily declined over the period, as highlighted in Figure 8. Standard theory predicts that prices and product differentiation move in the same direction. Given that in the first half of the time period studied, they move in opposite directions, tariff differentiation seems an unlikely driver.[17] Second, differentiation (e.g., via exclusivity) in terms of different handsets bundled with the tariffs by mobile operators is equally unlikely to drive our results. Although operators themselves do not decide on the characteristics of the handsets, they choose which brands and handsets to feature and how heavily to subsidize them. Consequently, operators may have differentiated their products through exclusive offerings of specific handsets, which in turn would allow them to raise prices (Sinkinson, 2014). We discussed some aspects of this handset differentiation in our descriptive analysis. However, some additional elements are worth mentioning. At the brand level, operators offered comparable variety in terms of brands, and the brands with the highest market shares (i.e., Apple, Samsung, etc.) were offered by all operators (Figure B.2), reducing the importance of brand exclusivity in our study period.[18] At the brand-model level (i.e., iPhone Apple 4 and 4S, Samsung S3, etc.), the pattern looks similar, with product line length (i.e., number of products)

[17] In additional analyses presented later, we show that controlling for differentiation in a regression setting does not "wipe out" the clear link between price and level of obfuscation at the industry level. Indeed, in Table 4, in Column 4, we add our differentiation measure as an additional regressor to explain tariff prices. Estimation results indicate that the degree of differentiation is negatively related to prices, without qualitatively affecting the role of obfuscation.

[18] Most operators also had their own handset brand, but they always represented a small part of the market.

comparable across operators and covering similar ranges of list prices, which proxy for handset quality (Figure B.3). Again, assessing the product overlap, almost two-thirds of handsets were available from multiple operators, and especially more popular handsets tended to be offered by more than just a single operator (Figure B.4). Therefore, handset exclusivity does not appear to be a widely used differentiation strategy.[19]

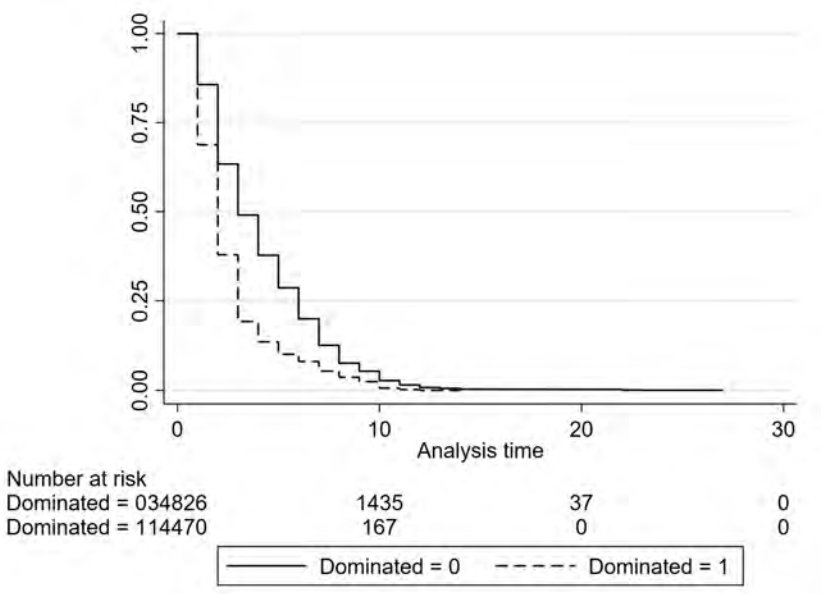
Yet, despite our efforts and the inclusion of every observable characteristic both for the tariffs and the handsets, one could argue that there is still some unobserved component that leads to higher quality-adjusted prices. One such plausible source of unobserved variation in our setting is advertising. Additional analyses presented next suggest that their impact is negligible. Therefore, even though we acknowledge the possibility of some unobserved (to us) characteristics affecting preferences, we find it highly unlikely that consumers' love for variety would change so drastically over the period of these two and a half years to generate the phenomena we observe.

In sum, the alternative explanations we discussed can explain at most part of the pattern, but not all of it. The fact that obfuscation and prices move in such close synchronicity strongly suggests that they are chosen jointly by the firms. Moreover, the strong correlation between prices and obfuscation at the industry level suggests that these parallel movements may have been part of an *industry-wide* process covering *both* strategic variables. Absent an exogenous shock that would facilitate a quasi-experimental research design and applying Occam's razor, we have ruled out a host of plausible alternative explanations, making us confident that obfuscation indeed plays the role we attribute to it, namely that it creates a shroud over the most efficient prices such that even the most competitive price in the industry can be raised.

We next turn to additional evidence that helps characterize the nature of obfuscation strategies themselves. In particular, we investigate whether dominated tariffs differ from efficient ones in their market dynamics and longevity, and whether obfuscation affects not only dominated tariffs but also efficient ones. These analyses provide further insight into how obfuscation is

[19]However, operators may still exploit consumers who purchase "rare" handsets by charging them higher prices. In additional analyses, we show how handset differentiation affects the link between price and level of obfuscation. In regressions based on increasingly restrictive subsamples of tariffs, we find that, even for tariffs with handsets available from all operators, the price premium for dominated tariffs and the role of the "shroud" of dominated tariffs persist in magnitude and significance (Table B.11). In sum, handset selection is not a credible alternative explanation for the link between obfuscation and prices we find.

Figure 12: Survival of efficient and dominated tariffs: Kaplan-Meier Approach



Notes: Sample of 178,160 observations, 49,296 unique tariffs. An exit occurs for a given tariff if it is observed at t and not at $t+1$. We use our main definition of dominated to conduct this analysis.

implemented and how it influences the overall price level.

7.2.2 Introduction and withdrawal of dominated tariffs.

We now explore the introduction and withdrawal of tariffs. We have argued before that it is not costly for operators to bring "new products" to the market. Do dominated tariffs have a similar market lifespan as efficient tariffs? On the one hand, dominated tariffs are more profitable, so that firms may want to keep them on the market for longer. On the other hand, dominated tariffs may be "hit and run" products introduced as part of an obfuscation strategy and then taken off the market more quickly than efficient tariffs.

We ran a survival analysis to see if dominated tariffs differ from efficient ones in their longevity and found that dominated tariffs are withdrawn faster from the market on average (Table B.9). Our results hold whether we use a non-parametric approach (see the Kaplan-Meier curves in Figure 12), a semi-parametric approach (Columns 1-2, Table B.9),[20] and a parametric approach,

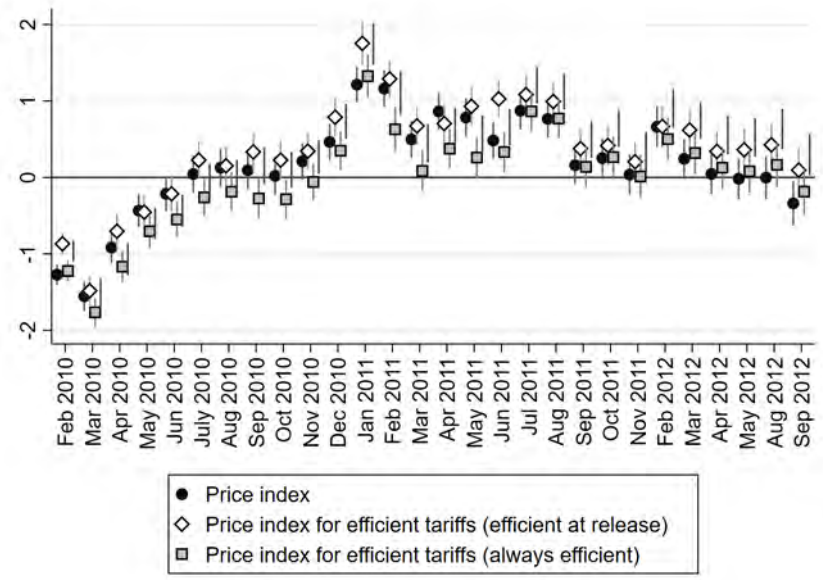
[20]We report these results even though the proportional hazard assumption is violated. See Figure B.5.

using accelerated failure time models (Columns 3-4, Tables B.9 and B.10). Thus, dominated tariffs appear to be strategically different from efficient ones. This could be explained by the fact that they are not introduced as core products of operators' portfolios but rather as "tools" for obfuscation purposes.[21]

7.2.3 Obfuscation and efficient tariffs

Since dominated products are, by definition, more expensive, the price of dominated tariffs might fully drive the market price increase. If firms launch dominated products, they are more expensive by design. We estimate again our price index by considering *only efficient products*. There are two possible ways of defining them: either tariffs that were efficient at release or those that remained efficient throughout their lifespan. We recompute our indices with sub-samples of our original data.

Figure 13: Price indices (all and efficient tariffs)



Note: Coefficients and their 95% confidence intervals are obtained from regressions including all tariffs or the sample of efficient tariffs.

[21]The rationale is that dominated products are likely not created to serve some stable niche markets, satisfying heterogeneous consumers' tastes. If that were the case, we would expect them to be performant (and profitable) and therefore maintained by the operators.

Figure 13 shows that the pattern is visible even for efficient tariffs, regardless of which definition we consider. In the next set of analyses, we focus on how obfuscation influences the overall price level, and more specifically, prices of efficient tariffs.

7.3 Linking prices and obfuscation

While the previous indices describe the evolution of firms' strategies, we also want to explore their potential interdependence. Specifically, we ask if and how the presence of dominated tariffs in the market influences tariff pricing. We now detail our methodology and results and then use them to compute the cost of the *confusopoly* at the industry level over the study period.

The model We estimate the following model for all tariffs i observed in year-month t:

$$Price_{it} = \alpha + \beta ShareDominated_{st} + \gamma X_{it} + \varepsilon_{it}, \tag{4}$$

where $Price_{it}$ denotes the list price in GBP of tariff i available in year-month t. Each tariff belongs to a segment s, which is defined at the market level as either "SIM-only" or "Tariff bundled with a handset". Thus, while tariffs are firm-specific, the segment index covers all operators. $ShareDominated_{st}$ denotes the share of dominated tariffs in segment s at time t. This variable therefore captures a cross-firm, segment-level measure of obfuscation rather than a within-firm share. It allows us to estimate how the prevalence of dominated tariffs in the market as a whole correlates with the prices of all tariffs in the same segment. X_{it} is a vector of controls including handset and tariff characteristics.[22] In one of our specifications, we also include product proliferation and differentiation measures. ε_{it} denotes the error term, assumed normally distributed. We estimate this model using both the entire sample (efficient and dominated tariffs) and only the efficient tariffs to investigate if the presence of dominated tariffs can indirectly raise the prices of all or the efficient tariffs by functioning as a shroud. In other words, because the model controls for whether a tariff is dominated, the coefficient on

[22] In our robustness tests, we also include a linear time trend, and alternatively, operator-specific time trends and operator-segment specific time trends. This lets us capture some unobservable elements that are potentially correlated with price. While multicollinearity with our variable of interest increases, our results remain stable.

$ShareDominated_{st}$ captures the indirect effect of obfuscation on the pricing of other tariffs in the same segment and month. This lets us quantify how the presence of dominated products shifts the overall price level, even for tariffs that remain efficient.

Estimation results Table 2 shows the estimates from Equation 4 using all tariffs (columns 1-3) and only efficient tariffs (columns 4-6). In Column 1, the coefficients of the share of dominated tariffs and the dominated indicator are positive and significant when we control for tariff characteristics and a time trend. This confirms that dominated tariffs were selling at a price premium, as expected, but also that the existence of a share of dominated tariffs was acting as a shroud and was raising the price of all tariffs. In Column 2, both coefficients retain their sign and significance, even after controlling for handset quality through brand-model fixed effects. Column 3 presents the results obtained when we interact all variables with a post-January 2011 indicator, which was the peak of new product releases. Both coefficients are much weaker in the post-confusopoly period.

In columns 4-6, we estimate the same model using only the efficient (i.e., cheapest for a given bundle of attributes) tariffs at release. The specification in Column 4 is similar to Column 1. The dominated indicator is dropped now, as there are only efficient tariffs in this sample. Yet, the coefficient of the share of dominated tariffs is positive and significant. In Column 5, when we add the handset brand-model fixed effects, we find that a 1 percentage point increase in the share of dominated tariffs at the industry level is associated with an additional monthly cost of 0.0270 GBP of efficient tariffs, ceteris paribus.

As shown in Figure 11 presented earlier, both the price and the obfuscation indices reverse in January 2011. As seen in the last column of Table 2, the share of dominated tariffs at the industry level is positively associated with tariff price by 4.39 GBP before January 2011 and only about 1.84 GBP after, a 60% decrease in magnitude. These results confirm the patterns presented earlier and highlight that the confusopoly period was associated with softer competition and significantly higher price premia for both dominated and efficient tariffs, both of which dropped after January 2011.

Table 2: Regression results linking obfuscation and prices

	(1)	(2)	(3)	(4)	(5)	(6)
		All tariffs			**Efficient tariffs**	
Estimation method	OLS	FE	FE	OLS	FE	FE
Dependent variable	$Price_{it}$	$Price_{it}$	$Price_{it}$	$Price_{it}$	$Price_{it}$	$Price_{it}$
Share of dominated tariffs	1.33***	1.15***		2.10***	2.70***	
	(0.16)	(0.14)		(0.21)	(0.19)	
Dominated dummy	1.63***	1.26***				
	(0.06)	(0.06)				
Post=0 × Share of dominated tariffs			4.00***			4.39***
			(0.64)			(0.65)
Post=1 × Share of dominated tariffs			0.58***			1.84***
			(0.17)			(0.27)
Post=0 × Dominated dummy			1.67***			
			(0.10)			
Post=1 × Dominated dummy			0.99***			
			(0.07)			
Observations	184,560	184,560	184,560	140,797	140,797	140,797
R2	0.86	0.88	0.88	0.86	0.88	0.88
SE Clusters	Tariff-level	Tariff-level	Tariff-level	Tariff-level	Tariff-level	Tariff-level
Tariff characteristics	Yes	Yes	Yes (× Post)	Yes	Yes	Yes (× Post)
Handset Fixed Effects	No	Yes	Yes (× Post)	No	Yes	Yes (× Post)
Time trend	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is the list price in GBP of tariff i available in month t. We use a subsample of efficient tariffs (i.e., not dominated) at release in Columns 4, 5, and 6. Tariff characteristics include mobile operator dummies, contract length, SMS, voice, data allowances or unlimited options, dummy for handset subsidy interacted with the amount of subsidy. The Least Squares Dummy Variable (LSDV) approach is used in Columns 2, 3, 5 and 6. The full list of estimates is presented in Table B.14. Standard errors clustered at the tariff level are reported in parentheses below coefficients: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. **Source**: Authors' calculations based on data from BillMonitor, GSMArena, and IDC combined for the UK market between January 2010 and September 2012.

