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Implications of the 3-to-2 Merger on Telecommunication Service Prices: Case Study of Thailand

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Implications of the 3-to-2 Merger on Telecommunication Service Prices: Case Study of Thailand

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Abstract

In the past decades, Thailand's telecommunication market has accommodated 3 dominant providers ranked by subscribers, namely AIS, TRUE, and DTAC, along with one minor government-owned provider NT. In 2021, TRUE and DTAC requested to merge, which was eventually approved by the national regulatory agency in 2022. The 3-to-2 merger here is likely to be more impactful onto the market than more typically seen 4-to-3 mergers. This paper estimates post-merger changes in prices and whether possible efficiency gained due to the merger would be sufficient to deter the mergers from raising their prices. By using time series data on pre-paid and post-paid subscribers of the major three operators, a merger simulation was employed. The proxy for price used in the simulation was average revenue per user divided by minute of use. The simulation assumed that collusion levels between the 3 operators before and after the merger mirror HHIs, and set the level of efficiency gain at 10%. The result showed a 12.95% increase in market price on average. Upward pricing pressure, under a similar setup, indicated a 7.19% increase in average market price. The result justified retail tariff regulation to limit the negative impact on consumers.

Keywords: Mobile telecommunications, Merger simulation, Upward pricing pressure, Demand estimation, Thailand

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1. Introduction

Mobile telecommunication services are the primary method of communication. Mobile penetration for the world is currently at 110%, while Thailand's is at 169% in 2021 (The World Bank, 2021). Smart phone penetration for leading countries like USA, UK, and Japan are at 82%, 80%, 66% while Thailand's is at 59% in 2021 (Statista, 2018). These indicators are quite impressive as they testify to the emphasis Thai people place on the use of mobile phones. Given that mobile phones have been one of the enabling factors for education (Sophonhiranrak, 2021), provision of accessible financial and payment services (Asli & Leora, 2012), and so on, mobile telecommunication services have been integrated into several aspects of life and flourishing economy.

National Regulatory Agencies (NRAs) are responsible for regulating mobile operators. The National Broadcasting and Telecommunications Commission (NBTC) is the NRA for Thailand that aims to motivate welfare for both the country and its citizens. That means the NBTC aspires to create a balanced environment that is conducive to competition, fairness, yet sufficiently lenient to the extent that operators may conduct their businesses. The NBTC particularly pays attention to aspects of competition as dictated in their legal foundation. For example, the Act on the Organization to Assign Radio frequency and to regulate the Broadcasting and Telecommunications Services B.E. 2553 (2010) granted the NBTC the power to implement policies against anticompetitive practices.

One worrisome trend that potentially thwarts competition is the wave of mergers between telecommunication operators, e.g., one in Europe starting since 2012 (Friederiszick et al., 2018). Mergers, especially horizontal ones, often cause concerns for NRAs. Those who request for approval would say that mergers and acquisitions allow parties to enjoy the economies of scale or scope as well as gain new synergy, which could have led to lower production cost, thereby lower price, and freed up cash flows for more investment. In contrast, a reduction in the number of distinctive firms means lower competition as mergers eliminate competitive constraints on firms via *non-coordinated* effect. With fewer players, firms might more likely coordinate and raise prices or engage in activities that harm competition. Such is called *coordinated* effect (EUR-Lex, 2020).

In Thailand, several mergers have been approved in the past as most of these are between parent company and its subsidiaries, while other cases involved aggregated assets worth less than the imposed limit. The most recent merger between mobile operators TRUE and DTAC, who ranked second and third by subscribers prior to the merger, however, requires closer examination by the commissioners. It raised an alarming concern especially when both were dominant service providers in the mobile market of three. They announced their plans to merge on November 22, 2021, and the NBTC had been contemplating the issue since the start of 2022. Eventually the merger was approved in October 2022, with several remedial action plans (Charoensombatpanich, 2022). The boards of both operators agreed to call their merged company True Corporation (Tortermvasana, 2023).

Past mergers in other countries are often cases where 4 big players were reduced to 3—e.g., in Australia (Farrer, 2018), Denmark, Netherlands (Grajek et al., 2019), and the US (Wallsten, 2019). Thailand's case of 3-to-2 merger is sparsely seen as, to our knowledge, only the Philippines underwent a similar situation and saw the period of duopoly from 2011 to 2021. Filipinos seemingly suffered from disruptive services and slow internet connections during that period (Hardy, 2021). The 3-to-2 merger is likely to be more impactful due to significantly lower competitive pressure.

The objectives of this study are to, firstly, explore the degree to which prices would increase after the merger between TRUE and DTAC, and secondly, examine if post-merger efficiency gain is sufficient to demotivate such price increase. As for the contribution to the literature, our analysis on the price effect of the merger would add to the literature of merger analyses for telecommunications

sector. Our approach also provides an innovative proxy to price as the literature often proxies price by average revenue per user (ARPU) which means that usage quantity is left out. Instead, we standardize by dividing ARPU by minutes of use (MoU), so we strictly get *per unit* price. This definition is not without drawbacks as shall be addressed later.

After the introduction, this study presents a literature review including general concepts and methodology, overview of the Thai mobile market, and takeaways from some cases of global mergers or acquisitions. The reader, who is already familiar with merger analysis using quantitative tools like UPP and merger simulation or more interested in practical application in the context of Thailand, may wish to skip ahead. Subsequently are data and methods for the analysis, followed by results and discussion. A conclusion is then provided along with recommendation and their relevance to the current situation. The last section briefly provides the limitations of this study.

2. Literature review

In this section, the study briefly discusses mergers including acquisitions in some respects, their advantages and disadvantages in contrast to operation as individual entities, concepts, and methodology for measurement of effects of a merger onto relevant markets.

2.1. Mergers: general overview, advantages, and disadvantages

A merger is when two entities combine to create a new joint legal entity through various financial transactions, such as tender offers or acquisition of major assets. Mergers can be categorized in many ways depending on the relationship between the merging firms. For example, according to Hayes (2023), *horizontal* merger is when two merging firms are competing directly against each other and share similar sets of product or services within overlapping markets; *vertical* merger is when a firm merges with either its customer or supplier, thus covering a bigger portion of chain of production; *congeneric* merger is when two firms that serve the same group of customers with different products or services; *conglomerate* is when two firms without common business areas merge.

The advantages and disadvantages of mergers and acquisitions (referred to as M&A) are given in the following table:

Table 1 *lists aspects about business operations, draws a brief conclusion in each aspect, and then indicates whether operating as individual firms vs. merged entity is better.*

Aspects	Who is better off?	
	Individual firms	M&A
Return to shareholders: Event studies in the literature found that shareholders of the target firms benefit, while those of the bidding firms generally break even. The net gains to shareholders of merging firms are thus generally positive (Fridolfsson & Stennek, 2005). In particular, combined returns are likely positive for non-stock acquisition and either neutral or slightly negative for stock acquisition. The reason is that stock acquisition implies that the acquiring firm likely thinks that its own stock is overvalued (Kaplan, 2006).		✓
Accounting profits: Numerous studies on comparison between mergers and control sample of firms found that mergers often lead to a reduction in merging firms' profitability (Kaplan, 2006).	✓	
Growth opportunity: Mergers allow the parties to quickly enter new markets, expand their services and products, acquire intellectual property, know-hows, or innovation, and, lastly, reduce competition (Patel, 2022). M&A allows the firm to capitalize their assets and potentially extend their sales to cover bigger customer base and expect higher customer loyalty (Dahlke & Haemmerlé, 2019). Theoretically, alternatives within the market have been reduced due to M&A, and so loyalty level increases. Furthermore, the acquisition of new resources could extend beyond knowledge to the extent of new management talents and resources, thus leading to development of competitive advantages over other competitors (Akram & Shahid, 2016).		✓

Aspects	Who is better off?	
	Individual firms	M&A
Operation efficiency: M&A potentially allows access to (1) (ray) economies of scale, i.e., production schedule in which average costs exceed marginal costs (Sinay & Campbell, 1995). Larger scale of production allows, for example, fixed cost to be distributed among mergers (Candra et al., 2021); (2) economies of scope, i.e., savings from joint production or cost complementarities (Sinay & Campbell, 1995). M&A allows the firm to exploit its position as market leader and, in telecommunications, to monetize its infrastructure (Dahlke & Haemmerlé, 2019). Despite this potential gain, some studies such as one on Australian telephone services finds that its production exhibits economies of scope but no ray economies of scale (Bloch et al., 2001). Lower production costs open the opportunity for the merger to be more competitive, as it can, for example, capture more market share via lower price.	Unclear	
Risk: Merger involves many risks, e.g., whether realized post-merger synergy is as expected, whether the merging firm is financially stable (Patel, 2022), uncertainty in prices of goods or services after the merger, and financial risk as obtained funds to complete the merger are expected to have some certain level of return on investment (Candra et al., 2021). Furthermore, actual costs and difficulties caused by integrating the merging firms could be higher than expected (Hartman, 1996). On the other hand, merger between firms not in the same market can lower idiosyncratic risks via diversification.	Unclear*	

* Individual firms could be better off in the sense that individual firms do not face risk from unknown factors associated with the other party. The merger could lower such risk through the process of due diligence. In the process, the merger needs to seek consultants with respectable expertise. Doing so could cost quite a fortune and is part of the pre-merger or pre-acquisition cost (Candra et al., 2021).