Measuring the cost of obfuscation We combine our estimates with national-level statistics to approximate the confusopoly cost to consumers in the market under consideration. Given that the average share of dominated tariffs is 13% in our sample (ranges between 2.5-56%), the point estimate from Table 2, Column 2, translates to an average price premium of 0.15 GBP over the period (ranging from 0.029 - 0.644 GBP).[23]

[23]The average number of dominated tariffs at the industry level over the period (January 2010 - September 2012) was 13%. Hence, the average price premium is calculated as the estimated coefficient for the share of dominated tariffs from Column 2, Table 2 multiplied by the average number of dominated tariffs during that

With a market of 82 million subscribers between 2010 and 2012 (Ofcom, 2013), of which 41 million are post-paid subscribers, an average churn rate of 13%[24] and an average switching rate within-operator estimated around 31% (See Genakos et al., 2023), we can approximate the number of consumers changing to a new tariff during this period to be between 5.33 and 12.71 million every year (or, between 16 and 38.1 million over the three years). Most of these consumers will sign up for a 24-month contract. Hence, even assuming that all these consumers are going to select an efficient and not a dominated tariff, the extra cost related to obfuscation in this market, paid by all consumers, is between 19.14m to 45.57m GBP per year or between 57.41m to 136.70m GBP over the period 2010-2012.[25] If some consumers select dominated tariffs, the total cost of confusopoly naturally increases, ranging between 105.76 and 251.92m, with only 10% of consumers selecting a dominated product. Table 3 summarizes these calculations.[26]

Table 3: Estimated confusopoly cost 2010-2012 (in millions GBP)

		Number of people switching tariff	
		Low (16m people)	High (38m people)
Share of consumers	0%	57	137
selecting a dominated	5%	82	194
tariff	10%	106	252

Notes: Estimations presented in this table are in millions of GBP. The computation relies on estimated coefficients presented in Table 2, Column 2. A contract length of 24 months is considered in all scenarios.

Other factors influencing prices As previously discussed, several factors influencing prices have to be considered. In additional regressions, we include regressors that capture potential confounders, suggesting the robustness of our estimated price-obfuscation link to alternative

period: $1.15 \times 0.13 = 0.15$.

[24]The churn rate corresponds to the share of consumers who change operators within a year.

[25]Based on industry reports and operators' financial statements, industry-level total profit can be estimated at 12 billion over the period. 60.4 million, the lowest bound of our estimated Confusopoly cost, represents 0.50% of this amount. 259.05 million, our highest estimation, gives 2.15% of the industry profit. This is comparable to the average increase in profit observed after the departure of a non-performing top manager (Denis and Denis, 1995). We detail our assumptions and computation in Section B.6 in Appendix B.

[26]The country level cost of confusopoly between 2010 and 2012 is estimated under two scenarios (Low=16M and High=38M) based on estimations published by Ofcom for consumers that they are "locked in" for 24-month contracts. Hence, when 0% consumers select a dominated tariff, the market-wide cost is between $0.13 \times 1.15 \times 24 \times 16 = 57$m GBP and $0.13 \times 1.15 \times 24 \times 38.1 = 137$m GBP. When 5% consumers select a dominated tariff, the cost increases between $0.05 \times 1.26 \times 24 \times 16 = 24$m and $0.05 \times 1.26 \times 38.1 \times 16 = 58$m GBP, or for 10% consumers between $0.1 \times 1.26 \times 24 \times 16 = 48$m GBP and $0.1 \times 1.26 \times 38.1 \times 16 = 115$m GBP.

explanations.

First, what we call obfuscation might be the outcome of improved opportunities for price discrimination, which could have been triggered by changes in consumer preferences that called for increasingly fine-grained segmentation of the market. Given the introduction and diffusion of new tariff characteristics (data) and new mobile devices (smartphones), one may argue that the coefficient on obfuscation simply captures the general trend of product proliferation, which would be a rational firm's response to consumers' changing needs and tastes. We explore the co-existence of these two elements by adding measures of product proliferation, measured as the total number of tariffs and its growth rate, as additional regressors to our preferred specification. In Columns 2 and 3 of Table 4, we see that the measures of product proliferation are positively correlated with tariff prices. However, they do not wash out the role of obfuscation, which is still positive and significant during the "confusopoly" period. Thus, although obfuscation -the introduction of a shroud of dominated tariffs- naturally goes hand-in-hand with the proliferation of tariffs, the two phenomena play separate roles in explaining industry-level tariff prices. Relatedly, the abundance of tariffs may also reflect experimentation by operators - as they do not know consumer preferences precisely, they would introduce a multitude of tariffs that may, or may not, meet the preferences of diverse segments of consumers. However, even if tariffs were introduced without superior knowledge of consumer preferences, it seems unlikely that operators would introduce dominated tariffs, i.e., ones for which better options are available by the same operator, with virtually identical characteristics. Overall, product proliferation cannot explain, *in itself*, the existence of dominated tariffs. Also, although positively correlated with prices, product proliferation plays only a minor role quantitatively. Finally, the incentives to increase product proliferation do not square with the observed decrease in product differentiation both within and between operators.

Column 4 of Table 4 lets us evaluate the impact of differentiation on prices. Here, we use a measure of distance of a given tariff vis-à-vis the other tariffs available in the same month. Intuitively, one would expect a positive association: a highly differentiated product should face less competitive pressure and thus yield a higher price, whereas a tariff situated in a "crowded"

Table 4: Alternative explanations

	(1)	(2)	(3)	(4)
Estimation method	FE	FE	FE	FE
Dependent variable	$Price_{it}$	$Price_{it}$	$Price_{it}$	$Price_{it}$
	Efficient tariffs Main model	Efficient tariffs Controlling for tariff proliferation	Efficient tariffs Controlling for tariff growth	Efficient tariffs Controlling for differentiation
Post=0 × Share of dominated tariffs	4.39***	2.33***	2.33***	4.36***
	(0.65)	(0.62)	(0.62)	(0.66)
Post=1 × Share of dominated tariffs	1.84***	0.57	0.57	2.18***
	(0.27)	(0.34)	(0.34)	(0.27)
Number of tariffs		0.10***		
		(0.01)		
Growth of number of tariffs			0.20***	
			(0.03)	
Distance with other tariffs				-4.01***
				(0.29)
Observations	140,797	140,797	140,797	140,797
R2	0.88	0.88	0.88	0.88
SE Clusters	Tariff-level	Tariff-level	Tariff-level	Tariff-level
Tariff characteristics	Yes (× Post)	Yes (× Post)	Yes (× Post)	Yes (× Post)
Handset Fixed Effects	Yes (× Post)	Yes (× Post)	Yes (× Post)	Yes (× Post)
Time trend	Yes	Yes	Yes	Yes

Notes: The dependent variable is the list price in GBP of tariff i available in month t. All tariffs are efficient at release (we exclude the dominated tariffs). Tariff characteristics include mobile operator dummies, contract length, SMS, voice, data allowances, or unlimited options, a dummy for handset subsidy interacted with the amount of subsidy. The full list of estimates is presented in Table B.16. Standard errors clustered at the tariff level are reported in parentheses below coefficients: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. **Source**: Authors' calculations based on data from BillMonitor, GSMArena, and IDC, combined for the UK market between January 2010 and September 2012.

area of the attribute space should be cheaper. Empirically, however, we find the opposite: the coefficient on the distance variable is negative and statistically significant, indicating that greater differentiation is associated with lower prices. While this is not the standard result, it can be explained by the fact that we observe a singular pattern for prices, which first increase and then decline, whereas differentiation steadily decreases throughout the entire period.[27] The introduction of this regressor does not wash out the role of obfuscation, which remains positive and significant before and after the "confusopoly" period.

Finally, in our discussion of possible unobserved characteristics of tariffs, we argued that the

[27]The "behavior" of our price and differentiation indices hints at this co-evolution. See Figure 9.

most plausible source of unobserved variation in our data is advertising. As we do not observe product-specific advertising, the best we can do is to introduce more restrictive time trends at the operator and operator-segment levels in our main regression models. Results from these regressions are presented graphically in Figure B.6. None of our previous results change in any fundamental way. Therefore, even though we acknowledge the possibility of some unobserved (to us) characteristics affecting preferences, we find it highly unlikely that consumers' love for variety would change so drastically over the period of these two and a half years to generate the observed phenomena.

8 Robustness and extensions

We now turn to the robustness of our findings and present several extensions. The main conclusions are reported below, with additional supporting evidence provided in the Appendices.

Alternative definitions for dominated tariffs. Dominated products are defined based on assumptions about what is likely observed by consumers, using the way products were displayed and described on the operators' websites between 2010 and 2012. Our main results used the *cost-conscious* consumer definition. Under this definition, we classify as efficient the tariff with the lowest price among all tariffs offered by the same operator with identical SMS, voice, and data allowances, upfront handset cost, handset subsidy (in amount ranges), and contract length. Any tariff that is more expensive than this benchmark is coded as dominated.

We also considered alternative definitions that used fewer or more criteria to reflect lower or higher levels of consumer attention. As shown in Figure A.3, all these measures evolve in a similar fashion over time. For robustness, we conducted our main analysis with two additional definitions. The first is the *brand-loving* consumer definition, which, in addition to SMS, voice, data, and contract length, restricts attention to a specific handset brand and its cost (e.g., "it has to be Samsung"). The second alternative definition is the even more restrictive *handset-obsessed* consumer definition, which further narrows the comparison to a specific brand–model combination (e.g., "I need the new iPhone")."

Table 5: Main price regressions with alternative sample and definitions

	(1)	(2)	(3)	(4)
	Efficient tariffs			
	Efficient Dominated Def. = *Cost-conscious*	Always efficient Dominated Def. = *Cost-conscious*	Efficient Dominated Def. = *Brand-loving*	Efficient Dominated Def. = *Model-obsessed*
Post=0 × Share of dom tariffs	4.39***	5.06***	6.37***	3.84***
	(0.65)	(0.47)	(0.80)	(0.52)
Post=1 × Share of dom tariffs	1.84***	1.54***	1.47***	1.70***
	(0.27)	(0.29)	(0.26)	(0.24)
Observations	140,797	128,896	136,637	153,034
R2	0.88	0.89	0.89	0.88
SE Clusters	Tariff-level	Tariff-level	Tariff-level	Tariff-level
Tariff characteristics	Yes (× Post)	Yes (× Post)	Yes (× Post)	Yes (× Post)
Handset Fixed Effects	Yes (× Post)	Yes (× Post)	Yes (× Post)	Yes (× Post)
Time trend	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Figure B.7 in Appendix B presents the coefficients obtained with all definitions. The full list of estimates is presented in Table B.15. The number of observations varies because the sample considered (efficient tariffs) depends on the definition of a dominated tariff considered. "Efficient" means efficient at release.

Table 5 presents the results for our regression of efficient tariffs for "always efficient tariffs" (i.e., tariffs that were efficient throughout their lifetime) or alternative definitions of dominated tariffs. Column 1 corresponds to Model 6 in Table 2. Column 2 corresponds to results obtained with a sample of *always efficient* tariffs, i.e., tariffs that remained non-dominated over their whole life span. Columns 3 and 4 show the coefficients of interest if we consider the *brand-loving* or *model-obsessed* definitions, respectively. We also estimated our main model using all definitions of dominated presented in Figure A.3. The coefficients are presented in Figure B.7. These results highlight the robustness of our main specification, even though the magnitude of the coefficient varies across models.

Handset exclusivities. As discussed to some extent in Section 7.2.1, differentiation in the handset dimension could result in the enhanced market power of some operators, which in turn increases the price of their tariffs. We already documented in our descriptive statistics that this is unlikely. In further regression analyses, we find that exclusivities also cannot explain the price pattern we observe. Indeed, we show in Figures B.2 and B.4 that the high-demand products

(i.e., those with a large market share) are, to a large extent, offered by all operators - or at least two of them - ruling out the market power over consumers stemming from exclusive device offerings. We also show, in Table B.11, how our results evolve if we exclude tariffs with handsets that are exclusive to a single operator. Our results remain very stable.

Comparing tariffs with handsets and SIM-only tariffs. Our main analyses uncovered the existence of obfuscation strategies and their association with higher tariff prices. We ruled out several plausible alternative explanations and now want to provide additional insights on *how* firms actually implement obfuscation strategies. Specifically, we expect the most "complex contracts" to be particularly obfuscation-prone. In our setting specifically, we believe that the bundling of tariffs with handsets introduces complexity that makes comparison particularly challenging for consumers. Therefore, we expect to observe obfuscation mostly with tariffs bundled with handsets. Our main dataset includes a sample of SIM-only tariffs (i.e., tariffs without handset associated) that we can use to empirically illustrate the likely mechanism of obfuscation. By estimating price and obfuscation indices for these tariffs, we find a very different pattern for both quality-adjusted prices and obfuscation levels (Figures B.8 and B.9). The result is not unexpected as SIM-only tariffs usually include a limited number of (easily observable) attributes, most notably no handset subsidy, which is often the dominated part of a tariff. Hence, the obfuscation we document in this paper is entirely driven by tariffs bundled with handsets, which represented the dominant market segment in our sample period (around 83% in the UK, Ofcom, 2011; OECD, 2013).

Heterogeneity across operators. Can the phenomenon be driven by one or two operators? Separating our indices by operator indicates that the trends observed at the aggregate level largely hold for all players in the industry (Figures B.10 and B.11). Table B.13 also shows a strong correlation between industry-level outcomes and operator-level outcomes (prices and obfuscation). The quality-adjusted price index and the obfuscation index of each operator follow the industry-wide pattern of an increase and then decrease (albeit less precisely) - save for Three, which decreased its prices between the summers of 2010 and 2011. This corroborates that Three

was the "maverick" firm behaving differently from the rest of the firms.

9 Discussion and conclusion

We documented the evolution of prices and dominated tariffs in the UK mobile phone market between January 2010 and September 2012. We define the level of obfuscation in the industry as the share of dominated tariffs in the market and find close co-movement between the tariffs' prices and the level of obfuscation. Thus, it appears that firms introduce a shroud of products to make it harder for consumers to pick their best alternative and to relax competition that way. We document this industry-wide pattern which was only reversed when Three, the smallest and youngest operator in the market, started offering "The One Plan", a tariff explicitly marketed as transparent and easy to understand, which simultaneously made it harder for operators to maintain obfuscation as an industry equilibrium and it created a transparent outside option for consumers, which eroded the operators' bargaining power vis-a-vis consumers. Employing a forensic approach, we look for alternative explanations and proceed to rule out changing tariff and handset characteristics as well as product proliferation or product differentiation as alternative channels, and find that strategic obfuscation was especially prevalent for tariffs with less salient attributes (those bundling a tariff with a handset) and that dominated tariffs tend to be short-lived compared to efficient tariffs, consistent with the intuition that their introduction follows different strategic considerations than for efficient ones. Prior work on the topic has highlighted that this is theoretically possible. We provide evidence that this can be a viable industry equilibrium.

Clearly, some caveats are in order. First, we do not observe consumer choices, just firm offerings. Nevertheless, the existence and persistence of obfuscated tariffs suggest that they must have attracted at least some consumers. Second, our obfuscation measure may be imprecise. However, we see the same pattern for more and less stringent definitions. Third, and most importantly, we document the evolution of price and obfuscation over a limited time. Confounding factors or industry events could blur the link we posit or even account for the co-movement through an alternative channel. Most notably, the merger of two large players may have driven

prices up initially. However, applying Occam's Razor, our candidate explanation needs just two assumptions (firms introduce tariffs to obfuscate, and the smallest firm had the least to gain from the obfuscation regime) to explain the evolution of prices. Statements by policymakers and industry participants support the view that obfuscation is indeed a deliberate strategy chosen by firms in this industry. Our data does not let us make a causal statement of the kind "obfuscation leads to higher prices": prices and the share of dominated tariffs are both choice variables by the firm, and the ease of launching and terminating tariffs makes it impossible to establish a temporary chain of events to establish causality. However, based on our descriptive and econometric evidence, we can confidently state that "obfuscation and higher prices go hand in hand".[28]

Our study offers suggestive evidence of strategic behavior that has largely gone unnoticed by scholars: Product choices in multiproduct firms have been studied from the perspective of firm resources (Barroso and Giarratana, 2013; Chatterjee and Wernerfelt, 1991) and from a market-based perspective (Sorenson, 2000), but the motivation of firms to create a shroud, or thicket, of products to reduce price pressures and to keep prices high is rarely discussed. Studying how firms identify their ability to obfuscate and how they implement it in practice in a causal setting would be very promising. For example, the introduction of labeling or transparency requirements would allow for studying the causal effect of obfuscation and transparency on performance. The dearth of research on obfuscation strategies offers many avenues for future work.

Some recent regulatory statements underscore the continued relevance of obfuscation strategies. In September 2018, the UK national telecommunications regulator Ofcom published a proposal to promote "clear and fair handset charges for mobile users" suggesting that the lack of transparency for mobile consumers is still a concern. In their press release, they cite requiring the operators to "break down the cost of the different parts of the mobile package" as one way to increase transparency.[29] With the current deployment of 5G networks and the imminent

[28] This is in line with the findings by Dushnitzky et al., (2022), who identify "bundles" of strategic choices that are likely to be used jointly because they reinforce each others' effectiveness.

[29] Ofcom's statement reads: "We are also concerned that, when a mobile customer signs up for a bundled contract, providers are not transparent about the respective costs of the handset and the airtime. This means customers cannot tell how much they are paying for the different parts of their deal. We think this is unacceptable. Consumers should be able to clearly identify the goods and services they are paying for, so they can make an informed decision about what to buy."

commercial launch of new services, which will require consumers to equip themselves with new, compatible devices, operators may be drawn to similar strategies again.

Obfuscation strategies are feasible and profitable in markets with complex contracts (or products) and low cost of product introduction. Interestingly, the expectation that the internet and digital sales will trigger an increase in transparency through the reduction in search costs (Goldfarb and Tucker, 2019) may be offset by the ease with which firms introduce variants of their products, creating confusion or fatigue among consumers. More generally, we document how firms in competitive markets with homogeneous and mature technology may still use innovative strategies to keep the market from becoming perfectly competitive. We also add to the literature analyzing firm strategies to exploit search costs and the bounded rationality of consumers, even in highly populated product markets. To conclude, while we cannot claim to have answered all questions about obfuscation strategies and their impact, our forensic study is one of the first to identify, operationalize, and analyze them in oligopolistic markets. We hope that documenting this phenomenon will inspire follow-up research on this frequently "hidden" part of firm strategy.

References

Allender, W. J., Liaukonyte, J., Nasser, S., & Richards, T. J. (2021). Price fairness and strategic obfuscation. *Marketing Science*, 40(1), 122-146.

Barroso, A., & Giarratana, M. S. (2013). Product proliferation strategies and firm performance: The moderating role of product space complexity. *Strategic Management Journal*, 34(12), 1435-1452.

Bayus, B. L., & Putsis Jr, W. P. (1999). Product proliferation: An empirical analysis of product line determinants and market outcomes. *Marketing Science*, 18(2), 137-153.

Bernhardt, D., Constantinou, E., & Shadmehr, M. (2022). When do Co-located Firms Selling Identical Products Thrive?. *The Journal of Industrial Economics*, 70(3), 565-590.

Berry, S. T., & Waldfogel, J. (2001). Do mergers increase product variety? Evidence from radio broadcasting. *The Quarterly Journal of Economics*, 116(3), 1009-1025.

Blake, T., Moshary, S., Sweeney, K., & Tadelis, S. (2021). Price salience and product choice. *Marketing Science*, 40(4), 619-636.

Bourreau, M., Sun, Y., & Verboven, F. (2021). Market entry, fighting brands and tacit collusion: the case of the French mobile telecommunications market. *American Economic Review*, 111(11), 3459-99.

Brown, J., Hossain, T., & Morgan, J. (2010). Shrouded attributes and information suppression: Evidence from the field. *The Quarterly Journal of Economics*, 125(2), 859-876.

Carlin, B. I. (2009). Strategic price complexity in retail financial markets. *Journal of Financial Economics*, 91(3), 278-287.

Célérier, C., & Vallée, B. (2017). Catering to investors through security design: Headline rate and complexity. *The Quarterly Journal of Economics*, 132(3), 1469-1508.

Chatterjee, S., & Wernerfelt, B. (1991). The link between resources and type of diversification: Theory and evidence. *Strategic Management Journal*, 12(1), 33-48.

Chiles, B. (2021). Shrouded prices and firm reputation: evidence from the US hotel industry. *Management Science*, 67(2), 964-983.

Chioveanu, I., & Zhou, J. (2013). Price competition with consumer confusion. *Management Science*, 59(11), 2450-2469.

Corrocher, N. & Zirulia, L. (2010). Demand and innovation in services: The case of mobile communications. *Research Policy*, 39(7), 945-955.

Cullen, J., & Shcherbakov, O. (2010). Measuring consumer switching costs in the wireless industry. *Working paper*.

D'Aspremont, C., Gabszewicz, J. J., & Thisse, J. F. (1979). On Hotelling's "Stability in competition". *Econometrica*, 47(5), 1145-1150.

DellaVigna, S., & Malmendier, U. (2006). Paying not to go to the gym. *American Economic Review*, 96(3), 694-719.

DellaVigna, S. (2009). Psychology and economics: Evidence from the field. *Journal of Economic Literature*, 47(2), 315-72.

Denis, D. J., & Denis, D. K. (1995). Performance changes following top management dismissals. *The Journal of Finance*, 50(4), 1029-1057.

Diamond, P. A. (1971). A model of price adjustment. *Journal of Economic Theory*, 3(2), 156-168.

Diehl, K., & Poynor, C. (2010). Great expectations?! Assortment size, expectations, and satisfaction. *Journal of Marketing Research*, 47(2), 312-322.

Draganska, M. & Jain, D. C. (2005). Product line length as a competitive tool. *Journal of Economics & Management Strategy*, 14(1), 1-28.

Dudey, M. (1990). Competition by choice: The effect of consumer search on firm location decisions. *American Economic Review*, 80(2), 1092-1104.

Dushnitsky, G., Piva, E., & Rossi-Lamastra, C. (2022). Investigating the mix of strategic choices and performance of transaction platforms: Evidence from the crowdfunding setting. *Strategic Management Journal*, 43(3), 563-598.

Ellison, G. (2005). A model of add-on pricing. *The Quarterly Journal of Economics*, 120(2), 585-637.

Ellison, G., & Ellison, S. F. (2009). Search, obfuscation, and price elasticities on the internet. *Econometrica*, 77(2), 427-452.

Ellison, G., & Ellison, S. F. (2018). Search and obfuscation in a technologically changing retail environment: Some thoughts on implications and policy. *Innovation Policy and the Economy*, 18(1), 1-25.

Ellison, G., & Wolitzky, A. (2012). A search cost model of obfuscation. *The RAND Journal of Economics*, 43(3), 417-441.

European Commission (2007). An Analysis of the Issue of Consumer Detriment and the Most Appropriate Methodologies to Estimate It. Europe Economics, *Report for the European Commission*.

European Commission (2017). Study on measuring consumer detriment in the European Union. Technical report, Civic Consulting. *Report for the European Commission*.

Fan, Y., & Yang, C. (2020). Competition, product proliferation, and welfare: A study of the US smartphone market. *American Economic Journal: Microeconomics*, 12(2), 99-134.

Gabaix, X., & Laibson, D. (2006). Shrouded attributes, consumer myopia, and information suppression in competitive markets. *The Quarterly Journal of Economics*, 121(2), 505-540.

Gavazza, A. (2011). Demand spillovers and market outcomes in the mutual fund industry. *The RAND Journal of Economics*, 42(4), 776-804.

Genakos, C., Roumanias, C. & Valletti, T. (2023). Is having an expert "friend" enough? An analysis of consumer switching behaviour in mobile telephony. *Journal of Economic Behavior & Organization*, 213, 359-372.

Giachetti, C., & Dagnino, G. B. (2014). Detecting the relationship between competitive intensity and firm product line length: Evidence from the worldwide mobile phone industry. *Strategic Management Journal*, 35(9), 1398-1409.

Goldfarb, A., & Tucker, C. (2019). Digital Economics. *Journal of Economic Literature*, 57(1), 3-43.

Götz, G., & Gugler, K. (2006). Market concentration and product variety under spatial competition: Evidence from retail gasoline. *Journal of Industry, Competition and Trade*, 6(3/4), 225-234.

Griliches, Z. (1961). Hedonic price indexes for automobiles: An econometric of quality change. In *The price statistics of the federal government* (pp. 173-196).

Grzybowski, L., & Liang, J. (2015). Estimating demand for fixed-mobile bundles and switching costs between tariffs. *Information Economics and Policy*, 33, 1-10.

Grubb, M. D. (2009). Selling to overconfident consumers. *American Economic Review*, 99(5), 1770-1807.

Grubb, M. D., & Osborne, M. (2015). Cellular service demand: Biased beliefs, learning, and bill shock. *American Economic Review*, 105(1), 234-271.

Gu, Y., & Wenzel, T. (2014). Strategic obfuscation and consumer protection policy. *The Journal of Industrial Economics*, 62(4), 632-660.

Halpern, D. (2015). Inside the nudge unit: How small changes can make a big difference. Published by *Random House*.

Hoernig, S. (2002). Collusion and Confusion. Working paper.

Hotelling, H. (1929). Stability in Competition. *The Economic Journal*, 39(153), 41-57.

Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing?. *Journal of Personality and Social Psychology*, 79(6), 995.

Janssen, A., & Kasinger, J. (2024). Obfuscation and rational inattention. *The Journal of Industrial Economics*, 72(1), 390-428.

Jin, G. Z., Luca, M., & Martin, D. (2022). Complex disclosure. *Management Science*, 68(5), 3236-3261.

Ketcham, J. D., Lucarelli, C., Miravete, E. J., & Roebuck, M. C. (2012). Sinking, swimming, or learning to swim in Medicare Part D. *American Economic Review*, 102(6), 2639-73.

Koski, H., & Kretschmer, T. (2007). Innovation and dominant design in mobile telephony. *Industry and Innovation*, 14(3), 305-324.

Lambrecht, A., & Skiera, B. (2006). Paying too much and being happy about it: Existence, causes, and consequences of tariff-choice biases. *Journal of Marketing Research*, 43(2), 212-223.

Lambrecht, A., Seim, K., & Skiera, B. (2007). Does uncertainty matter? Consumer behavior under three-part tariffs. *Marketing Science*, 26(5), 698-710.

Lancaster, K. (1990). The economics of product variety: A survey. *Marketing science*, 9(3), 189-206.

Lear, DIW Berlin & Analysys Mason. (2017). Economic impact of competition policy enforcement on the functioning of telecoms markets in the EU. *Report for the European Commission*.

MacMillan, I., McCaffery, M. L., & Van Wijk, G. (1985). Competitors' responses to easily imitated new products—Exploring commercial banking product introductions. *Strategic Management Journal*, 6(1), 75-86.

Miravete, E. J. (2009). Competing with menus of tariff options. *Journal of the European Economic Association*, 7(1), 188-205.

Miravete, E. J. (2013). Competition and the use of foggy pricing. *American Economic Journal: Microeconomics*, 5(1), 194-216.

Petrikaitė, V. (2018). Consumer obfuscation by a multiproduct firm. *The RAND Journal of Economics*, 49(1), 206-223.

Piazzai, M. & Wijnberg, N. M. (2019). Product Proliferation, Complexity, and Deterrence to Imitation in Differentiated? Product Oligopolies. *Strategic Management Journal*, 40(6), 945-958.

Putsis Jr, W. P. & Bayus, B. L. (2001). An empirical analysis of firms' product line decisions. *Journal of Marketing Research*, 38(1), 110-118.

Richards, T. J., Allender, W. J. & Hamilton, S. F. (2013). Rivalry in price and location by differentiated product manufacturers. *American Journal of Agricultural Economics*, 95(3), 650-668.

Richards, T. J., Klein, G. J., Bonnet, C., & Bouamra-Mechemache, Z. (2019). Strategic obfuscation and retail pricing. *Review of Industrial Organization*, 1-31.

Schmalensee, R. (1978). Entry deterrence in the ready-to-eat breakfast cereal industry. *The Bell Journal of Economics*, 305-327.

Seim, K., Vitorino, M. A., & Muir, D. M. (2017). Do consumers value price transparency? *Quantitative Marketing and Economics*, 15, 305-339.

Sinkinson, M. (2014). Pricing and entry incentives with exclusive contracts: Evidence from smartphones. *Working paper*.

Sorenson, O. (2000). Letting the market work for you: An evolutionary perspective on product strategy. *Strategic Management Journal*, 21(5), 577-592.

Spiegler, R. (2006). Competition over agents with boundedly rational expectations. *Theoretical Economics*, 1(2), 207-231.

Spiegler, R. (2011). Bounded rationality and industrial organization. United Kingdom, *Oxford: Oxford University Press*.

Spiegler, R. (2016). Choice complexity and market competition. *Annual Review of Economics*, 8(1), 1-25.

Stahl, K. (1982). Differentiated products, consumer search, and locational oligopoly. *The Journal of Industrial Economics*, 31(1/2), 97-113.

Stern, I., & Henderson, A. D. (2004). Within-business diversification in technology-intensive industries. *Strategic Management Journal*, 25(5), 487-505.

Suarez, F. F., & Utterback, J. M. (1995). Dominant designs and the survival of firms. *Strategic Management Journal*, 16(6), 415-430.

Swaminathan, A. (1998). Entry into new market segments in mature industries: endogenous and exogenous segmentation in the U.S. brewing industry, *Strategic Management Journal*, 19(4), 389-404.

Sweeting, A. (2010). The effects of mergers on product positioning: evidence from the music radio industry. *The RAND Journal of Economics*, 41(2), 372-397.

Wilson, C. M. (2010). Ordered search and equilibrium obfuscation. *International Journal of Industrial Organization*, 28(5), 496-506.

Zia, M., & Kuksov, D. (2025). Consumer search and product line length: The role of the consumer-product fit distribution. *Marketing Science*, 44(4), 802-819.

Appendices

A Definition of key variables

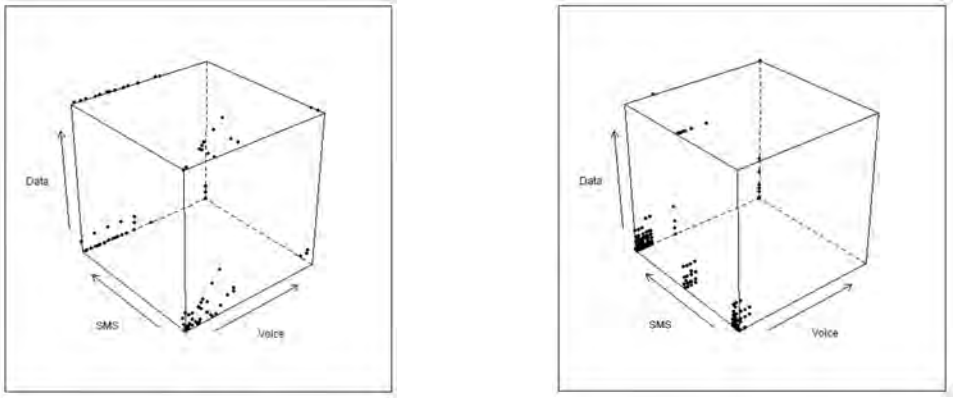
A.1 Differentiation of tariffs: computation of pairwise distances

Given the low cost of introducing a new tariff for mobile operators, we monitor the evolution of the number of products (typically a combination of handset and mobile services) available in the market. While this gives us some insights into the number of options faced by consumers and the potential proliferation strategies used by firms, it cannot properly capture the degree of differentiation of products available on the market. Indeed, a large number of products does not necessarily translate into a high degree of differentiation. A first, simple way to get an idea of the industry trend is to look at the location of products in the attribute space. As an illustration, Figure A.1 provides a 3D representation of product location at the beginning and the end of our study.[30] We observe that products offered by firms are positioned much closer to each other at the end of the focal time period. We introduce both variables (number of products and distances) in our robustness tests to control for the influence of proliferation and the variety of tariffs on their prices.

[30] Points are not proportional to the number of products located at this position.