The advantages and disadvantage listed in **Table 1** is to be taken as a general observation, since realized benefits and costs heavily depend on the circumstance of each M&A.

2.2. Concepts and Methodology on the Analysis of the Effects due to Mergers

From here on, we are focusing mainly on mergers as the case of TRUE and DTAC is a horizontal one. Currently, DTAC offers only mobile services, while TRUE offers both mobile and fixed services. Given that both have one overlapping substitutable service within the same national market and both have significant market shares, we focus only on the impact of the merger on mobile services.

The economic framework for studying the effects of mergers by the NBTC closely follows OECD (2020)'s Economic Analysis in Merger Investigations. The following steps are considered. In *step 1*, market concentration, level of competition, and factors affecting market power such as barriers to entry and countervailing power are examined per boundary drawn by market definition. In *step 2*, realize the possible loss in welfare as mergers tend to reduce competitive pressure and lead to higher prices borne by consumers, yet cost saving through possible efficiency gained might offset such loss. In *step 3*, examine the effects the merger has on the industry's structure and eventually the competition by measuring, for example, unilateral effects and coordinated effects. A few quantitative techniques mentioned in the OECD's document that were chosen for this study are measuring diversion ratios, upward pricing pressure (UPP) and its popular derivatives such as GUPPI, as well as merger simulation (MS). Lastly, OECD mentions that it is imperative that the quantitative analyses be complemented by qualitative ones.

We now review standard approaches for computations of, firstly, UPP and then MS.

2.2.1. Upward Pricing Pressure (UPP)

The origin of UPP can be traced back to Shapiro (1995). Farrell and Shapiro (2010) propose that UPP be used to indicate the merger's unilateral effects. Positive net UPP requires further examination. Suppose that there are two merging firms, each of which produces a single product namely product 1 and 2, with pre-merger prices P_1 and P_2. Each product has marginal cost C_1 and C_2.

The diversion ratio from product 1 to 2, D_{12}, is defined as fraction of sales gained by product 1 when P_1 falls that comes at the loss of sales of product 2. Suppose further that the merger creates efficiency of E_1, meaning that the merger reduces the marginal cost of product 1 by E_1C_1. The net UPP on product 1 is thus defined as

$$UPP_1 = D_{12}(P_2 - C_2) - E_1C_1$$

The idea behind UPP is that competing to gain more sales exerts negative externality on the other merging party. Once merging firms internalize this additional cost imposed on each other, they are motivated to act less competitively. Furthermore, the higher the degree of substitutability between merging firms' products, the more likely the firms would raise their prices. The higher degree of substitution corresponds to higher diversion ratio and higher pre-merger margin, both of which raise the chance of UPP being positive.

Farrell and Shapiro (2010a) provide suggestions and caveats in the interpretation of UPP. For example, marginal cost likely cannot be represented by average variable cost; a more appropriate alternative is average increment cost measured over some change in output. Limitation of UPP, such as its inability to address coordinated effects, has been raised. Using UPP with regards to other evidence is advised.

Given that UPP has currency unit, it can be expressed as a percentage of pre-merger price or marginal cost. To render UPP unitless, Valletti and Zenger (2021) defines Gross Upward Pricing Pressure Index (GUPPI) (following Salop and Moresi (2009), as cited in Valletti and Zenger (2021)) as follows:

$$GUPPI_1 = \frac{UPP_1}{P_1}$$

However, GUPPI measures just the *first round* of pre-merger externality that firm 1 exerts onto firm 2. It ignores the feedback effects, since firms are bound to react and, thus, prices would gradually build up into higher post-merger prices. Following Werden (1996), as cited in Valletti and Zenger (2021), another alternative to measuring price pressure is Compensating Marginal Cost Reductions (CMCR). CMCR measures the magnitude of marginal cost reduction as ratio of pre-merger price needed to completely offset the motivation to increase price, and thus already integrates all feedback effects between firms. GUPPI provides a lower bound of potential price increase, however CMCR provides the upper bound. CMCR is defined here under the same setup as UPP's where we consider two merging firms, each of which is producing just one good.

$$CMCR_1 = \frac{D_{12}(P_2 - C_2)\frac{P_2}{P_1} + D_{12}D_{21}(P_1 - C_1)}{1 - D_{12}D_{21}}$$

As for computation of relevant values, Valletti and Zenger (2021) suggest several alternatives. Diversion ratio can be estimated from mobile number portability (MNP) switching data, customer surveys, or demand estimation. For example, the European Commission drew preliminary diversion ratios from MNP data; however, they noted some limitations of MNP including that it captures switching patterns where users ported their numbers, not cases where they simply disregarded their old SIM and replaced with a new one. Furthermore, switching does not necessarily reflect effects from pricing alone, whereas diversion ratio is restricted to change in price (*CASE M.7612 - HUTCHISON 3G UK / TELEFONICA UK*, 2016). A similar concern regarding the use of MNP by the Commission in European cases of mergers and acquisitions was summarized by Friederiszick et al. (2018).

2.2.2. Merger Simulation (MS)

MS is used to calculate price effects with economic models that replicate demand or supply. Valletti and Zenger (2021) consider static effects of a merger, meaning that product attributes are assumed fixed. They mention two broad categories of MS. The first is calibrated MS, where price prediction is made based on observable pre-merger data such as market shares, diversion ratios, and margins. One approach is called first-order approach (FOA) that aims to estimate pre-merger pass-through matrix using information in the local proximity to pre-merger equilibrium. The second category is MS based on demand estimation that relies heavily on the econometric estimation of parameters that characterize competition within the market. Key implications such as diversion ratios are obtained from derived demand system as well. Some estimation techniques include nested logit models and more complex variants like random coefficients logit models.

Björnerstedt and Verboven (2014) provide implementation of MS in Stata software via command *mergersim*. They propose estimating nested logit demand system with a linear regression model. Their programming implementation specifies that the firm sets its own price to maximize profit given constant marginal cost. Marginal costs for all products are uncovered using pre-merger prices and an estimated demand system. Nested logit demand can be traced back to McFadden (1978)'s discrete choice model. Consumers choose a single alternative or an outside good that maximizes their random utility. Nested structure avoids the independence of an irrelevant alternative property seen in simplistic logit model, as it allows correlated preferences for products that belong to the same subgroup. Estimation model might involve unobservable terms of attributes that are unobservable to the econometrician, meaning there is endogeneity associated with price. This estimation problem must be corrected using instrumental variables. Björnerstedt and Verboven (2014) provides more in-depth detail regarding model setup, estimation, and Stata command. Valletti and Zenger (2021) provide more information on the relationship between different tools, including UPP-based tools and MS as well.