Figure A.1: Products in the attribute space

January 2010 September 2012



Note: Each dot represents the position of one (or several) tariff(s) in the attribute space. Each cube represents all the tariffs available in the focal month. Some tariffs overlap because they include exactly the same allowances of voice, SMS, and data.

We measure the level of differentiation of tariffs in the market by computing the Euclidean distance between each tariff pair available on the market in a given month. Excluding different handset models and defining our tariffs as a combination of network, contract length, and allowances, we have 10,477 observations with 1,306 unique tariffs. We use this dataset to compute the distance between tariffs — we do not account for handsets in this case. This eventually gives 1,978,742 pairs of tariffs.

Because the allowances have different measures (SMS are counted in units, voice in minutes, and data in GB) and some tariffs include one or more flat-rates (i.e., unlimited units of SMS, voice and/or data)[31], we normalize the allowances using the following formula:

$$z_i = \frac{x_i - min(x)}{max(x) - min(x)}$$

The normalized allowances take a value between 0 and 1, 0 corresponding to no allowance and 1 to unlimited allowance. Then, for each pair of tariffs i and j observed in month t and for an

[31]Flat rates are originally coded with an arbitrary value that is set at 10 000.

attribute $k \in \{data, voice, SMS\}$, we compute the following:

$$distance_{kijt} = (k_{it} - k_{jt})^2$$

Finally, we obtain our product differentiation measure by computing the following:

$$distance_{ijt} = \sum_{k=1}^{K} (k_{it} - k_{jt})^2$$

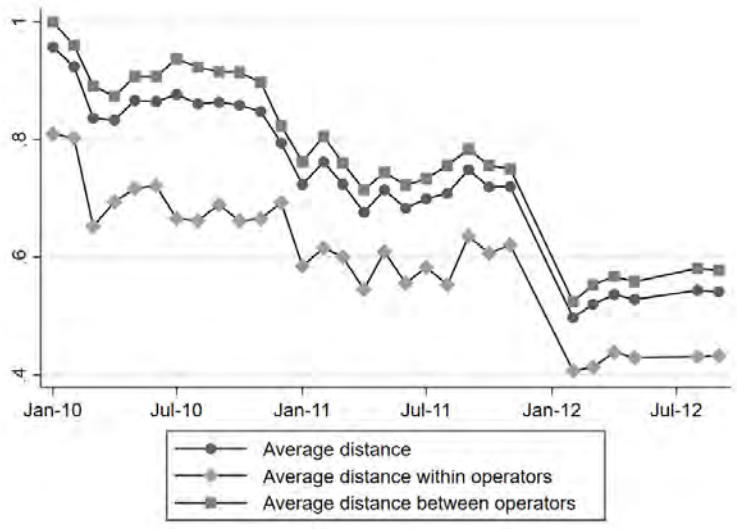
This measure captures how tariffs are positioned relative to each other in the attribute space, including the allowances of SMS, voice, and data. Table A.1 shows descriptive statistics on the pairwise distance ranging between 0 and 3.[32] For example, a tariff with no allowance at all will have a pairwise distance of 3 with a tariff with unlimited voice, text and data – while the distance will be 2 for a tariff with unlimited voice and text and no data at all.

Table A.1: Descriptive statistics on the distances (pairwise observations)

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Distance (SMS, voice, data)	0.70	0.64	0	3
Distance SMS	0.41	0.44	0	1
Distance voice	0.09	0.25	0	1
Distance data	0.2	0.38	0	1
N		1,978,742		

[32]The maximum distance between two tariffs in each of the dimensions (SMS, voice, data) is 1, the maximum overall distance is 3.

Figure A.2: Evolution of pairwise distance at the industry level



A.2 Definition of dominated tariffs

Measuring dominated tariffs and obfuscation. Consumers selecting a tariff in this environment have to choose from a mobile operator a contract of a certain length that combines a number of texts, volume of data, minutes of call (both on-net and off-net), volume of mixed allowance, as well as the handset brand and model. The size of the choice set is potentially very large, given all the possible combinations, so consumers have to perform a complex computation to find the cheapest option. Moreover, some tariff characteristics might be more salient depending on how they are positioned on the firm's website or catalogue, while others require sophisticated calculations. For example, computing the level of handset subsidy requires the consumer to find the list price of the phone,[33] so comparing subsidies across tariffs requires some serious research effort. While some consumers undoubtedly can perform such a complex choice selection, most consumers would restrict their attention to a limited number of the above characteristics to make their choice, which is how the obfuscation strategy of firms can unfold.

To uncover the existence and magnitude of obfuscation strategies in this market, we construct an aggregate measure, *dominated tariffs*. We define "dominated" tariffs using the following rules: (i) for a given combination of attributes, we identify the cheapest option by an operator (we

[33]The difference between the phone's list price and its upfront price for the consumer constitutes the subsidy.

call this the "efficient" tariff), and (ii) we code as "dominated" all other tariffs by the operator offering the same combination of attributes (plus potentially other characteristics that are not the focus) at a higher price. We analyze three consumer-focused definitions to proxy for different levels of attention.[34] First, *cost-conscious consumers* consider all tariffs from an operator with the same allowances for SMS, voice, data, upfront handset cost, handset subsidy (in amount ranges), and contract length. Second, *brand-loving consumers* are, on top of the allowances of SMS, voice, data, and contract length, particularly sensitive to a specific handset brand and its cost ("it has to be Samsung"). Third, *handset-obsessed consumers* will, in addition to the allowances of SMS, voice, data, and contract length, only consider a specific brand-model of handset ("I need the new iPhone"). Tables A.2, A.3, and A.4 give one example each for each consumer type, using a slice of our data. All other tariffs by the same operator, sold at a higher price that month, with the same characteristics in focus, are considered dominated.[35]

Our measures of "dominated" tariffs broadly correspond to Miravete's (2013) "fogginess" measure for tariffs in the early cellular telephone industry in the US, but also deviate in important ways. Miravete (2013) covers three-part tariffs, where the allowance (priced $P_{\bar{q}}$) covers a given volume of minutes $\bar{q}$, and the usage price corresponds to a unit price p for all minutes consumed beyond the allowance. A tariff then takes the form $Bill = P_{\bar{q}} + p(min\{0, q - \bar{q}\})$. We do not consider the unit price beyond the allowances in our computation, as we do not have information on actual consumption. However, the tariffs we use include a larger number of attributes, including data, handset cost, subsidy, and contract length, which enter a consumer's utility but are not consumed in a linear fashion. While Miravete simulates usage patterns, we assume that the tariff price (the recurring charge) is the expected bill. The prices we analyze are a lower bound of the actual prices paid by consumers, and the obfuscation we measure takes place at the tariff selection stage prior to consumption. On average, over the period, 15% of the tariffs are dominated.

[34] These definitions are derived from analyzing the way products were organized and presented on operators' websites in our sample period. Documentation that supports these definitions is discussed in Section 6.4.1.

[35] We also consider alternative definitions of "dominated" with fewer or more elements entering the computation to reflect lower or higher levels of attention by consumers. We show, with Figure A.3, that all measures evolve in a similar fashion over time - which is what matters for our obfuscation index.

Share of dominated tariffs at the industry level. By definition, a dominated tariff has a higher price. However, our aim is to examine how the share of dominated tariffs overall correlates with the prices charged for efficient tariffs. That is, we ask how the presence of *dominated* tariffs at the industry level serves as an indirect mechanism to create a "shroud" over the *efficient* tariffs and to raise prices paid by all consumers. To this end, we compute the share of dominated tariffs each month and include it as an explanatory variable in our main regression.

A.3 Dominated tariffs: examples and evolution over time

Table A.2: Example of dominated tariffs (main definition, i.e., *cost-conscious* consumers)

yearmo	tariff id	tariff cost	handset cost	network	sms	voice	data	onnet	mixed	contract length	brand model	handset model	list price	subsidy	group subsidy	min price	dominated (defs)
January 2010	23105	13.5	0	three	0	0	0	300	500	18	SONY ERICSSON	G502	46	46	1	13.5	0
January 2010	23107	13.5	0	three	0	0	0	300	500	18	INQ	INQ1	46	46	1	13.5	0
January 2010	23110	13.5	0	three	0	0	0	300	500	18	INQ	MINI 3G	57	57	1	13.5	0
January 2010	23118	13.5	0	three	0	0	0	300	500	18	HUAWEI	U7510	45	45	1	13.5	0
January 2010	23079	15	0	three	0	0	0	300	300	18	SONY ERICSSON	G502	46	46	1	13.5	1
January 2010	23081	15	0	three	0	0	0	300	300	18	INQ	INQ1	46	46	1	13.5	1
January 2010	23084	15	0	three	0	0	0	300	300	18	INQ	MINI 3G	57	57	1	13.5	1
January 2010	23092	15	0	three	0	0	0	300	300	18	HUAWEI	U7510	45	45	1	13.5	1
January 2010	23131	15.75	0	three	0	0	0	300	700	18	SONY ERICSSON	G502	46	46	1	13.5	1
January 2010	23133	15.75	0	three	0	0	0	300	700	18	INQ	INQ1	46	46	1	13.5	1
January 2010	23136	15.75	0	three	0	0	0	300	700	18	INQ	MINI 3G	57	57	1	13.5	1
January 2010	23144	15.75	0	three	0	0	0	300	700	18	HUAWEI	U7510	45	45	1	13.5	1
January 2010	23157	24	0	three	0	0	0	300	900	18	SONY ERICSSON	G502	46	46	1	13.5	1
January 2010	23159	24	0	three	0	0	0	300	900	18	INQ	INQ1	46	46	1	13.5	1
January 2010	23162	24	0	three	0	0	0	300	900	18	INQ	MINI 3G	57	57	1	13.5	1
January 2010	23170	24	0	three	0	0	0	300	900	18	HUAWEI	U7510	45	45	1	13.5	1
January 2010	23184	27	0	three	0	0	0	300	1100	18	SONY ERICSSON	G502	46	46	1	13.5	1
January 2010	23186	27	0	three	0	0	0	300	1100	18	INQ	INQ1	46	46	1	13.5	1
January 2010	23189	27	0	three	0	0	0	300	1100	18	INQ	MINI 3G	57	57	1	13.5	1
January 2010	23199	27	0	three	0	0	0	300	1100	18	HUAWEI	U7510	45	45	1	13.5	1

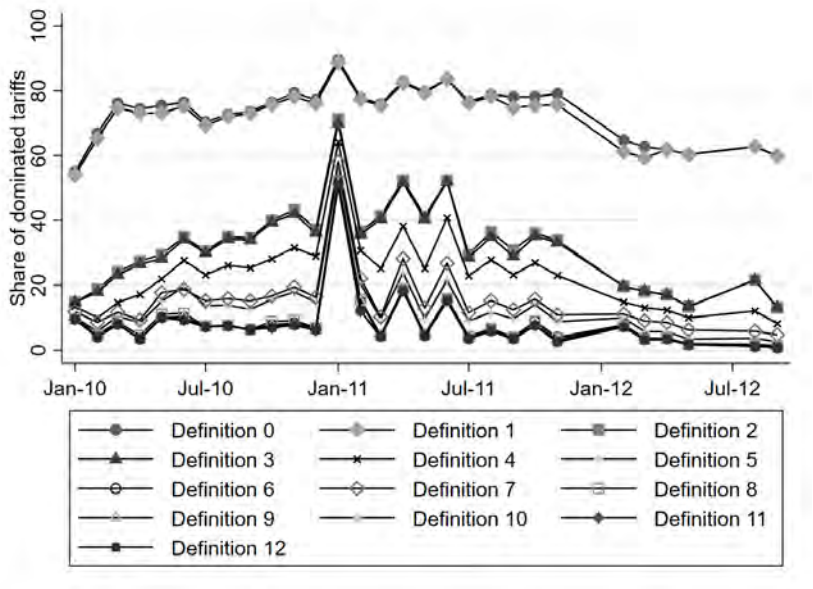
Table A.3: Example of dominated tariffs (*brand-loving* consumers)

yearmo	tariff id	tariff cost	handset cost	network	sms allow	voice allow	data allow	onnet	mixed	contract length	brand model	handset model	list price	subsidy	group subsidy	min price	dominated (def7)
February 2010	26597	40	0	tmobile	0	0	unli	0	1150	18	SAMSUNG	GALAXY I7500	296	296	17	40	0
February 2010	26598	40	0	tmobile	0	0	unli	0	1150	18	SAMSUNG	GENIO TOUCH	110	110	5	40	0
February 2010	26606	40	0	tmobile	0	0	unli	0	1150	18	SAMSUNG	S3100	82	82	2	40	0
February 2010	26607	40	0	tmobile	0	0	unli	0	1150	18	SAMSUNG	S5230 TOCCO LI	114	114	5	40	0
February 2010	26622	50	0	tmobile	0	0	unli	0	1625	18	SAMSUNG	GALAXY I7500	296	296	17	40	1
February 2010	26623	50	0	tmobile	0	0	unli	0	1625	18	SAMSUNG	GENIO TOUCH	110	110	5	40	1
February 2010	26631	50	0	tmobile	0	0	unli	0	1625	18	SAMSUNG	S3100	82	82	2	40	1
February 2010	26632	50	0	tmobile	0	0	unli	0	1625	18	SAMSUNG	S5230 TOCCO LI	114	114	5	40	1
February 2010	26647	60	0	tmobile	0	0	unli	0	2125	18	SAMSUNG	GALAXY I7500	296	296	17	40	1
February 2010	26648	60	0	tmobile	0	0	unli	0	2125	18	SAMSUNG	GENIO TOUCH	110	110	5	40	1
February 2010	26656	60	0	tmobile	0	0	unli	0	2125	18	SAMSUNG	S3100	82	82	2	40	1
February 2010	26657	60	0	tmobile	0	0	unli	0	2125	18	SAMSUNG	S5230 TOCCO LI	114	114	5	40	1
February 2010	26672	75	0	tmobile	0	0	unli	0	2875	18	SAMSUNG	GALAXY I7500	296	296	17	40	1
February 2010	26673	75	0	tmobile	0	0	unli	0	2875	18	SAMSUNG	GENIO TOUCH	110	110	5	40	1
February 2010	26681	75	0	tmobile	0	0	unli	0	2875	18	SAMSUNG	S3100	82	82	2	40	1
February 2010	26682	75	0	tmobile	0	0	unli	0	2875	18	SAMSUNG	S5230 TOCCO LI	114	114	5	40	1
February 2010	26697	100	0	tmobile	0	0	unli	0	3875	18	SAMSUNG	GALAXY I7500	296	296	17	40	1
February 2010	26698	100	0	tmobile	0	0	unli	0	3875	18	SAMSUNG	GENIO TOUCH	110	110	5	40	1
February 2010	26706	100	0	tmobile	0	0	unli	0	3875	18	SAMSUNG	S3100	82	82	2	40	1
February 2010	26707	100	0	tmobile	0	0	unli	0	3875	18	SAMSUNG	S5230 TOCCO LI	114	114	5	40	1

Table A.4: Example of dominated tariffs (*model-obsessed* consumers)

yearmo	tariff id	tariff cost	handset cost	network	sms allow	voice allow	data allow	onnet	mixed	contract length	brand model	handset model	list price	subsidy	group subsidy	min price	dominated (def10)
May 2010	23345	16	0	three	0	0	unli	0	100	24	NOKIA	2730	82	82	2	16	0
May 2010	23373	17	0	three	0	0	unli	0	100	24	NOKIA	2730	82	82	2	16	1
May 2010	23425	18	0	three	0	0	unli	0	300	24	NOKIA	2730	82	82	2	16	1
May 2010	23451	19	0	three	0	0	unli	0	300	24	NOKIA	2730	82	82	2	16	1
May 2010	23514	23	0	three	0	0	unli	0	500	24	NOKIA	2730	82	82	2	16	1
May 2010	23540	24	0	three	0	0	unli	0	500	24	NOKIA	2730	82	82	2	16	1
May 2010	23599	26	0	three	0	0	unli	0	900	24	NOKIA	2730	82	82	2	16	1
May 2010	23625	27	0	three	0	0	unli	0	900	24	NOKIA	2730	82	82	2	16	1

Figure A.3: Share of dominated tariffs according to various definitions



To create the obfuscation index, we define which tariffs are dominated. Because we are facing particularly complex combinations of attributes, we have considered several definitions for a dominated tariff, described below:

Handset is ignored

- Definition 0: Operator, allowances of SMS, voice, and data are the same.
- Definition 1: Operator, allowances of SMS, voice, data, and on-net calls are the same.
- Definition 2: Operator, allowances of SMS, voice, data, and contract length are the same.
- Definition 3: Operator, allowances of SMS, voice, data, contract length, and on-net calls are the same.
- Definition 4: Operator, allowances of SMS, voice, data, contract length, and handset cost are the same.
- **Definition 5**: Operator, allowances of SMS, voice, data, contract length, handset cost, and level of handset subsidy are the same. Main definition for *Cost-conscious consumers*.
- Definition 6: Operator, allowances of SMS, voice, data, contract length, handset cost, and exact amount of handset subsidy are the same.
- **Definition 7**: Operator, allowances of SMS, voice, data, contract length, brand, and handset cost are the same. Main definition for *Brand-loving consumers*.
- Definition 8: Operator, allowances of SMS, voice, data, on-net calls, contract length, brand, handset cost, and level of handset subsidy are the same.
- Definition 9: Operator, allowances of SMS, voice, data, on-net calls, contract length, brand, handset cost, and exact amount of handset subsidy are the same.
- **Definition 10**: Operator, allowances of SMS, voice, data, on-net calls, contract length, handset model, and handset cost are the same. Main definition for *Model-obsessed consumers*.
- Definition 11: Operator, allowances of SMS, voice, data, on-net calls, contract length, handset model, handset cost, and level of handset subsidy are the same.
- Definition 12: Operator, allowances of SMS, voice, data, on-net calls, contract length, handset model, handset cost, and exact amount of handset subsidy are the same.

Groups of handset subsidies are defined based on 20 quantiles of the subsidy distribution. Group 0 corresponds to no subsidy at all. Our preferred definition (used in the analysis) is Definition 5. We also use definitions 7 (*brand-loving)* and 10 (*model-obsessed*).

B Additional descriptive statistics and results

B.1 Additional descriptive statistics

Table B.1: Descriptive statistics on tariffs (per operator)

	Tariff cost	Handset cost	Contract length	SIM-only	Voice	SMS	Data	On-net allowance	Mixed allowance	Unlimited voice	Unlimited SMS	Unlimited data	Unlimited on-net
O2	37.92	24.64	20.58	0.02	508	65	338	1.57	0.00	0.14	0.85	0.07	0.10
Orange	32.58	33.68	21.04	0.02	664	79	309	0.00	0.00	0.00	0.74	0.09	0.00
Three	23.07	16.10	22.57	0.03	534	2912	347	1147	137.95	0.00	0.16	0.37	0.16
Tmobile	27.92	63.90	20.77	0.01	554	291	126	0.00	4.68	0.02	0.28	0.28	0.27
Vodafone	39.45	22.15	20.50	0.02	1106	180	323	0.00	0.00	0.00	0.57	0.16	0.00
Total	32.98	39.03	20.82	0.02	651	292	258	52.54	7.85	0.04	0.56	0.17	0.12

Table B.2: Contract length per tariff type

	SIM-only tariff	Tariffs with handsets
1	57.20	0
3	1.90	0
12	36.7	1.86
18	3.05	45.10
24	0.65	52.93
30	0.5	0.00
36	0	0.11
N	3,210	181,350

Table B.3: Correlation matrix with main variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
(1) Tariff price	1																
(2) Share of dominated tariffs	0.01***	1															
(3) Dominated dummy	0.09***	0.34***	1														
(4) Dummy for O2	0.21***	-0.06***	-0.04***	1													
(5) Dummy for Orange	-0.01***	-0.01***	-0.08***	-0.30***	1												
(6) Dummy for Three	-0.16***	-0.02***	0.10***	-0.13***	-0.11***	1											
(7) Dummy for Tmobile	-0.26***	0.00*	0.01***	-0.41***	-0.37***	-0.16***	1										
(8) Dummy for Vodafone	0.20***	0.09***	0.07***	-0.25***	-0.22***	-0.09***	-0.31***	1									
(9) Contract length	-0.11***	0.10***	0.07***	-0.04***	0.03***	0.10***	-0.01***	-0.04***	1								
(10) Unlimited voice	0.41***	-0.05***	0.02***	0.27***	-0.10***	-0.05***	-0.07***	-0.09***	0.03***	1							
(11) Voice allowance	0.63***	0.05***	0.05***	-0.13***	0.01***	-0.04***	-0.11***	0.31***	0.01**	-0.22***	1						
(12) Unlimited SMS	0.25***	-0.02***	-0.01***	0.33***	0.19***	-0.18***	-0.40***	0.01***	-0.02***	0.15***	0.08***	1					
(13) SMS allowance	-0.13***	-0.02***	0.04***	-0.16***	-0.13***	0.69***	0	-0.06***	0.10***	-0.06***	0.04***	-0.40***	1				
(14) Unlimited data	0.07***	0.05***	0.08***	-0.15***	-0.11***	0.12***	0.20***	-0.02***	0.05***	0.03***	0.09***	-0.15***	0.10***	1			
(15) Data allowance	0.31***	-0.15***	-0.06***	0.12***	0.07***	0.05***	-0.25***	0.07***	0.04***	0.06***	0.15***	0.13***	0.06***	-0.31***	1		
(16) Mixed allowance	-0.01***	0	0.13***	-0.05***	-0.04***	0.30***	-0.02***	-0.04***	0.01***	-0.02***	-0.09***	-0.09***	-0.03***	0.05***	0	1	
(17) Subsidy	0.40***	0	0.10***	0.08***	-0.08***	-0.02***	-0.04***	0.06***	0.15***	0.12***	0.21***	0.07***	0.01***	0.07***	0.17***	-0.02***	1

*** p<0.01, ** p<0.05, * p<0.1

B.2 Estimation results: indices

Table B.4: Estimation results from the hedonic price regression

	Model 1	
Dep. Var.	Tariff price	
Estimation method	OLS	
Tariff characteristics		
O2	0.00	(.)
Orange	-2.19***	(0.07)
Three	-9.27***	(0.24)
T-Mobile	-5.70***	(0.08)
Vodafone	-3.26***	(0.08)
Contract length=1	14.13***	(0.45)
Contract length=3	12.16***	(0.67)
Contract length=12	10.20***	(0.15)
Contract length=18	5.71***	(0.05)
Contract length=24	0.00	(.)
Contract length=30	-3.89***	(0.72)
Unlimited voice=0	0.00	(.)
Unlimited voice=1	34.56***	(0.18)
Voice allowance	0.02***	(0.00)
Unlimited SMS=0	0.00	(.)
Unlimited SMS=1	0.34***	(0.06)
SMS allowance	-0.00***	(0.00)
Unlimited data=1	3.12***	(0.08)
Data allowance	0.01***	(0.00)
Mixed allowance	0.01***	(0.00)
Handset subsidy=0	0.00	(.)
Handset subsidy=1	16.63***	(0.39)
Handset subsidy=0 × Amount of subsidy	0.00	(.)
Handset subsidy=1 × Amount of subsidy	0.02***	(0.00)
Smartphone=1	0.10	(0.06)
SIM-only	0.00	(.)
Acer	2.79***	(0.39)
Apple	3.52***	(0.14)
Blackberry	1.18***	(0.09)
Dell	2.10***	(0.28)
Emporia	-2.33**	(0.85)
Htc	-0.11	(0.09)
Huawei	0.58	(0.81)
Inq	0.84	(0.57)
Lg	0.30**	(0.12)
Motorola	-0.34*	(0.16)
Nokia	0.10	(0.08)
Orange	1.66***	(0.20)
Palm	2.85***	(0.18)
Samsung	0.00	(.)
Sony	2.26***	(0.33)
Sony Ericsson	0.04	(0.09)
T-Mobile	0.86**	(0.30)
Vodafone	4.85***	(0.67)
Zte	-1.95	(1.48)
Year-Month Dummies	Yes	
Constant	-0.42	(0.41)
Observations	184,560	
R2	0.87	

Standard errors in parentheses, clustered at the tariff-level.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Coefficients estimated for Year-Month dummies are presented in Figure 7. The base category for the variable "Manufacturer" is Samsung. 36-month contracts are grouped with 30-month contracts.

Table B.5: Estimation results from the regression of pairwise distances

Dep var	$Distance_{ijt}$	
Model	OLS	
Within operators FEs		
O2 to O2	0.00	(.)
Orange to Orange	0.01	(0.01)
Three to Three	0.03	(0.02)
Tmobile to Tmobile	0.25***	(0.01)
Vodafone to Vodafone	-0.06***	(0.01)
Between operators FEs		
O2 to Orange	0.07***	(0.01)
O2 to Three	0.30***	(0.01)
O2 to Tmobile	0.51***	(0.01)
O2 to Vodafone	0.09***	(0.01)
Orange to Three	0.14***	(0.01)
Orange to Tmobile	0.32***	(0.01)
Orange to Vodafone	0.02***	(0.01)
Three to Tmobile	0.25***	(0.01)
Three to Vodafone	0.10***	(0.01)
Tmobile to Vodafone	0.31***	(0.01)
Between segments FEs		
Tariff with handset to tariff with handset	0.17***	(0.00)
SIM-only to tariff with handset/tariff with handset to SIM-only	0.11***	(0.00)
SIM-only to SIM-only	0.00	(.)
Year-Month FEs		
Jan 2010	0.00	(.)
Feb 2010	-0.10***	(0.00)
Mar 2010	-0.18***	(0.01)
Apr 2010	-0.18***	(0.01)
May 2010	-0.14***	(0.01)
Jun 2010	-0.12***	(0.01)
July 2010	-0.12***	(0.01)
Aug 2010	-0.15***	(0.01)
Sep 2010	-0.13***	(0.01)
Oct 2010	-0.14***	(0.01)
Nov 2010	-0.15***	(0.01)
Dec 2010	-0.17***	(0.01)
Jan 2011	-0.29***	(0.01)
Feb 2011	-0.22***	(0.01)
Mar 2011	-0.26***	(0.01)
Apr 2011	-0.31***	(0.01)
May 2011	-0.27***	(0.01)
Jun 2011	-0.28***	(0.01)
Jul 2011	-0.28***	(0.01)
Aug 2011	-0.28***	(0.01)
Sep 2011	-0.27***	(0.01)
Oct 2011	-0.29***	(0.01)
Nov 2011	-0.30***	(0.01)
Feb 2012	-0.49***	(0.01)
Mar 2012	-0.50***	(0.01)
Apr 2012	-0.47***	(0.01)
May 2012	-0.46***	(0.01)
Aug 2012	-0.49***	(0.01)
Sep 2012	-0.48***	(0.01)
Constant	0.67***	(0.01)
Observations	1978742	
R2	0.11	

Standard errors in parentheses, clustered at the tariff pair-level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Coefficients estimated for Year-Month dummies are also presented in Figure 8.

Table B.6: Estimation results from the dominated tariffs regressions

	Model 2.a		**Model 2.b**	
Dep. Var.	Dominated (0/1)		Dominated (0/1)	
Estimation method	OLS		Maximum Likelihood	
Model	Linear		Logit	
O2	0.00	(.)	0.00	(.)
Orange	-0.05***	(0.00)	-0.49***	(0.03)
Three	0.19***	(0.01)	1.29***	(0.05)
T-Mobile	0.01***	(0.00)	0.13***	(0.04)
Vodafone	0.05***	(0.00)	0.37***	(0.04)
SIM-only=1	-0.13***	(0.00)	-3.56***	(0.29)
Jan 2010	0.00	(.)	0.00	(.)
Feb 2010	-0.04***	(0.01)	-0.61***	(0.08)
Mar 2010	0.01	(0.01)	0.10	(0.08)
Apr 2010	-0.01	(0.01)	-0.14	(0.08)
May 2010	0.04***	(0.01)	0.38***	(0.08)
Jun 2010	0.10***	(0.01)	0.90***	(0.08)
July 2010	0.03***	(0.01)	0.35***	(0.08)
Aug 2010	0.04***	(0.01)	0.42***	(0.08)
Sep 2010	0.03***	(0.01)	0.32***	(0.08)
Oct 2010	0.05***	(0.01)	0.51***	(0.08)
Nov 2010	0.08***	(0.01)	0.70***	(0.08)
Dec 2010	0.04***	(0.01)	0.47***	(0.08)
Jan 2011	0.46***	(0.01)	2.54***	(0.07)
Feb 2011	0.10***	(0.01)	0.90***	(0.08)
Mar 2011	0.00	(0.01)	0.05	(0.08)
Apr 2011	0.15***	(0.01)	1.22***	(0.08)
May 2011	0.00	(0.01)	0.05	(0.08)
Jun 2011	0.12***	(0.01)	0.97***	(0.08)
Jul 2011	-0.01	(0.01)	-0.03	(0.08)
Aug 2011	0.02***	(0.01)	0.29***	(0.08)
Sep 2011	0.01	(0.01)	0.11	(0.08)
Oct 2011	0.06***	(0.01)	0.63***	(0.08)
Nov 2011	-0.00	(0.01)	-0.01	(0.08)
Feb 2012	0.01*	(0.01)	0.17*	(0.08)
Mar 2012	-0.04***	(0.01)	-0.54***	(0.09)
Apr 2012	-0.03***	(0.01)	-0.52***	(0.09)
May 2012	-0.06***	(0.01)	-1.07***	(0.10)
Aug 2012	-0.06***	(0.01)	-1.04***	(0.10)
Sep 2012	-0.07***	(0.01)	-1.40***	(0.12)
Constant	0.09***	(0.01)	-2.38***	(0.07)
Observations	184,560		184,560	
R2	0.13			
Log Likelihood			-684,31.68	

Standard errors in parentheses, clustered at the tariff-level

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: Coefficients estimated for Year-Month dummies are presented in Figure 10.

B.3 Exploring other factors influencing prices

B.3.1 Collusion: vector autoregressions and Granger causality

Using the price and obfuscation indices obtained from the estimation of Equations 1 and 3 at the industry and operator level, we estimate the following models:

$$\begin{aligned} PriceIndex_t = {} & \alpha + \beta_1 PriceIndex_{t-1} + \beta_2 PriceIndex_{t-2} + \beta_3 PriceIndex_{t-3} \\ & + \beta_4 ObfuscationIndex_{t-1} + \beta_5 ObfuscationIndex_{t-2} \\ & + \beta_6 ObfuscationIndex_{t-3} + \varepsilon_t \end{aligned} \tag{5}$$

$$\begin{aligned} ObfuscationIndex_t = {} & a + b_1 ObfuscationIndex_{t-1} + b_2 ObfuscationIndex_{t-2} \\ & + b_3 ObfuscationIndex_{t-3} + b_4 PriceIndex_{t-1} + b_5 PriceIndex_{t-2} \\ & + b_6 PriceIndex_{t-3} + \varepsilon_t \end{aligned} \tag{6}$$

This corresponds to simple vector autoregressions with three lags. $PriceIndex_t$ is the time series obtained with the coefficients δ_t from Equation 1. $ObfuscationIndex_t$ is the time series obtained with the coefficients θ_t from Equation 3. Given that we have some gaps in our time series, some observations are dropped from the estimation sample. The results are presented in Table B.7.