2.3. Some other practical raised concerns regarding mergers

EUR-Lex (2020) raises many concerns, some of which we find relevant to the situation in Thai telecommunications market. First is coordinated vs non-coordinated effects. Non-coordinated effects are measured quantitatively using GUPPI and MS, while coordinated effects can be measured using MS where we modify the parameter in *mergersim* command that indicate degree of collusion. Secondly, mergers may hinder expansion by competitors. Thirdly, effects of mergers upon buyers depend on countervailing buyer power—bargaining power exercised by the buyers, e.g., its ability to switch to other suppliers, and the size of buyer groups. Fourthly, the likelihood of entry and barriers to entry. These concerns regarding wholesale interaction shall be addressed in the following topic where we discuss structure of Thai telecommunications market. Lastly, efficiency gained from merging. This can be addressed by plugging in different values of efficiency into corresponding parameter in both UPP and MS analyses. This is essentially a sensitivity test.

3. Overview of the Thai mobile market prior to the merger

In the very beginning, two state-owned operators—namely the Telephone Organization of Thailand (TOT) and the Communications Authority of Thailand (CAT)—serve mobile telecommunication services in Thailand. Later, three private companies—namely Advance Information Services (AIS), Total Access Communication (DTAC), and True Corporation (TRUE)—were granted concessions to operate mobile services. In 1986, AIS obtained a 20-year concession from TOT to provide mobile phone services using 900 MHz frequency. Later in 1987, DTAC received concession from CAT for operation on 800 MHz and 1800 MHz; meanwhile, TRUE received similar contract in 2002 for operation on 1800 MHz. Nevertheless, the Telecommunications Business Act B.E. 2544 (2001)

mandated that the two state enterprises and the concessionaires may only operate until the termination of their concessions, as spectrum bands were deemed national resource that must be redistributed efficiently by the NRA, namely the NBTC.

In 2011, the NBTC was successfully formed and able to hold an auction for 2100 MHz spectrum, where each of the major three operators (AIS, TRUE and DTAC) won three blocks of 2 x 15 MHz spectrum at the reserve price. To facilitate development of mobile services, the NBTC held auctions in 2015 to 2018 and 2020. Crucial standard bands for 4G mobile services like 900 MHz and 1800 MHz were auctioned early on, while bands more suitable for 5G like 700 MHz, 2600 MHz, and 26 GHz were auctioned in 2020. Also, in 2019, 700 MHz was allocated per dictated by the military-ruled government. In fact, the mobile operators must apply for 700 MHz if they wanted to have a payment extension plan for 900 MHz to alleviate financial burden due to its world-record setting price. The major three operators opted for such an opportunity.

The following **Table 2** provides a summary of spectrum holding of the three major operators. Since CAT and TOT merged to form the National Telecom PLC (NT) in 2021, they are thus referred as such in the table. Note however that NT's market share is merely 2.81% by Q3 of 2021; thus, they are the smallest network operator. In Q3 of 2021, AIS had the highest market share of 46.82% by subscribers, while TRUE had 32.52% and DTAC had 17.82%. By the end of 2022, AIS owned licenses to operate on 1420 MHz of spectrum, the largest share by far. TRUE owned licenses to operate on 990 MHz of spectrum. Using partnership scheme, DTAC had access to 330 MHz, among which 60 MHz was under the contract with NT.

Table 2 *provides size of customer base, spectrum holding, financial status, and offered services for mobile network operators in Thailand.*

Service provider (first year of service)	Number of mobile subscribers by (end of 2022)	Allocated frequency (license expiration year)	Amount of frequency held (MHz)	Mobile-related only financial performance in 2022 (million Baht/value per subscriber)	Services provided*
AIS	46,013,100	2100 MHz (2027) 1800 MHz (2033) 900 MHz (2031) 2600 MHz (2035) 700 MHz (2035) 26 GHz (2035)	2 x 15 2 x 15 2 x 15 100 2 x 15 1200 Total: 1420	OPEX: 22,353/485.80 CAPEX: 32,319/702.39 Revenue: 185,485/4,031.14 Profit: 26,014/565.36	MV, MI FV, FI
DTAC	21,159,292	2300 MHz (2025)* 2100 MHz (2027) 1800 MHz (2033) 900 MHz (2033) 700 MHz (2035) 26 GHz (2035)	60 2 x 15 2 x 5 2 x 5 2 x 10 200 Total: 330	OPEX: 13,212/624.42 CAPEX: 18,087/854.77 Revenue: 80,600/3,809.25 Profit: 3,119/147.41	MV, MI
TRUE	33,776,769	2100 MHz (2027) 1800 MHz (2033) 900 MHz (2033) 2600 MHz (2035) 700 MHz (2035) 26 GHz (2035)	2 x 15 2 x 15 2 x 10 90 2 x 10 800 Total: 990	OPEX: 33,757/999.41 CAPEX: 39,809/1,178.58 Revenue: 135,076/3,999.05 Profit: -18,394/-544.57	MV, MI FV, FI
NT	2,835,112	850 MHz (2025) 2100 MHz (2025) 2300 MHz (2025) 700 MHz (2035) 26 GHz (2035)	2 x 15 2 x 15 60 2 x 10 400 Total: 540	Their 2022 financial report has not been released at the time of writing.	MV, MI FV, FI

source: Bloomberg, The Stock Exchange of Thailand (SET), Office of The National Broadcasting and Telecommunications Commission (NBTC). ** spectrum usage is due to partnership between DTAC and TOT.

* Services provided are denoted by the following notations. MV = mobile voice; MI = mobile internet; FV = fixed voice; FI = fixed internet. Note further that these four are network operators; so, all of them provide wholesale services as well. Most operators often confine the provision of wholesale services to just within themselves or their own subsidiaries. Domestic roaming was limited to certain regions in the country. Only NT currently hosts mobile virtual network operators (MVNOs), whose total market share was negligible by the end of 2022.

Figure 1 depicts trajectories of subscribers to the major three mobile operators in Thailand. It is apparent that DTAC has been losing its customers to AIS and TRUE, following its failure to secure 1800 MHz and 900 MHz from the auction back in 2016 despite its pickup of both bands in the smallest lots in 2018.

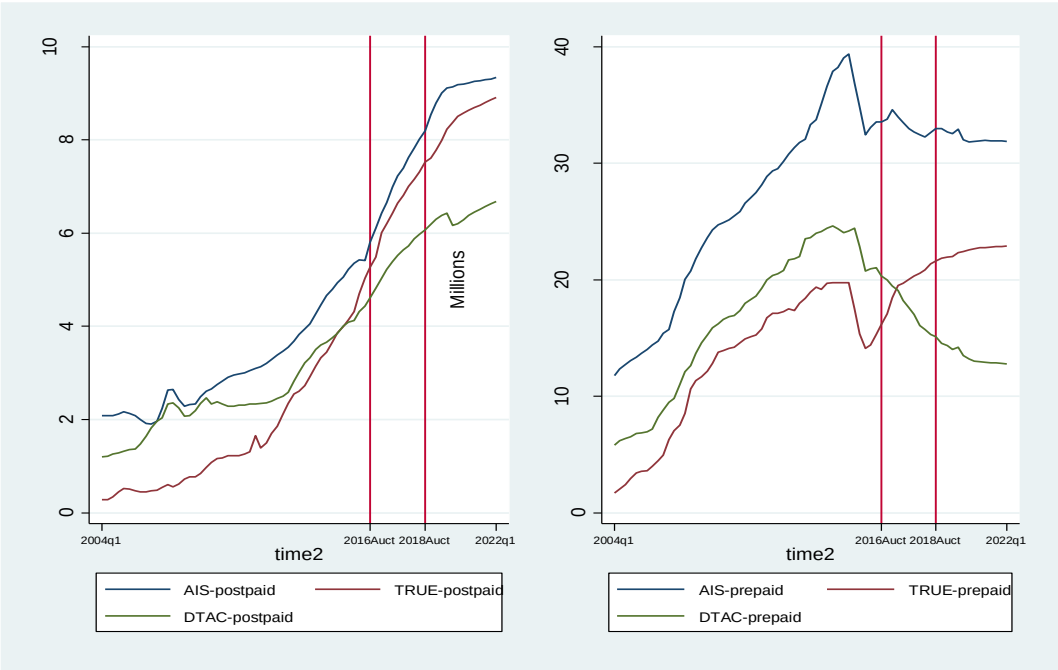

***Figure 1** depicts subscribers by operator and type of service. The first 900 MHz and 1800 MHz auction was held in 2016, marked by "2016Auct", which were ultimately picked up by AIS and TRUE. The second auction of these bands were held in 2018, marked by "2018Auct", in which DTAC won some lots.*

More importantly, the merger between TRUE and DTAC is a horizontal merger, as both are vertical network operators albeit having different portfolios of selling products. Each firm controls significant portions of wholesale and retail markets. Furthermore, the major operators rarely share infrastructure, be it passive or active types; therefore, the merger does not raise concern about foreclosure more than it already does. The one that likely stands to lose the most from the merger is the end users, and so we choose to focus on post-merger prices in this study.

4. International practice and lessons learned

4.1. Implications from international cases of mergers and acquisitions

In this section, we examine other global cases of mergers as they reflect both concerns and corrective measures. We consider the following cases in these four countries:

4.1.1.Philippines

Acquisition approved: formation of the duopoly. In 2011, the Philippine Long Distance Telephone company (PLDT) bought controlling stake in Digital Telecommunications

Philippines (Digitel) that owned the third-largest mobile operator, Sun Cellular. PLDT, under the brand of Smart, then owned a combined market share of 69%. The other operating company operating at the time was Globe Telecom. At the time of merging, Digitel announced that the network, despite having been merged, would continue its rollout of broadband services and other next generation technologies (Olandres, 2011). For the mergers to be approved, the National Telecommunications Commission (NTC) ordered PLDT to divest 10 MHz of 3G radio frequencies to level the playing field with Globe Telecom. Furthermore, the NTC ordered PLDT to retain provision of highly competitive plans offered by Digitel prior to the merger. These conditions were imposed to thwart the mergers from abusing their increased market power (Lucas, 2011).

The period of duopoly from 2011 to 2020. The World Bank's Digital Economy Report 2020 indicates that the effective duopoly market structure was disadvantageous to smaller ISPs, especially when there are no open access or nondiscriminatory pricing regulations (World Bank, 2020). Furthermore, this has been supplemented by a 2015 study by the think tank LIRNEasia that found that internet users in the Philippines paid more for lower quality services when compared to other Asian countries (OOKLA, 2022).

Entrance of a new player. The third player, DITO, entered the market in March 2021. The entrance led to an improvement of 4G performance, as operators seemed to have made more investment. Furthermore, DITO revamped the competition landscape as it tried to differentiate itself from the other two operators by delivering faster speeds, distinctive customer experience, and offering simpler products (OOKLA, 2022).

Lessons learned. The acquisition and the effective duopoly structure seemingly led to lower investment, higher price, and lower-quality services. It ultimately led to negative repercussions beyond worse internet usage experience when compared to other countries. For example, Salac and Kim (2016) found that inefficiency in internet connection in the Philippines thwarts the motivation to innovate as well.

4.1.2.Australia

Merger proposal and merging firms' standings at the time. In 2018, the horizontal merger between the mobile operator with the market share of 17%, Vodafone, and the second largest fixed broadband operator TPG was announced. TPG at first intended to enter the mobile market and became the fourth mobile network operator, following its acquisition of 700 MHz, 1800 MHz, and 2.5 GHz bands (Kidman, 2017). Furthermore, TPG at that time provided retail mobile services as MVNO under its own retail brands. In 2017, Vodafone started supplying fixed broadband services to customers in selected cities as well (ACCC, 2019).

Australian Competition and Consumer Commission (ACCC)'s opposition to the merger. ACCC released a statement saying that the proposed merger between the two would likely reduce competition, as TPG had planned to and invested accordingly with the aim of entering the mobile market. Furthermore, Vodafone would likely be interested in entering the fixed broadband services as well. More importantly, the merger would preclude TPG from entering as the fourth mobile network operator (ACCC, 2019).

Merger approved by the Federal Court. In February 2020, the Federal Court decided that the merger would not have significant impact onto the competition, and thus allowed the two firms to merge. There are other reasons as well, such as TPG's insertion that they would not roll out a mobile network if the merger was disapproved. Much emphasis was given on the

quality of competition, as having four competitors needs not mean strictly better competition than having three competitors. The merged firm would stand a better chance at competing against the two incumbent mobile operators Telstra and Optus (Zuk, 2020).

Lessons learned. There are many concerns regarding mergers. Loss in competitive pressure is expected in any merger; however, a merger in this case reduces the costly entry and motivates the smaller operator against the bigger incumbent ones.

4.1.3.The EU

Instances of mergers. There are many instances of mergers and attempts to merge in the EU. Tyagi (2018) studied these cases and drew several remarks regarding conditions under which the European Commission approved or disapproved mergers. The following detail was drawn from his study.

Details regarding each merger case. The two cases considered are Hutchison 3G (H3G) and Telefónica UK (prohibited), and H3G Italy/WIND/JV (approved).

Case H3G Italy/WIND/JV: The parties proposed remedies including strong ones such as entry of Iliad as a new MNO into the Italian market. The merging parties claimed that the mergers would bring more investment, as MNOs in the Italian market back in 2016 often shared only passive infrastructure. The Commission thus considered the alternative—Network-Sharing Agreement (NSA)—that can create similar efficiency without threats to competition. Nevertheless, NSA contains some flaws such as anti-competitive practice through coordinated effects, and delay in investment if the parties sharing the active infrastructure disagree on said investment. Furthermore, the European Commission considered the structure of the market. For example, prior to the merger, the Italian market had four MNOs as well as many MVNOs. H3G was an important competitive force, as it provides network access to many niche MVNOs. Moreover, post-merger structure would be characterized by operators whose market shares become more symmetric, meaning that the MNOs are more likely to coordinate, compete less aggressively, and raise price.

The merging parties offered ex-ante remedies where they sold divested assets, access to some spectrum, and network access that ensured smoother operation for Iliad, the French MNO. Iliad was also deemed a suitable candidate as it had experience and resources. Such structural remedy is clear-cut and sufficiently alleviates competition concerns.

Note that the merger was approved despite empirical evidence in favor of negative impact of the merger without remedies. For example, calibrated merger simulation for baseline scenario predicted price change in the range of 10 – 13% for WIND and H3G Italy after the merger (*CASE M.7758-HUTCHISON 3G ITALY / WIND / JV*, 2016).

Case H3G/Telefónica UK: Ofcom, the regulatory body for the UK, considered the interaction between MNOs and MVNOs. For example, Ofcom pointed out that the merger would likely impede wholesale access, due to the loss in presence of a significant bidder in bidding contract negotiations for wholesale access. The market structure was also considered. Emphasis was given to the NSAs. The merger would likely have an adverse effect on investment into networks, as both merging parties operated on different NSAs. The Commission examined past behaviors and merging firms' strategic standings as well. For example, they found that H3G was quite a *maverick* as they offered innovative packages that motivated other MNOs to follow suit in the past.

The parties proposed several remedies. They offered to divest their stake in Tesco Mobile, one major MVNO in the market, to create an independent MVNO. Furthermore, they promised to bring in a new entrant, NEO, which would have wholesale access to the merged firms. They offered to amend the NSAs by committing to using both networks regularly. Nevertheless, the Commission found these remedies not sufficient.

The Commission examined the closeness of competition between H3G and Telefónica using quantitative tools such as diversion ratios. The Commission calculated diversion ratios based on both MNP data and survey data where they tried to elicit stated behaviors and switching patterns in response to price changes (*CASE M.7612 - HUTCHISON 3G UK / TELEFONICA UK*, 2016). Diversion ratios were mainly focused on end users, and they separated computation for prepaid and private segments. The Commission also used GUPPI, CMCR, and merger simulation. For instance, the calibrated merger simulation indicates that the merging firms' price increase is much higher than others in the market. Diversion ratios also indicate that the merging parties were likely the best alternatives for one another.

Lessons learned. Tyagi (2018) drew some important lessons as follows. Unilateral effects are evaluated alongside whether merging parties are close competitors and whether some are considered *maverick*, e.g., players with innovative business strategy. Furthermore, there seems to be no magic number regarding how many MNOs should be sustained, as it is more about the competition's quality. Many examples pointed out that 4-to-3 mergers were approved if remedies would adequately address competition concerns. One solution is the creation of competition through market structure, such as introduction of a new MNO in place of the merged one through upgrading MVNO or recruiting a new player.