Table B.7: Estimation results from VAR

Equ. (4)	**Price Index**	
L.Price Index	0.72**	(0.24)
L2.Price Index	-0.28	(0.27)
L3.Price Index	0.10	(0.15)
L.Obfuscation Index	0.07	(0.12)
L2.Obfuscation Index	0.04	(0.12)
L3.Obfuscation Index	0.21	(0.12)
Constant	0.02	(0.09)
Observations	21	
R2	0.76	
Equ. (5)	**Obfuscation Index**	
L.Obfuscation Index	-0.00	(0.27)
L2.Obfuscation Index	0.28	(0.27)
L3.Obfuscation Index	0.37	(0.28)
L.Price Index	0.20	(0.55)
L2.Price Index	-0.10	(0.64)
L3.Price Index	-0.39	(0.34)
Constant	0.20	(0.22)
Observations	21	
R2	0.24	

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

At the industry level, the price index is "persistent" with an AR(1) process. We also observe that the price time series is not dependent on the level of obfuscation observed in the past at the industry level. Our Granger causality test (presented in Table B.8) supports the idea that prices and obfuscation indices are not Granger-causally linked.

Table B.8: Granger causality

Y	X	$\chi 2$	$Prob > \chi 2$
Price Index	Obfuscation Index	4.56	0.207
Obfuscation Index	Price Index	3.24	0.356

Notes: Null hypothesis: Lagged values of X do not cause Y. If p value>0.05, we cannot reject the null hypothesis.

We conducted additional analyses with price and obfuscation indices at the operator level to see if a causal effect can be identified for some firms. The tests are always negative. We, therefore, conclude that obfuscation and price increases arise at the same time and that there are no dynamics at play (one does not cause the other – i.e., firms do not obfuscate and then raise their prices). This goes in the direction of obfuscation, directly increasing prices, i.e., prices are increasing through obfuscation. This conclusion is reinforced by the fact that we see this very strong pairwise correlation occurring at the operator level presented in Table B.12. Indeed, we observe a significant coefficient for three out of five operators (correlation is not significant for the biggest and the smallest players). Are price indices more correlated than obfuscation indices? If yes, this might mean that there is collusion. As presented in Table B.13, obfuscation indices at the operator level are more correlated to the industry-level index than the price indices at the operator level with the industry price index.

B.3.2 Differentiation of handsets

Figure B.1: Evolution of the average list price of handsets

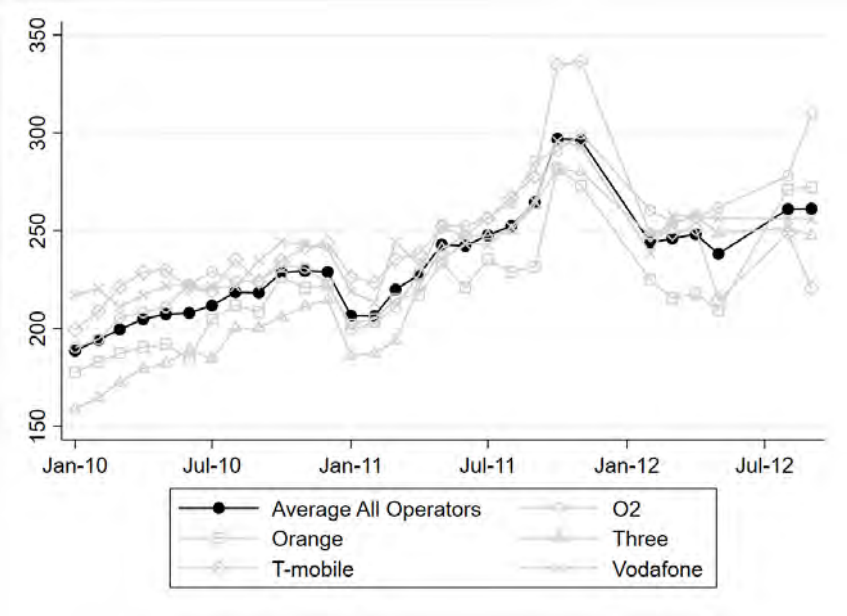
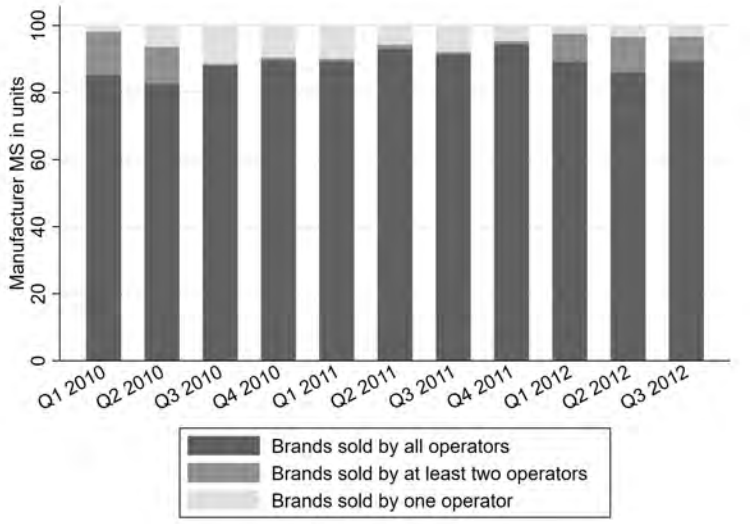
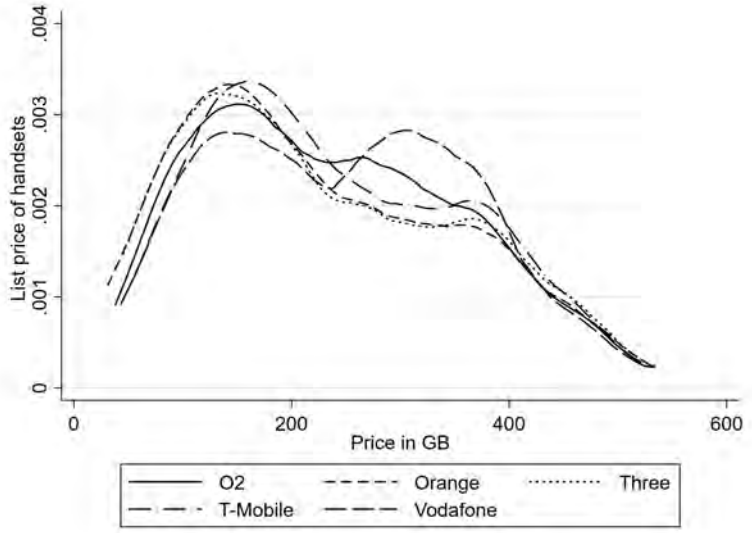


Figure B.2: Market share of brands offered by operators in the sample



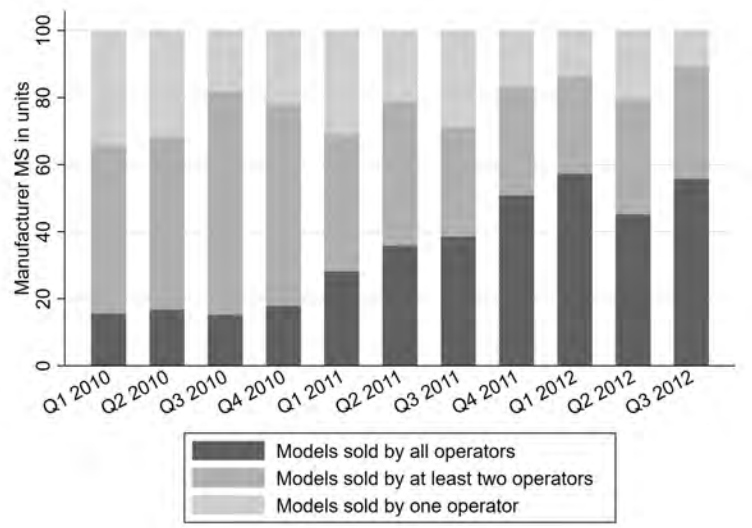
Note: The figure presents the market share in volume at the country level based on data from IDC. A few marginal brands that appear in IDC's data but are not sold by any operator in a given quarter are excluded from the computation.

Figure B.3: Distribution of handset list prices per operator, over years



Note: This figure highlights that all operators were offering very comparable ranges of products, from low to premium segments. Price is a reasonable proxy for the quality of products.

Figure B.4: Market share of models



Note: The figure presents the market share in volume at the country level, based on data from IDC. Models that appear in IDC's data but are not sold by any operator in a given quarter are excluded from the computation.

B.4 Hazard rate models

Table B.9: Survival analyses

	Exit		**Survival**	
	Cox Proportional Hazard Models		Accelerated Failure-Time Models	
	Coef >1 → increased likelihood of exit		Coef >1 → increased likelihood of survival	
	(1)	(2)	(3)	(4)
Dominated tariff	1.34***		0.74***	
	(0.01)		(0.01)	
Dominated tariff (always)		2.21***		0.54***
		(0.03)		(0.00)
Number of tariffs in thousands	1.17***	1.17***	0.90***	0.90***
	(0.00)	(0.00)	(0.00)	(0.00)
SIM-only tariff (0/1)	0.30***	0.31***	1.93***	1.88***
	(0.02)	(0.03)	(0.12)	(0.11)
O2	1.00	1.00	1.00	1.00
	(.)	(.)	(.)	(.)
Orange	1.17***	1.23***	0.90***	0.86***
	(0.01)	(0.01)	(0.01)	(0.01)
Three	1.61***	1.47***	0.69***	0.73***
	(0.03)	(0.03)	(0.01)	(0.01)
T-Mobile	0.90***	0.90***	1.09***	1.09***
	(0.01)	(0.01)	(0.01)	(0.01)
Vodafone	1.36***	1.30***	0.81***	0.83***
	(0.02)	(0.02)	(0.01)	(0.01)
ln sigma			0.63***	0.62***
			(0.00)	(0.00)
kappa			1.26***	1.25***
			(0.01)	(0.01)
Observations	178160	178160	178160	178160
Log Likelihood	-4.47e+05	-4.46e+05	-46724.38	-44901.25
AIC	893,535	891,088	93,469	89,822
BIC	893,606	891,160	93,570	89,923

Exponentiated coefficients; Robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: All results are obtained with the Maximum Likelihood Estimator. An exit occurs for a given tariff if it is observed at t and not at $t+1$. We use our main definition of dominated to conduct this analysis. See Table B.10 for results with alternative parametrization of the AFT model.

Figure B.5: Graphical test for the proportional hazards assumption

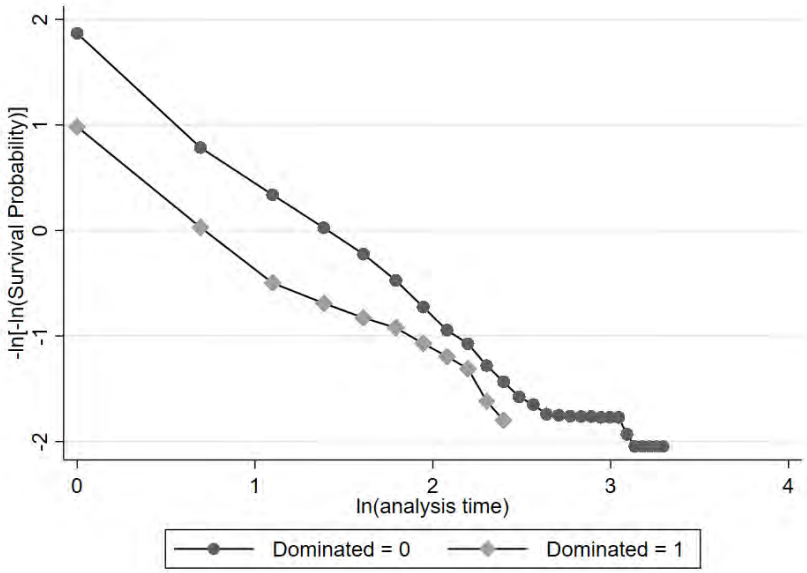


Table B.10: AFT models: parametrization

	(1) Gen Gamma	(2) LogLogistic	(3) LogNormal	(4) Weibull	(5) Exponential
Survival of tariffs					
Dominated tariff	0.74***	0.70***	0.74***	0.77***	0.91***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of tariffs in thousands	0.90***	0.90***	0.90***	0.90***	0.87***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SIM-only tariff (0/1)	1.93***	1.87***	1.69***	2.56***	2.65***
	(0.12)	(0.11)	(0.11)	(0.13)	(0.16)
O2	1.00	1.00	1.00	1.00	1.00
	(.)	(.)	(.)	(.)	(.)
Orange	0.90***	0.91***	0.91***	0.87***	0.90***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Three	0.69***	0.68***	0.70***	0.70***	0.66***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
T-Mobile	1.09***	1.07***	1.10***	1.07***	1.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Vodafone	0.81***	0.81***	0.82***	0.78***	0.78***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ln sigma	0.63***		0.64***		
	(0.00)		(0.00)		
kappa	1.26***				
	(0.01)				
ln gamma		0.37***			
		(0.00)			
ln p				1.66***	
				(0.01)	
Observations	178160	178160	178160	178160	178160
Statistics					
Log Likelihood	-46,724.38	-48,038.83	-46,883.27	-48,683.78	-57,148.53
AIC	93,468.76	96,095.66	93,784.55	97,385.57	11,4313.06
BIC	93,569.67	96,186.47	93,875.36	97,476.38	114,393.79

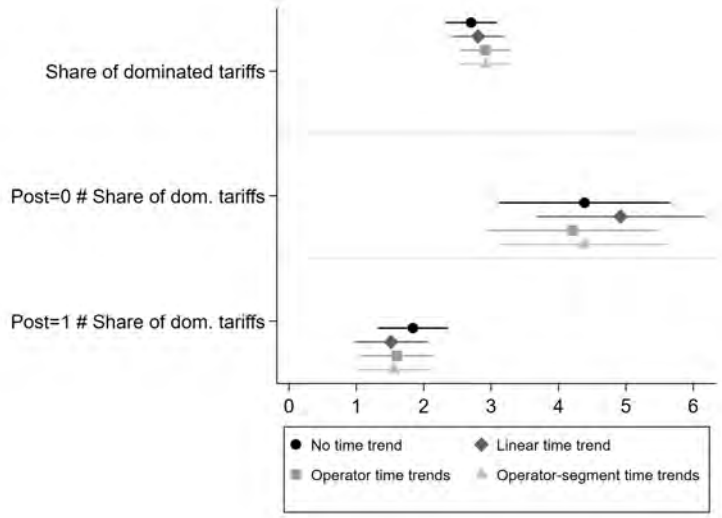
Exponentiated coefficients; Robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B.5 Robustness

B.5.1 Unobserved characteristics

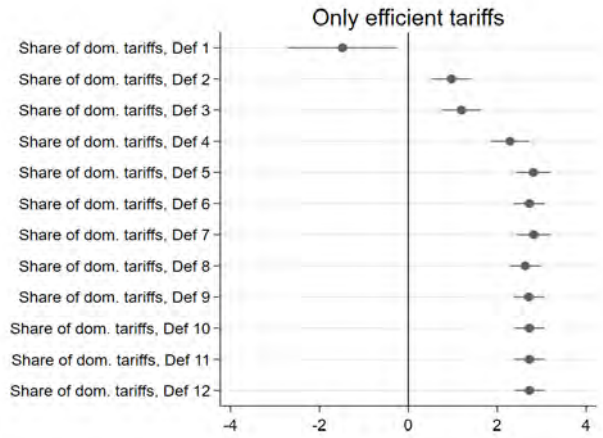
Figure B.6: Coefficients on the share of dominated tariffs, with various time trends.