4.1.4.USA

Merger proposal. The proposal to merge Sprint with T-Mobile was first started in 2014 during Obama's administration. Antitrust concerns however paused the attempt at merger. In 2018, the talk about merger was restarted (Roumeliotis, 2018). FCC Chairman at the time, Ajit Pai, voiced support of the merger as the merging firms could provide nationwide 5G services due to Sprint's access to mid-band spectrum but its lack of capacity to expand into serving rural parts (Wagner, 2019). In contrast, the Communication Workers of America opposed by saying that the merger could have resulted in more than 28,000 jobs lost based on an analysis on data of retail stores of both operators (Wagner, 2018a). Cable provider Altice voiced their concern over prohibitive power of the merger on its potential expansion into the wireless market as an MVNO. DISH also claimed that the merger would likely lead to increase in price by drawing lessons from mergers, for example, in Austria where inflation-adjusted price was shown to have increased after the merger between Orange Austria and H3G Austria (Wagner, 2018b).

Merger approved by the Federal Communications Commission (FCC). In 2019, the FCC approved the merger due to many reasons (FCC, 2019). Firstly, the merger would help reduce the digital divide across the US and advance the 5G deployment. The merging firms committed to deploying 5G services to cover 97% of the population within three years. Furthermore, they committed to providing 90% of Americans with access to mobile broadband services with speed exceeding 100 Mbps. Furthermore, the merger's divestiture of Boost Mobile, Sprint's prepaid brand, alleviated some reduction in competition. Lastly, the merger would coincide with the entry of a new mobile network operator, DISH. DISH would receive Sprint's prepaid subscribers, 800 MHz spectrum, some retail stores and cell towers, as well as access to the

merged firm's network (Wang & Morton, 2021). DISH would enter the wireless market as the fourth operator and committed to deploy 5G broadband network capable of serving 70% of the US population within June 2023. In other words, DISH's entry would alleviate the loss in competitive pressure within the market (Hardesty, 2020). Eventually, the two firms merged to become T-Mobile in 2020 (Wagner, 2020).

Lessons learned. Like other cases where a merger was approved, the merging parties must provide some redeeming features or promises to be delivered in the future that alleviate the regulator's concern about reduced competitive pressure. In this case, despite potential reduction in competition brought about by the merger between the third and fourth largest operators (Dano, 2018), T-Mobile and Sprint, the merger was eventually approved due to having a new entrant, asset divestiture, and verifiable claims committed by the merging parties.

Overall, instances of mergers in many countries imply that mergers are allowed if there are redeeming remedies. The remedies to fix the structure of the market, such as bringing in a viable entrant seem highly appropriated by the regulators. The case of Philippines however served as one example where relatively lax remedies like divestiture and retention of innovative promotion plans did not sufficiently address competition issues.

4.2. Discussion about efficiency gain

4.2.1. Lessons learned from other mergers

In this part, we presented preliminary findings on efficiency gain in some merger cases during 2014 to 2020 across the globe. Efficiency gain is defined as a change in marginal cost relative to marginal cost in the previous period. We estimated marginal cost using EBITDA margin and published price of high-consumption basket (140 minutes + 70 SMS + 2 GB) provided by International Telecommunication Union (ITU, n.d.). Data on EBITDA and price for this specific basket (denoted as P_t) in both the year of the merger (denoted as t) and the following year are used to approximate the change in marginal cost (denoted as MC_t) as follows.

$$\mathrm{EBITDA_t} \approx \frac{P_t - MC_t}{P_t}$$

$$MC_t = P_t(1 - \mathrm{EBITDA_t})$$

$$\text{short} - \text{term efficiency gain} = \Delta MC_t = \frac{MC_{t+1} - MC_t}{MC_t}$$

The cases of mergers in the US, Europe, and India are considered. Efficiency gains are reported in **Table 3**.

Table 3 *shows rough estimates of percentage change in marginal cost due to mergers in several countries from North America, Europe, and Asia.*

Region	North America	Europe					Asia
Country	**USA**	**Netherlands**	**Italy**	**Norway**	**Germany**	**Ireland**	**India**
Merging parties	T-Mobile and Sprint	T-Mobile and Tele2	Hutchison and Wind	Telia and Tele2	Telefónica Deutschland and E-Plus	Hutchison 3G UK and Telefónica Ireland	Vodafone India and Idea Cellular
Year	2020	2019	2016	2015	2014	2014	2018
$\%\Delta MC_t$	-10.53%	-5.36%	-19.74%	-0.47%	-28.48%	-16.56%	-25.33%

The calculation shows that all mergers seem to have led to lower marginal cost, which is effective right within one year after the merger. The range is from -0.47% to -28.48%.

4.2.2.Possible efficiency gain in the merger between TRUE and DTAC

In reference to list of items in the **Table 1**, we find that the merger between TRUE and DTAC likely benefits the firms in terms of growth opportunity and operation efficiency. The reason is that both firms have overlapping markets, and both provide mobile services. Fixed costs can be distributed among larger customer bases; therefore, economies of scale are likely. Monetization of infrastructure is likely increased, as both firms have extensive network's 4G coverage now. Under the umbrella of TRUE Corporation are companies that offer services other than mobile services such as TrueMoney wallet for financial services, TrueID for entertainment, etc. Former DTAC customers may have access to these services at a discount. This leads to a higher degree of customer loyalty and higher switching costs if these customers were to switch to AIS.

As for the computation of possible efficiency gained due to a merger, there are several attempts to estimate some tangible numbers. For example, Andini and Cabral (2011) use the average market share as indicator of market concentration. They estimate separate reduced-form models: one that uses market share to explain price, and the other that uses market share to explain price-cost margin. The reduction in post-merger marginal cost is derived using similar methodology as in section 4.1, where change in market share is defined as difference between average market share pre-merger and post-merger. Jeziorski (2014) estimates fixed-cost efficiency from mergers that would rationalize merger decisions in the data by making use of the estimates of extra revenues generated by mergers. Gantumur and Stephan (2007) use counterfactual technique base on propensity score matching to take care of observed and unobserved heterogeneity between the merged firms and the control group. They find that M&A in general has a better innovation performance.

Due to difficulty in the estimation of efficiency gain, limited implication from international cases, and the need for forensic accounting if one was to estimate the efficiency more accurately, we decided to adopt a simpler approach by running sensitivity test where we consider a range of efficiency gain from 0% to 10%.

5. Data and methods

Our objective is to analyze the impacts the merger between DTAC and TRUE exert onto competition, where we are mainly concerned with changes in price. We are using two approaches in the analysis: Upward Pricing Pressure (UPP) and Merger Simulation (MS). The analysis will consist of two major scenarios: one is when major players in the market are non-collusive, and the other is when they collude. UPP would quantify unilateral effects, while MS would consider behavioral response by AIS. Both are universally used tools as seen from review of several merger cases earlier. In this section MS is considered first and then UPP.

5.1. Merger Simulation (MS)

Our method follows Björnerstedt and Verboven (2014). Since the discrete choice model is rooted in utility maximization where utility is invariant across individuals is widely known, we chose to present a brief sketch of the model. We list our specifications befitting Thai context as follows:

Step 1: characterization of demand

Assume that consumers' decision depends on price, product's characteristics (number of users as it denotes network effect and quality) as well as characteristics unobserved by econometricians. We further assume that decision-making process is nested, meaning that, first,

consumers decide whether to purchase prepaid or postpaid service, or none; second, they decide whether to opt for AIS, TRUE, or DTAC. The decision making can be represented by the diagram.

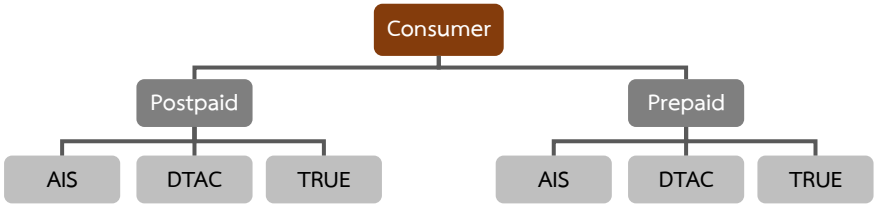

Figure 2 *illustrates decision process by a consumer who chooses to exclusively use either postpaid or prepaid.*

Furthermore, assume that that each person purchases at most one service (defined by operator and type of service) as often assumed in a discrete choice model. However, Thai market displays the fact that each person on average uses more than one SIM (Kemp, 2021). Therefore, to amend this, we assume that the market size in each period be *potential* market size, which is the product of average SIMs per user and the number of population in corresponding period. This adjustment permits the possibility that some people might choose not to purchase any package.