Notes: Coefficients presented correspond to those presented in Columns 5 and 6 of Table 2. In our main specification, we do not use any time trends because of a multicollinearity issue occurring between the linear time trend and the variable "Share of dominated tariffs".

B.5.2 Alternative definitions

Figure B.7: Coefficients on the share of dominated tariffs, with all definitions



Notes: The model estimated corresponds to our main model, presented in Column 5 of Table 2. Definitions are presented in Figure A.3.

B.5.3 Handset exclusivities

Table B.11: Estimation results with samples of tariffs

	(1)		(2)		(3)	
Estimation method	FE		FE		FE	
Dep. var	$Price_{it}$		$Price_{it}$		$Price_{it}$	
Sample	All tariffs		Tariffs with handsets sold by at least two op.		Tariffs with handsets sold by all op.	
Share of dominated tariffs	2.85***	(0.20)	2.99***	(0.21)	2.42***	(0.38)
O2	0.00	(.)	0.00	(.)	0.00	(.)
Orange	-2.12***	(0.09)	-2.14***	(0.09)	-1.68***	(0.14)
Three	-9.14***	(0.32)	-9.49***	(0.34)	-6.71***	(0.52)
T-Mobile	-4.89***	(0.10)	-4.91***	(0.10)	-3.52***	(0.14)
Vodafone	-2.17***	(0.12)	-2.15***	(0.12)	-1.14***	(0.16)
Contract length=12	10.62***	(0.17)	10.79***	(0.18)	10.82***	(0.25)
Contract length=18	5.91***	(0.05)	5.86***	(0.06)	5.85***	(0.08)
Contract length=24	0.00	(.)	0.00	(.)	0.00	(.)
Contract length=36	-6.05***	(0.60)	-6.14***	(0.70)	-3.57***	(0.35)
Unlimited voice=0	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited voice=1	33.94***	(0.22)	33.70***	(0.25)	30.64***	(0.42)
Voice allowance	0.02***	(0.00)	0.02***	(0.00)	0.01***	(0.00)
Unlimited SMS=0	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited SMS=1	0.45***	(0.07)	0.48***	(0.08)	0.69***	(0.12)
SMS allowance	-0.00**	(0.00)	-0.00	(0.00)	-0.00*	(0.00)
Unlimited data=1	2.78***	(0.09)	2.67***	(0.09)	1.95***	(0.14)
Data allowance	0.00***	(0.00)	0.00***	(0.00)	0.00***	(0.00)
Mixed allowance	0.01***	(0.00)	0.02***	(0.00)	0.01***	(0.00)
Handset subsidy=1 × Amount of subsidy	0.03***	(0.00)	0.03***	(0.00)	0.03***	(0.00)
Time trend	0.03***	(0.01)	0.04***	(0.01)	-0.02	(0.01)
Constant	-4.48	(4.18)	-12.45**	(4.50)	23.97***	(7.27)
Observations	137,654		122,563		52,323	
R2	0.88		0.87		0.87	
SE Clusters	Tariff-level		Tariff-level		Tariff-level	
Handsets Fixed Effects	Yes		Yes		Yes	

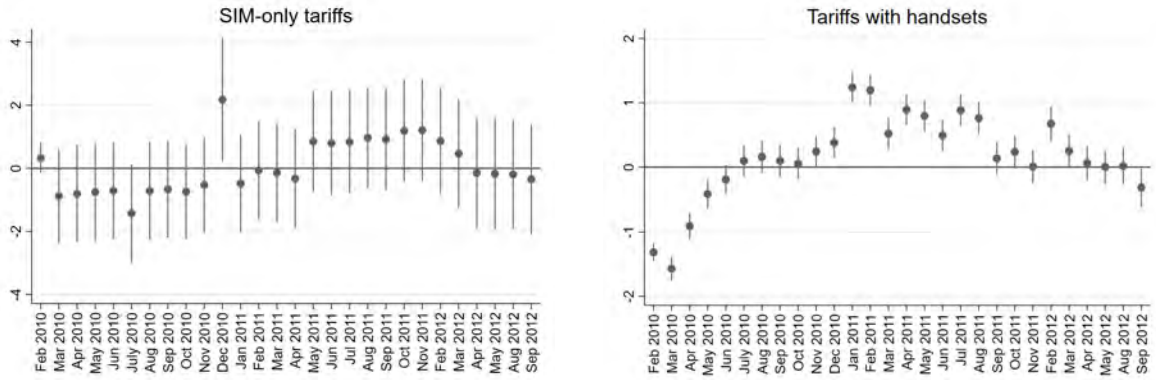
Standard errors in parentheses, clustered at the tariff-level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: All tariffs are efficient tariffs at release. Column 1 corresponds to Model 2 presented in Table 2. Column 2 presents the results obtained with a similar model estimated on a sample of tariffs combined with a handset sold by at least two operators. Column 3 presents the results obtained with a similar model estimated on a sample of tariffs, which are combined with a handset sold by all operators.

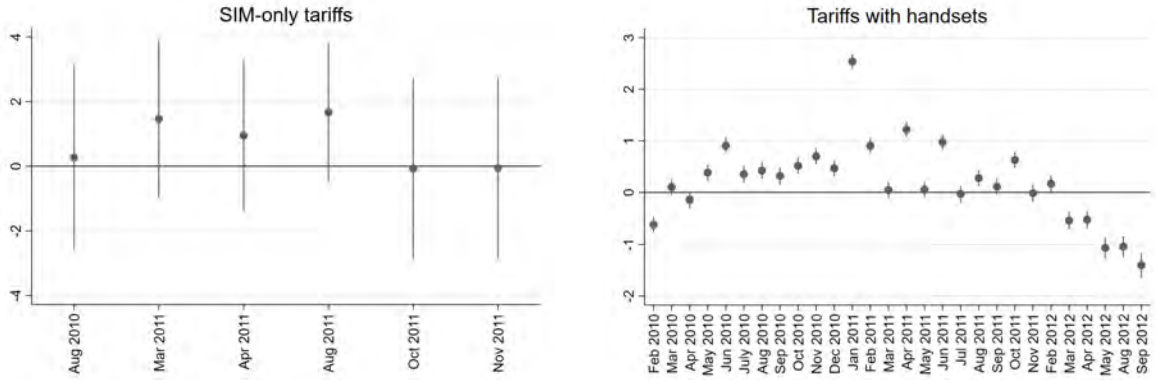
B.5.4 Indices for different SIM-only/tariffs with handsets

Figure B.8: Price indices SIM-only/tariffs with handsets



B.5.5 Indices for different SIM-only/tariffs with handsets

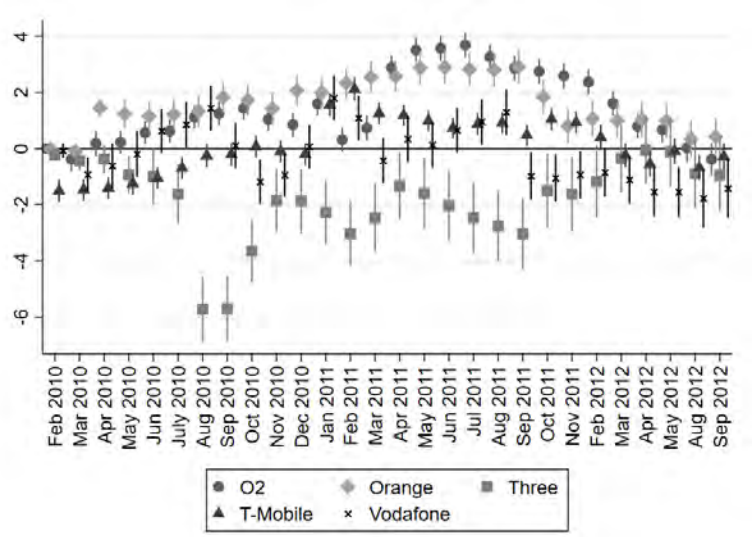
Figure B.9: Obfuscation indices SIM-only/tariffs with handsets



Note: Indices obtained with regressions performed on subsamples.

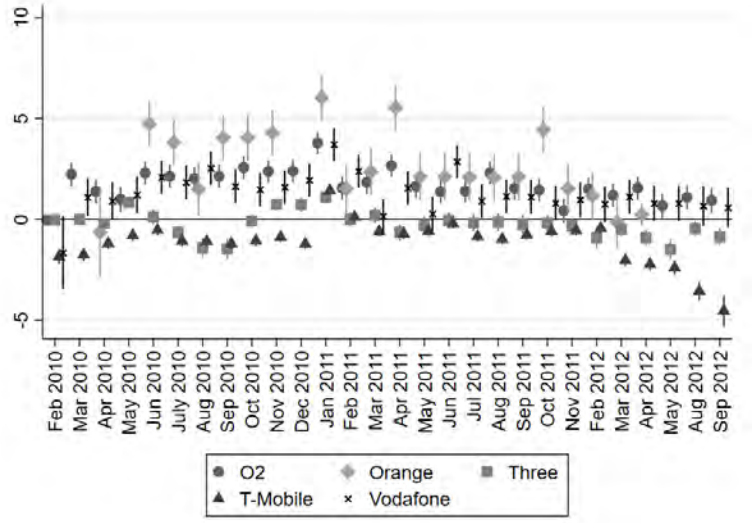
B.5.6 Indices for different operators

Figure B.10: Price indices per operators



Note: Indices obtained with regressions performed on subsamples.

Figure B.11: Obfuscation indices per operators



Note: Indices obtained with regressions performed on subsamples.

Table B.12: Correlation between price and obfuscation at the operator level

	O2	Orange	Three	T-Mobile	Vodafone
Correlation coefficient	0.19	0.47**	0.19	0.51***	0.51***
Market Share Jan 2010	26.6	20.5	7.8	21.4	23.7

Significance of the pairwise coefficient: *** p<0.01, ** p<0.05, * p<0.1.

Table B.13: Correlation of operator-level indices with industry-level indices

	$Price_{Ind}$	Obf_{Ind}
Price index O2	0.61***	0.32*
Price index Orange	0.71***	0.48***
Price index Three	-0.38**	-0.37**
Price index T-Mobile	0.87***	0.45**
Price index Vodafone	0.44**	0.67***
Obfuscation index O2	0.39**	0.71***
Obfuscation index Orange	0.47***	0.74***
Obfuscation index Three	0.08	0.51***
Obfuscation index T-Mobile	0.48***	0.85***
Obfuscation index Vodafone	0.46**	0.72***

Significance of the pairwise coefficient: *** p<0.01, ** p<0.05, * p<0.1. $Price_{Ind}$ is the price index at the industry level. Obf_{Ind} is the obfuscation index at the industry level.

B.6 Confusopoly and profits: Computation

Industry revenue: We collected publicly available data collected from reports published by Ofcom: Telecommunications Market Data Update 2010, 2011 and 2012. We obtain a total of 43.4 billion GBP for the focal market (UK, Retail, Post-Paid contracts). *Profitability* We can estimate the profitability of the main operators to be about 26%. This number is based on our own computation, which is based on reported revenue and operating income as presented in operators' financial reports for the year 2009. Vodafone and Telefonica (02) both have, for 2009, an estimated profit of 26%. Orange reported very low operating income, T-Mobile a negative result, and Hutchison (Three) did not report at all. *Profits over the period* Based on this estimation, we can quantify the industry-level total profits to be 12 billion GPB. *Confusopoly cost as a share of profit* 60.4 million, the lowest bound of our estimated Confusopoly cost, represents 0.50%. 259.05 million, our highest estimation, gives 2.15% of the industry profit.

B.7 Full version of main tables

Table B.14: Main estimation results (with all controls)

	(1)		(2)		(3)		(4)		(5)		(6)	
	All tariffs						**Efficient tariffs**					
Estimation method	OLS		FE		FE		OLS		FE		FE	
Dependent variable	$Price_{it}$		$Price_{it}$		$Price_{it}$		$Price_{it}$		$Price_{it}$		$Price_{it}$	
Share of dom tariffs	1.33***	(0.16)	1.15***	(0.14)			2.10***	(0.21)	2.70***	(0.19)		
Dominated=0	0.00	(.)	0.00	(.)								
Dominated=1	1.63***	(0.06)	1.26***	(0.06)								
O2	0.00	(.)	0.00	(.)			0.00	(.)	0.00	(.)		
Orange	-2.07***	(0.08)	-2.05***	(0.08)			-2.20***	(0.08)	-2.04***	(0.09)		
Three	-9.80***	(0.26)	-9.01***	(0.26)			-9.87***	(0.28)	-9.01***	(0.31)		
T-Mobile	-5.67***	(0.08)	-5.12***	(0.08)			-5.46***	(0.08)	-4.77***	(0.10)		
Vodafone	-3.01***	(0.09)	-3.03***	(0.09)			-2.24***	(0.10)	-2.10***	(0.11)		
Contract length=1	-1.90***	(0.25)	14.31***	(0.44)			13.95***	(0.45)	14.02***	(0.44)		
Contract length=3	-4.17***	(0.53)	12.29***	(0.68)			11.05***	(0.65)	11.30***	(0.68)		
Contract length=12	6.14***	(0.39)	10.53***	(0.16)			9.99***	(0.16)	10.18***	(0.17)		
Contract length=18	5.65***	(0.05)	5.74***	(0.05)			5.82***	(0.06)	5.92***	(0.05)		
Contract length=24	0.00	(.)	0.00	(.)			0.00	(.)	0.00	(.)		
Contract length=30	-5.33***	(0.48)	-5.14***	(0.81)			-3.66***	(0.78)	-4.43***	(0.86)		
Unlimited voice=0	0.00	(.)	0.00	(.)			0.00	(.)	0.00	(.)		
Unlimited voice=1	34.24***	(0.20)	33.99***	(0.18)			34.37***	(0.22)	33.86***	(0.22)		
Voice allowance	0.02***	(0.00)	0.01***	(0.00)			0.02***	(0.00)	0.02***	(0.00)		
Unlimited SMS=0	0.00	(.)	0.00	(.)			0.00	(.)	0.00	(.)		
Unlimited SMS=1	0.18**	(0.07)	0.21***	(0.06)			0.46***	(0.07)	0.48***	(0.07)		
SMS allowance	-0.00***	(0.00)	-0.00***	(0.00)			-0.00	(0.00)	-0.00**	(0.00)		
Unlimited data=1	3.04***	(0.08)	2.89***	(0.07)			2.75***	(0.09)	2.76***	(0.09)		
Data allowance	0.01***	(0.00)	0.01***	(0.00)			0.01***	(0.00)	0.00***	(0.00)		
Mixed allowance	0.01***	(0.00)	0.01***	(0.00)			0.01***	(0.00)	0.01***	(0.00)		
Handset subsidy=1 × Amount of subsidy	0.02***	(0.00)	0.03***	(0.00)			0.02***	(0.00)	0.03***	(0.00)		
Post=0 × Share of dom tariffs					4.00***	(0.64)					4.39***	(0.65)
Post=1 × Share of dom tariffs					0.58***	(0.17)					1.84***	(0.27)
Dominated=0 × Post=0					0.00	(.)						
Dominated=0 × Post=1					0.00	(.)						
Dominated=1 × Post=0					1.67***	(0.10)						
Dominated=1 × Post=1					0.99***	(0.07)						
O2 × Post=0					0.00	(.)					0.00	(.)
O2 × Post=1					0.00	(.)					0.00	(.)
Orange × Post=0					-1.88***	(0.13)					-1.49***	(0.14)
Orange × Post=1					-1.79***	(0.09)					-2.01***	(0.11)
Three × Post=0					-9.10***	(0.29)					-8.99***	(0.35)
Three × Post=1					-6.24***	(0.44)					-5.46***	(0.49)
T-Mobile × Post=0					-6.56***	(0.13)					-6.20***	(0.14)
T-Mobile × Post=1					-4.11***	(0.10)					-3.58***	(0.12)
Vodafone × Post=0					-2.62***	(0.17)					-1.69***	(0.19)
Vodafone × Post=1					-2.99***	(0.11)					-2.05***	(0.13)
Contract length=1 × Post=0					9.63***	(0.70)					9.57***	(0.70)
Contract length=1 × Post=1					15.73***	(0.44)					15.33***	(0.44)
Contract length=3 × Post=0					0.00	(.)					0.00	(.)
Contract length=3 × Post=1					13.67***	(0.67)					12.52***	(0.68)
Contract length=12 × Post=0					6.88***	(0.34)					6.79***	(0.36)
Contract length=12 × Post=1					11.15***	(0.18)					10.69***	(0.20)
Contract length=18 × Post=0					5.13***	(0.07)					5.16***	(0.07)
Contract length=18 × Post=1					5.98***	(0.05)					6.30***	(0.07)
Contract length=24 × Post=0					0.00	(.)					0.00	(.)
Contract length=24 × Post=1					0.00	(.)					0.00	(.)
Contract length=30 × Post=0					-6.33***	(0.74)					-6.27***	(0.72)
Contract length=30 × Post=1					-4.56***	(1.39)					-2.53	(1.72)
Unlimited voice=0 × Post=0					0.00	(.)					0.00	(.)
Unlimited voice=0 × Post=1					0.00	(.)					0.00	(.)
Unlimited voice=1 × Post=0					35.00***	(0.17)					35.41***	(0.19)
Unlimited voice=1 × Post=1					33.63***	(0.22)					33.24***	(0.27)
Post=0 × Voice allowance					0.02***	(0.00)					0.02***	(0.00)
Post=1 × Voice allowance					0.01***	(0.00)					0.01***	(0.00)
Unlimited SMS=0 × Post=0					0.00	(.)					0.00	(.)
Unlimited SMS=0 × Post=1					0.00	(.)					0.00	(.)
Unlimited SMS=1 × Post=0					-0.09	(0.09)					-0.06	(0.10)
Unlimited SMS=1 × Post=1					0.23**	(0.08)					0.68***	(0.09)
Post=0 × SMS allowance					-0.00	(0.00)					-0.00	(0.00)
Post=1 × SMS allowance					-0.00***	(0.00)					-0.00***	(0.00)
Unlimited data=1 × Post=0					2.26***	(0.08)					2.09***	(0.09)
Unlimited data=1 × Post=1					2.38***	(0.11)					2.04***	(0.16)
Post=0 × Data allowance					-0.00	(0.00)					-0.00	(0.00)
Post=1 × Data allowance					0.01***	(0.00)					0.01***	(0.00)
Post=0 × Mixed allowance					0.01***	(0.00)					0.02***	(0.00)
Post=1 × Mixed allowance					0.00***	(0.00)					0.00*	(0.00)
Handset subsidy=1 × Post=0					0.00	(.)					0.00	(.)
Handset subsidy=1 × Post=1					0.00	(.)					0.00	(.)
Handset subsidy=1 × Post=0 × Amount of subsidy					0.03***	(0.00)					0.03***	(0.00)
Handset subsidy=1 × Post=1 × Amount of subsidy					0.03***	(0.00)					0.03***	(0.00)
Post=1					-5.56***	(0.71)					-5.25***	(0.73)
Handset subsidy=1							16.23***	(0.40)	0.00	(.)		
Constant	15.94***	(0.12)	14.71***	(0.12)	18.28***	(0.51)	-0.60	(0.41)	13.81***	(0.13)	17.07***	(0.50)
Handset Fixed Effects	No		Yes		Yes (× Post)		No		Yes		Yes (× Post)	
Observations	184,560		184,560		184,560		140,797		140,797		140,797	
R2	0.86		0.88		0.88		0.86		0.88		0.88	