The use of mobile service j brings about utility to the consumer in the form of:

$$U_j = -\alpha P_j + X_j\beta + \xi_j + \varepsilon_j + (1-\sigma)\varepsilon_{jg}$$

where P_j is price of service j; X_j is factors that affect demand; ξ_j is unobserved characteristics thereby bringing about endogeneity issue with price; σ denotes the substitutability level among services within the same group; both ε denote error terms. The joint distribution of the errors is generalized extreme value. Also, ε_{jg} within each subset g are correlated with each other. The nested logit model allows partial relaxation of the assumption of independence of stochastic components of utility of alternatives, avoiding the issue of independence of irrelevant alternatives (IIA) across subsets of goods (McFadden (1978), Mcfadden (1981), as cited in SAS (n.d.)). Share of service j is defined as

$$s_j = \Pr\left(U_j > U_{j'}, \forall j' \in J - \{j\} \middle| \boldsymbol{X}, \boldsymbol{P}\right)$$

Furthermore, the ratio between share of service j and share of choosing no service can be shown to be

Equation 1

$$\ln\left(\frac{\hat{s}_j}{\hat{s}_0}\right) = -\alpha P_j + X_j\beta + \xi_j + \sigma \ln s_{j|g}$$

where g denotes group of services that are substitutes to j, e.g., if j is AIS-prepaid, then g would denote all prepaid services offered by AIS, True, and DTAC.

Step 2: define interaction between producers

This step is characterization of pre-merger stage. Assume that the three operators (AIS, TRUE, DTAC) compete with price (in the spirit of Bertrand) where services are differentiated, and marginal cost is constant in each period. Assume that operators are profit maximizers and can only change prices of their own services. The equilibrium under this setup would be Bertrand-Nash. In case that operators collude such that profit(s) of colluding firm(s) matter in own decision making, the model reserves coefficient ϕ to denote the level of collusion. It enters the profit function for firm f as follows:

$$\Pi_f(\boldsymbol{p}) = \sum_{j \in F_f} (p_j - c_j) q_j(p) + \phi \sum_{j \notin F_f} (p_j - c_j) q_j(p)$$

We can derive FOCs by differentiating with p_j for any $j \in F_f$, the set of outputs by firm f. Further, we can compute matrix inversion of FOCs to derive past marginal costs for all services once we have estimated demand as specified in **Equation 1**. If there is no collusion prior to the merger, then ϕ equals 0. Otherwise, setting a positive ϕ denotes collusion among the three operators. Change in value of ϕ would result in different set of MCs.

Step 3: analysis of the post-merger stage

We are interested in quantifying likely changes in price. We are also concerned with efficiency gain, i.e., reduction in MC, which might happen after the merger. The level of collusion post-merger can be changed by changing the value of ϕ. Once both degree of collusion and efficiency gain have been configured, the optimal set of prices that satisfy FOCs for profit maximization are computed using the estimated demand system. Individual services' change in prices after the merger can then be calculated, along with the market average.

As for estimation method, **Equation 1** is estimated using 2SLS with fixed effects, following Björnerstedt and Verboven (2014). Instrumental variables (IV) must be used to correct the endogeneity of price. Typically, IVs for demand equation are supply-side variables. Berry et al. (1995) suggest that functions of characteristics of other related goods are also viable instruments. MS would be completed using STATA command *mergersim*, provided by Björnerstedt and Verboven (2014).

Data used in MS

The following data are used for estimation of demand system per model specification given by **Equation 1**. The equation denoting the share of product j with respect to not using any product, now with time subscript t to denote time, is reproduced below.

$$\ln\left(\frac{s_{jt}}{s_{0t}}\right) = -\alpha P_{jt} + X_{jt}\beta + \xi_{jt} + \sigma \ln s_{j|g,t} + \varepsilon_t$$

Table 4 *lists variables used for estimation of demand system, source of data, and rationale behind the use of each variable.*

Variable	Proxy	Rationale
Dependent variable		
s_j/s_0	s_j refers to the market share of service j, where market size is a *potential* market size. Here j is characterized by both (1) type of service: prepaid or postpaid; and (2) provider: AIS, TRUE, or DTAC. s_0 refers to the market share of not using mobile services. Potential market size at time t is computed by multiplying concurrent population with concurrent penetration rate.	Potential market size is greater than actual population at any time, as on average Thai person possesses more than one SIM card.
Independent variables		
P_j: price	Price's proxy is average revenue per user (ARPU) divided by minute of use of voice service per month (MoU). The unit is thus in THB/minute/month.	Due to potential difference in actual use volumes for each service provider, we attempt to standardize using MoU; however, such method has limitations that shall be addressed later. Breaking down ARPU into parts related to voice and non-voice would be ideal, but it cannot be done due to limitation in data. Per law of demand, we expect that $-\alpha$ should have a negative sign (α be positive).
X_1: lagged subscribers	This variable is the number of subscribers in the previous period (t-1)	These two together potentially explain the network effect—the more subscribers there are,

Variable	Proxy	Rationale
X_2: lagged subscribers squared	This variable is the number of subscribers in the previous period (t-1) squared	the higher the utility a user may derive from joining said network. Lagged value is used, instead of current one, to circumvent the issue of endogeneity. We expect that the benefit incurred at the last unit (marginal benefit) should decline. To capture such changes, we thus propose using both lagged subscribers and its square.
X_3: 3G coverage	Percentage of population that have access to 3G services	These factors denote the quality of services. The more coverage the service provider has, the better the user experience. 3G has been made available since 2013 (Pearce & Phoosuphanusorn, 2013a). True had deployed 4G services earlier than others back in 2013, but it was not well adopted given limited handsets were 4G-compatible (Pearce & Phoosuphanusorn, 2013b). 4G was made commercial with considerable coverage in 2015, following the 1800 MHz spectrum auction (Capacity Magazine, 2015). Nowadays 4G has become a new standard; even 5G services now are becoming available everywhere (Business, Bangkok Post, 2020). However, in the past, 4G could potentially be considered luxurious to some group of people.
X_4: 3G coverage squared	Percentage of population that have access to 3G services squared	
X_5: 4G coverage	Percentage of population that have access to 4G services	
X_6: 4G coverage squared	Percentage of population that have access to 4G services squared	
$s_{j\|g}$: share of product	Share of service j within the same group of services namely group g.	This factor makes the user's decision-making process more realistic, as we posit that users first choose whether to use prepaid or postpaid, and then choose the service provider. σ_g thus denotes the level of substitutability among services within the group. The coefficient for this variable is theoretically between 0 and 1. Higher value is associated with higher degree of substitutability.
Instrumental variables		
IV_1: CAPEX	Capital expense in fixed assets such as network	These two are cost-side variables that potentially cause demand shift, and thus are often chosen to be IV for demand estimation. For example, in the estimation of fish demand, Angrist, Graddy, and Imbens (2000) uses dummies for wind speed and wave heights, both of which affect fishing activities from the supply side (Angrist et al., 2000).
IV_2: OPEX	Operation expense such as administrative and personnel cost	
IV_3: average of other operators' lagged subscribers	The average number of subscribers of other service providers in the previous period	This serves as IV that shows network effect or quality of other operators. This variable could potentially capture competitive pressure exerted by other players. Intuitively, demand should have shifted if there was an increase in competitive pressure, signaled by the average increase in the number of subscribers of other operators. Data of previous period is chosen to avoid endogeneity as well.

As noted earlier, there is limitation on the interpretation of price which is defined as ARPU/MoU. ARPU is revenue per month per user from both voice and non-voice services (e.g., mobile internet). MoU captures average monthly use of voice service measured in minutes. From past data during Q1/2004 and Q1/2022, MoU increased in the beginning and descended at a faster rate towards the end; meanwhile, ARPU quickly descended in the beginning and started to level towards the end. When combined, ARPU/MoU plummeted in the beginning, hit rock bottom, and then slightly ascended towards the end. Given such a trend, it is possible that price (defined this way) might be increasing even if there was no merger. That is why, in section 6, we need to compare implications on price from MS and UPP against its *likely* trajectory. The trajectory of ARPU/MoU could have been at odds with

general understanding that the share of income spent on telecommunication and internet services has been declining in general, except for during period of COVID-19 pandemic that triggered economic downtrend. Also, the quantity has been increased during the time (ITU, 2022).

Summary statistics of variables that appear in **Table 4** are given below. The data is quarterly and is drawn from the first quarter of 2004 to the first quarter of 2022, just before the merger proposal was submitted by TRUE and DTAC.

Table 5 *provides summary statistics of variables used in the estimation for MS.*

Variables	Observations	Average	Standard deviation	Min	Max
Coverage3g (population coverage by 3G network)	438	0.56	0.42	0	0.98
Coverage4g (population coverage by 4G network)	438	0.35	0.44	0	0.98
Subscribers	438	1.20×10^{7}	1.20×10^{7}	276726	3.94×10^{7}
Population	438	6.79×10^{7}	1.54×10^{6}	6.49×10^{7}	7×10^{7}
Potential market size	438	1.09×10^{8}	9.47×10^{6}	8.42×10^{7}	1.25×10^{8}
Minute of use (MoU) (in minutes)	438	306.53	152.60	66	774

The following shows average revenue per unique user (ARPU).

Table 6 *provides data on average revenue per unique user (ARPU) and price, which is calculated as ARPU divided by minutes of use (MoU) in the corresponding period.*

ARPU (THB/month/user)						
Type	Service provider	Sample size	Average	Standard deviation	Min	Max
Postpaid	AIS	73	791.561	299.125	568.548	1660.318
	DTAC	73	784.944	265.549	557.791	1614.166
	TRUE	73	642.894	262.485	433.959	1388.287
Prepaid	AIS	73	245.012	84.434	177.802	484.254
	DTAC	73	232.152	83.172	141.004	450.064
	TRUE	73	156.737	117.903	55.751	517.781
Price (= ARPU / MoU) (THB/month/user/min)						
Type	Service provider	Sample size	Average	Standard deviation	Min	Max
Postpaid	AIS	73	2.062	.693	1.128	3.525
	DTAC	73	2.102	.677	1.328	3.871
	TRUE	73	1.669	.605	.824	2.843
Prepaid	AIS	73	1.433	.913	.655	4.175
	DTAC	73	1.455	.987	.750	5.398
	TRUE	73	.965	.919	.204	4.533

Since MS provides post-merger price and subscribers, weighted average of percentage change in price is as follows:

$$\text{weighted average of \% price change across service types for a firm}$$
$$= \sum_{\text{i=prepaid,postpaid}} \left(\frac{\text{sub}_{\text{i,post-merger}}}{\sum_{\text{i}} \text{sub}_{\text{i,post-merger}}}\right)\left(\frac{\text{price}_{\text{i,post-merger}} - \text{price}_{\text{i,pre-merger}}}{\text{price}_{\text{i,pre-merger}}}\right) \times 100\%$$

We can also calculate the average change in price for the entire market as well as for just the merging firms using similar approach. Ultimately, the result would be a single numerical indicator for price

change. Price for pre-merger would be price observed as of Q1/2022; MC prior to reduction by efficiency gain would be MC derived for Q1/2022 as well.

5.2. Upward Pricing Pressure (UPP)

UPP is about measuring whether there is unilateral incentive for merging firms to increase price. Prior to the merger, neither merging parties need to consider others' profits. Once they have merged, they must now do so because gain incurred upon one firm comes partially from loss of the other firm. That means the incentive for one firm to, say, reduce price to boost sales revenue could potentially be diminished. The important measure for UPP approach is diversion ratio, which also indicates the closeness of competition between two firms. Following Farrell and Shapiro (2010), diversion ratio between product 1 and 2 is defined as

$$\mathrm{D}_{12} = -\frac{\partial q_2/\partial p_1}{\partial q_1/\partial p_1}$$

With $q_j = s_j M$, where potential market size M is fixed, diversion ratio can be derived using shares instead, say $-\frac{\partial s_2/\partial p_1}{\partial s_1/\partial p_1}$.

Following Valletti and Zenger (2021), gross upward pricing pressure index (GUPPI) is defined as

$$\mathrm{GUPPI}_1 = \frac{UPP_1}{P_1} = \frac{D_{12}(P_2 - C_2) - E_1 C_1}{P_1}$$

where P denotes price; C, marginal cost; and E, efficiency gain in terms of percentage reduction in marginal cost. One indicator that implies a preliminary direction of price trajectory is to consider the sign of the term $D_{12}(P_2 - C_2) - E_1 C_1$. To simplify this expression, consider factoring out the C_1 and ignoring the efficiency gain for now. The indicator now becomes $\frac{D_{12}(P_2 - C_2)}{C_1}$. Let us define this term as preUPP_1. If preUPP_1 is higher than (potential) efficiency gain, then the firm has an incentive to increase price. Otherwise, it does not.

We can calculate the weighted average of percentage change in price as follows:

$$\text{weighted average of \% price change across service types for a firm}$$

$$= \sum_{\mathrm{i=prepaid,postpaid}} \frac{\mathrm{sub_{i,pre-merger}}}{\sum_{\mathrm{i}} \mathrm{sub_{i,pre-merger}}} \mathrm{GUPPI_i} \times 100\%$$

We can also calculate the average change in price for the entire market as well as for just the merging firms using similar approach. Since UPP approach does not result in numbers that characterize post-merger status such as subscribers, we use pre-merger subscribers as weights.

Data used in UPP

The data used for UPP approach are listed below.

Table 7 *lists variables used in calculation of UPP and brief explanation*

Variable	Proxy	Explanation
Price-cost margin	The difference between observable price and the computed marginal cost	Price is directly observed from the market, while marginal cost is implied by MS.
Diversion ratio	Diversion of sales from one service to another	(1) Diversion ratio is derived from estimated demand in MS using formulas given by Grzybowski and Pereira (2007), because MS

Variable	Proxy	Explanation
		provides estimated coefficient α and σ, which can be interpreted as marginal utility of income and degree of substitutability of products within the same group. (2) Diversion ratio can also be derived from mobile number portability (MNP), which was first implemented in Thailand back in 2013 (Tortermvasana, 2017). The most recent statistics from the whole year of 2021 was used for estimation of diversion ratio, as it most likely reflects user behaviors. The limitation of using MNP data will be addressed later.
Efficiency Gain	Efficiency gain in terms of MC reduction. We assume 2 possible scenarios for the analysis: 0 and 10%.	These values are assumed.

The calculation to derive diversion ratio for each of the merging firms from MNP data can best be explained via the following example. Note that we do not distinguish between prepaid and postpaid as the data does not provide such detail. The diversion ratio between the merging firms for TRUE is the proportion of those who left TRUE for DTAC, i.e., $\frac{c}{a+b+c}$. The diversion ratio for DTAC is $\frac{e}{d+e+f}$.

Table 8 *provides an example for the computation of diversion ratio from MNP data.*

	Receiver			
Donor	**AIS**	**TRUE**	**DTAC**	**Sum**
TRUE	a	b	c	a + b + c
DTAC	d	e	f	d + e + f

6. Results and discussion

Estimated coefficients for demand system as specified in **Equation 1** are given below.

Table 9 *shows the estimation result of demand system as specified in* ***Equation 1****.*

Variables	Coefficient (SD)
Independent variables	
Price and market share among similar services	
Price (P_{jt})	-0.7029 (0.1029)***
Market share of service within the same group ($\ln s_{j\|g,t}$)	0.5066 (0.07423)***
Variables explaining service coverage	
3G network coverage per population	2.7410 (0.5078)***
3G coverage squared	-0.0465 (0.3171)
4G network coverage per population	-0.7060 (0.3722)*
4G coverage squared	1.2557 (0.3747)***
Variables explaining network effect	
Own subscribers in the previous period	2.41×10^{-7} (8.90×10^{-9})***
Own subscribers in the previous period squared	-4.40×10^{-15} (1.99×10^{-16})***
Time dummy	
Time index	-0.1493 (0.02043)***
Time index squared	0.001314 (0.0001979)***
Constant	-0.7905 (0.4766)*
σ_u	0.2691
σ_e	0.3287
ρ	0.4014

Variables	Coefficient (SD)
Fixed effects	**F (2,419) = 32.74** **Prob > F = 0.0000** **R-squared = 0.9280**
Instrumental variables used	OPEX, CAPEX, and lagged average subscribers of other operators are used

* denotes the statistical significance at the level of 0.1. ** at the level of 0.05. *** at the level of 0.01.