Standard errors in parentheses, clustered at the tariff-level. Contracts with length = 36 grouped with length = 30.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.15: Main price regressions with alternative sample and definitions (with all controls)

	(1)		(2)		(3)		(4)	
	Efficient tariffs							
	At release Dominated Def. = *Cost-conscious*		Always efficient Dominated Def. = *Cost-conscious*		At release Dominated Def. = *Brand-loving*		At release Dominated Def. = *Model-obsessed*	
Post=0 × Share of dom tariffs (Def 5)	4.39***	(0.65)	5.06***	(0.47)				
Post=1 × Share of dom tariffs (Def 5)	1.84***	(0.27)	1.54***	(0.29)				
Post=0 × Share of dom tariffs (Def 7)					6.37***	(0.80)		
Post=1 × Share of dom tariffs (Def 7)					1.47***	(0.26)		
Post=0 × Share of dom tariffs (Def 10)							3.84***	(0.52)
Post=1 × Share of dom tariffs (Def 10)							1.70***	(0.24)
O2 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
O2 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Orange × Post=0	-1.49***	(0.14)	-1.60***	(0.13)	-1.49***	(0.14)	-1.95***	(0.13)
Orange × Post=1	-2.01***	(0.11)	-1.76***	(0.11)	-1.55***	(0.11)	-1.99***	(0.11)
Three × Post=0	-8.99***	(0.35)	-5.84***	(0.34)	-9.01***	(0.36)	-9.35***	(0.35)
Three × Post=1	-5.46***	(0.49)	-4.97***	(0.50)	-5.20***	(0.56)	-5.56***	(0.45)
T-Mobile × Post=0	-6.20***	(0.14)	-6.48***	(0.14)	-6.33***	(0.15)	-6.42***	(0.14)
T-Mobile × Post=1	-3.58***	(0.12)	-3.29***	(0.12)	-3.05***	(0.11)	-3.46***	(0.11)
Vodafone × Post=0	-1.69***	(0.19)	-1.36***	(0.20)	-1.61***	(0.19)	-2.24***	(0.18)
Vodafone × Post=1	-2.05***	(0.13)	-1.87***	(0.14)	-1.56***	(0.14)	-2.32***	(0.13)
Contract length=1 × Post=0	9.57***	(0.70)	9.45***	(0.73)	9.64***	(0.70)	9.47***	(0.69)
Contract length=1 × Post=1	15.33***	(0.44)	15.56***	(0.44)	15.85***	(0.44)	15.41***	(0.45)
Contract length=3 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Contract length=3 × Post=1	12.52***	(0.68)	12.75***	(0.68)	12.94***	(0.69)	12.90***	(0.69)
Contract length=12 × Post=0	6.79***	(0.36)	6.87***	(0.37)	6.86***	(0.36)	6.72***	(0.34)
Contract length=12 × Post=1	10.69***	(0.20)	10.94***	(0.20)	11.25***	(0.20)	10.82***	(0.19)
Contract length=18 × Post=0	5.16***	(0.07)	5.19***	(0.07)	5.16***	(0.07)	5.17***	(0.07)
Contract length=18 × Post=1	6.30***	(0.07)	6.55***	(0.07)	6.61***	(0.07)	6.17***	(0.06)
Contract length=24 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Contract length=24 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Contract length=30 × Post=0	-6.27***	(0.72)	-5.89***	(0.79)	-6.17***	(0.73)	-6.35***	(0.71)
Contract length=30 × Post=1	-2.53	(1.72)	-0.93	(2.02)	-2.63	(1.76)	-2.84	(1.78)
Unlimited voice=0 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited voice=0 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited voice=1 × Post=0	35.41***	(0.19)	35.81***	(0.18)	35.35***	(0.19)	35.06***	(0.18)
Unlimited voice=1 × Post=1	33.24***	(0.27)	33.02***	(0.30)	33.47***	(0.27)	33.25***	(0.25)
Post=0 × Voice allowance	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)
Post=1 × Voice allowance	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)
Unlimited SMS=0 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited SMS=0 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited SMS=1 × Post=0	-0.06	(0.10)	-0.63***	(0.10)	-0.11	(0.10)	-0.14	(0.10)
Unlimited SMS=1 × Post=1	0.68***	(0.09)	0.64***	(0.09)	0.49***	(0.09)	0.63***	(0.09)
Post=0 × SMS allowance	-0.00	(0.00)	-0.00***	(0.00)	-0.00	(0.00)	0.00	(0.00)
Post=1 × SMS allowance	-0.00***	(0.00)	-0.00***	(0.00)	-0.00***	(0.00)	-0.00***	(0.00)
Unlimited data=1 × Post=0	2.09***	(0.09)	1.78***	(0.09)	2.08***	(0.09)	2.10***	(0.09)
Unlimited data=1 × Post=1	2.04***	(0.16)	2.00***	(0.17)	2.21***	(0.17)	2.23***	(0.15)
Post=0 × Data allowance	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Post=1 × Data allowance	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)
Post=0 × Mixed allowance	0.02***	(0.00)	0.01***	(0.00)	0.02***	(0.00)	0.02***	(0.00)
Post=1 × Mixed allowance	0.00*	(0.00)	0.00*	(0.00)	0.00*	(0.00)	0.00*	(0.00)
Handset subsidy=1 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Handset subsidy=1 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Handset subsidy=1 × Post=0 × Amount of subsidy	0.03***	(0.00)	0.02***	(0.00)	0.03***	(0.00)	0.03***	(0.00)
Handset subsidy=1 × Post=1 × Amount of subsidy	0.03***	(0.00)	0.03***	(0.00)	0.03***	(0.00)	0.03***	(0.00)
Post=1	-5.25***	(0.73)	-5.93***	(0.74)	-5.81***	(0.73)	-5.70***	(0.72)
Handset Fixed Effects	Yes (× Post)		Yes (× Post)		Yes (× Post)		Yes (× Post)	
Constant	25.44***	(4.60)	17.73***	(4.68)	23.62***	(4.64)	27.04***	(4.29)
Observations	140,797		128,896		136,637		153,034	
R2	0.88		0.89		0.89		0.88	

Standard errors in parentheses, clustered at the tariff-level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: All regressions include handset fixed effects. Thus, the time-invariant characteristics of handsets are captured by the fixed effects.

Table B.16: Robustness tests (with all controls)

	(1)		(2)		(3)		(4)	
Estimation method	FE		FE		FE		FE	
Dependent variable	$Price_{it}$		$Price_{it}$		$Price_{it}$		$Price_{it}$	
	Efficient tariffs Main model		Efficient tariffs Controlling for tariff proliferation		Efficient tariffs Controlling for tariff growth		Efficient tariffs Controlling for differentiation	
Post=0 × Share of dom tariffs	4.39***	(0.65)	2.33***	(0.62)	2.33***	(0.62)	4.36***	(0.66)
Post=1 × Share of dom tariffs	1.84***	(0.27)	0.57	(0.34)	0.57	(0.34)	2.18***	(0.27)
O2 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
O2 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Orange × Post=0	-1.49***	(0.14)	-1.48***	(0.14)	-1.48***	(0.14)	-1.45***	(0.14)
Orange × Post=1	-2.01***	(0.11)	-2.01***	(0.11)	-2.01***	(0.11)	-1.98***	(0.11)
Three × Post=0	-8.99***	(0.35)	-8.98***	(0.35)	-8.98***	(0.35)	-8.86***	(0.36)
Three × Post=1	-5.46***	(0.49)	-5.50***	(0.49)	-5.50***	(0.49)	-5.13***	(0.48)
T-Mobile × Post=0	-6.20***	(0.14)	-6.21***	(0.14)	-6.21***	(0.14)	-6.13***	(0.14)
T-Mobile × Post=1	-3.58***	(0.12)	-3.57***	(0.12)	-3.57***	(0.12)	-3.58***	(0.12)
Vodafone × Post=0	-1.69***	(0.19)	-1.70***	(0.19)	-1.70***	(0.19)	-1.72***	(0.19)
Vodafone × Post=1	-2.05***	(0.13)	-2.07***	(0.13)	-2.07***	(0.13)	-2.05***	(0.13)
Contract length=1 × Post=0	9.57***	(0.70)	9.63***	(0.70)	9.63***	(0.70)	9.54***	(0.71)
Contract length=1 × Post=1	15.33***	(0.44)	15.31***	(0.44)	15.31***	(0.44)	15.44***	(0.46)
Contract length=3 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Contract length=3 × Post=1	12.52***	(0.68)	12.64***	(0.68)	12.64***	(0.68)	11.90***	(0.69)
Contract length=12 × Post=0	6.79***	(0.36)	6.83***	(0.36)	6.83***	(0.36)	6.59***	(0.35)
Contract length=12 × Post=1	10.69***	(0.20)	10.69***	(0.20)	10.69***	(0.20)	10.72***	(0.20)
Contract length=18 × Post=0	5.16***	(0.07)	5.16***	(0.07)	5.16***	(0.07)	5.15***	(0.07)
Contract length=18 × Post=1	6.30***	(0.07)	6.30***	(0.07)	6.30***	(0.07)	6.29***	(0.07)
Contract length=24 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Contract length=24 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Contract length=30 × Post=0	-6.27***	(0.72)	-6.27***	(0.72)	-6.27***	(0.72)	-6.25***	(0.71)
Contract length=30 × Post=1	-2.53	(1.72)	-2.60	(1.70)	-2.60	(1.70)	-2.62	(1.72)
Unlimited voice=0 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited voice=0 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited voice=1 × Post=0	35.41***	(0.19)	35.41***	(0.19)	35.41***	(0.19)	38.69***	(0.33)
Unlimited voice=1 × Post=1	33.24***	(0.27)	33.24***	(0.27)	33.24***	(0.27)	36.42***	(0.34)
Post=0 × Voice allowance	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)
Post=1 × Voice allowance	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)
Unlimited SMS=0 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited SMS=0 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Unlimited SMS=1 × Post=0	-0.06	(0.10)	-0.06	(0.10)	-0.06	(0.10)	-0.82***	(0.12)
Unlimited SMS=1 × Post=1	0.68***	(0.09)	0.69***	(0.09)	0.69***	(0.09)	0.09	(0.10)
Post=0 × SMS allowance	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00***	(0.00)
Post=1 × SMS allowance	-0.00***	(0.00)	-0.00***	(0.00)	-0.00***	(0.00)	-0.00***	(0.00)
Unlimited data=1 × Post=0	2.09***	(0.09)	2.09***	(0.09)	2.09***	(0.09)	3.55***	(0.14)
Unlimited data=1 × Post=1	2.04***	(0.16)	2.04***	(0.16)	2.04***	(0.16)	4.82***	(0.25)
Post=0 × Data allowance	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00*	(0.00)
Post=1 × Data allowance	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)
Post=0 × Mixed allowance	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)	0.02***	(0.00)
Post=1 × Mixed allowance	0.00*	(0.00)	0.00*	(0.00)	0.00*	(0.00)	0.00	(0.00)
Handset subsidy=1 × Post=0	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Handset subsidy=1 × Post=1	0.00	(.)	0.00	(.)	0.00	(.)	0.00	(.)
Handset subsidy=1 × Post=0 × Amount of subsidy	0.03***	(0.00)	0.03***	(0.00)	0.03***	(0.00)	0.03***	(0.00)
Handset subsidy=1 × Post=1 × Amount of subsidy	0.03***	(0.00)	0.03***	(0.00)	0.03***	(0.00)	0.03***	(0.00)
Post=1	-5.25***	(0.73)	-5.46***	(0.73)	-5.46***	(0.73)	-5.99***	(0.73)
Number of tariffs			0.10***	(0.01)				
Growth of number of tariffs					0.20***	(0.03)		
Distance with other tariffs							-4.01***	(0.29)
Handset Fixed Effects	Yes (× Post)		Yes (× Post)		Yes (× Post)		Yes (× Post)	
Constant	17.07***	(0.50)	16.78***	(0.49)	16.98***	(0.50)	20.56***	(0.55)
Observations	140,797		140,797		140,797		140,797	
R2	0.88		0.88		0.88		0.88	

Standard errors in parentheses, clustered at the tariff-level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$