In the estimation of **Equation 1**, we introduce time dummy for each period, as it denotes temporal change due to technology from 2002 (2G) to 2022 (4G/5G). Fixed effects specification is used as well to take care of difference due to branding. From the estimation results in **Table 9**, we find that the coefficient for price is -0.703, which is negative and statistically significant. The coefficient for market share of services in the same group ($\ln s_{j|g,t}$) is 0.507, which situated between theoretical values of 0 and 1. Its value sitting relatively in the middle means that similar products (either prepaid or postpaid) offered by different operators are moderately differentiated. Furthermore, the first-stage regression reports F-statistic of 224.34, which is much higher than a rule of thumb of 10 and implies that instruments are not weak. As for the issue of overidentification given that the number of endogenous variables is lower than the number of used instruments, we use the Chi-square test following Sargan (1958) and find the test statistic to be 5.736 (p = 0.0568), failing to reject the null hypothesis that the instruments are valid and correctly specified.

The following table provides summary statistics of parameters needed to compute diversion ratios, as well as margins for all products as implied by MS. Note that margin, measured as the difference between price and marginal cost, is the highest for AIS, be it postpaid or prepaid services.

Table 10 *provide data for Q1 of 2022 including observable data (subscribers and price) and computed results (MC).*

Provider	Type	Subscribers (mil subs)	Price (THB/min)	Computed MC (THB/min)	Price – MC (THB/min)
Potential market size = 108 million subs // in reality, there are 92.5 million subs					
AIS	postpaid	9.34	2.702	1.788	0.915
TRUE	postpaid	8.91	2.350	1.449	0.902
DTAC	postpaid	6.68	2.755	1.914	0.842
AIS	prepaid	31.88	2.222	1.082	1.141
TRUE	prepaid	22.90	1.471	0.501	0.970
DTAC	prepaid	12.79	1.867	1.037	0.830

The following table shows same-group diversion ratios implied by MS. We focus on same-group diversion ratio as it is more likely in comparison to switching between prepaid and postpaid. Diversion ratio drawn from MNP data however is not presented here, as it pertains to sensitive information.

Table 11 *provides diversion ratios from MS and preUPP from both MS and MNP.*

Provider	Type	Diversion within the same type of services		Diversion ratio to others (from MS)	preUPP (from MS)	preUPP (from MNP)
		Diversion ratio among mergers (from MS)	Diversion ratio from Provider to AIS (from MS)			
TRUE	postpaid	0.214	0.299	0.487	0.124 – E	0.112 – E
DTAC	postpaid	0.266	0.279	0.455	0.125 – E	0.169 – E
TRUE	prepaid	0.213	0.532	0.255	0.353 – E	0.318 – E
DTAC	prepaid	0.327	0.455	0.218	0.306 – E	0.334 – E

* E denotes the efficiency gain.

Regarding interpretation, for example, this table indicates that when TRUE increases price for its postpaid service and former subscribers switch to other alternatives, about 21% moves to DTAC postpaid and 30% moves to AIS postpaid. More importantly, when compared between two columns of diversion ratios, diversion ratio between TRUE and AIS is much higher than diversion ratio between DTAC and AIS. This implies that AIS and TRUE are closer competitors than the two mergers are. The strongest player, implied by diversion ratio, is AIS, which corresponds to the fact that AIS retains its highest market share throughout history (as seen in **Figure 1**).

As for preUPP, we see that relatively higher value of efficiency, say 10%, is not enough to make preUPP strictly positive. That means both merging firms have strong incentive to increase their prices. We would next consider likely case scenarios and the magnitude of price increase associated with each case.

We assume that the merger was to be effective right after Q1/2022. Given the implications from international cases where we considered rough efficiency gain post-merger, we would consider either the efficiency gain of 0% (imminent upon the merger) or 10% (possibly achieved within short- to medium-run). MS cannot produce estimated efficiency gain as it does MC. We would also like to consider the possibility of collusion and how degree of collusion might affect price changes. Although the merger likely facilitates the possibility of collusion, perhaps implicitly, it is possible that pre-merger competing firms might be collusive as well as they have been serving the same market for decades. We thus propose using Herfindahl–Hirschman Index (HHI)[3] as a rough proxy for the level of collusion among firms for some cases. Although it is intuitive that HHI likely correlates to ease of collusion, HHI needs not perfectly reflect firms' conducts. For example, suppose that all three operators compete fiercely by offering similar products. They would have the same market share of 1/3. A cartel of three equally sized players would have produced the same market structure. Therefore, different market structures need not have distinct values of HHI.

Note further that the post-merger prices implied by MS are prices that satisfy the FOCs for Bertrand Nash-equilibrium; therefore, it lacks dynamic aspects, e.g., how long prices take to reach the suggested equilibrium. Prices cannot be easily adjusted because mobile promotions are considered contracts and agreed tariffs are bound for some period. One caveat for interpretation is that such findings do not guarantee that prices would increase; rather, these findings indicate whether merging parties have incentives to increase prices of their services.

The following table provides 6 case scenarios that we would consider. They are combinations of different degrees of post-merger collusion and levels of efficiency gain. 2 cases include pre-merger and post-merger degrees of collusion that are drawn from HHI. The rest deal with extreme cases of either no collusion or cartel in the post-merger period.

Table 12 *shows detail about 6 case scenarios that would be considered to seek implications on price from both UPP and MS approaches.*

Case	Degree of collusion prior to merger, $\phi_{pre-merger}$	Degree of collusion after merger, $\phi_{post-merger}$	Efficiency gain
1	0	0	0%
2	0	1	0%
3	0	0	10%

[3] HHI is an index that measures concentration within the market. It is calculated as the sum of market share (in percentage) squared; therefore, its value is strictly limited to a number between 0 and 10,000.

Case	Degree of collusion prior to merger, $\phi_{pre-merger}$	Degree of collusion after merger, $\phi_{post-merger}$	Efficiency gain
4	0	1	10%
5	0.3536*	0.4739**	0%
6	0.3536*	0.4739**	10%

* is HHI value (divided by 10,000) prior to merger. ** is HHI (divided by 10,000) post-merger value.

The following table provides price increase as implied by MS.

Table 13 *provides weighted average price change from MS.*

Case	Weighted average price change for the market	Weighted average price just for the merging firms	Change in HHI
1	7.15%	11.50%	1488
2	61.82%	72.27%	1586
3	5.12%	7.98%	1544
4	58.18%	65.37%	1718
5	14.16%	18.79%	1514
6	12.95%	16.31%	1588

The following table provides price increase as implied by GUPPI.

Table 14 *provides weighted average price change using GUPPI.*

		Weighted average % price increase for the merging firms (by GUPPI)	
Case	Efficiency gain	Using diversion ratio from MS	Using diversion ratio from MNP
1,2,5	0%	12.07%	12.19%
3,4,6	10%	7.19%	7.31%

In summary, GUPPI either from MS or from MNP implies an increase in price ranging from 7% to 12%. However, MS shows a much more extreme price increase, as the range extends from merely 5% to more than 70%, depending on degree of collusion and efficiency gain. These results also indicate that the efficiency of 10% is not enough to demotivate merging firms from raising prices. We believe that case (6) seems the most likely among all the possibilities as it, firstly, reflects practical level of collusion before and after the merger and corresponds to the fact that few operators tacitly collude in an oligopolistic market structure. Secondly, case (6) assumes the efficiency gain of 10% which is well within range of rough estimates that were implied by financial data from mergers in other countries.

There is a limitation to the interpretation of price as mentioned before. The price, defined as ARPU/MoU, might be increasing *naturally*. To determine possible trajectory of prices for both the market and the merging firms, we would be fitting time series of percentage change in ARPU with appropriate AR(1). The following figure illustrates the fluctuation of ARPU over the periods.

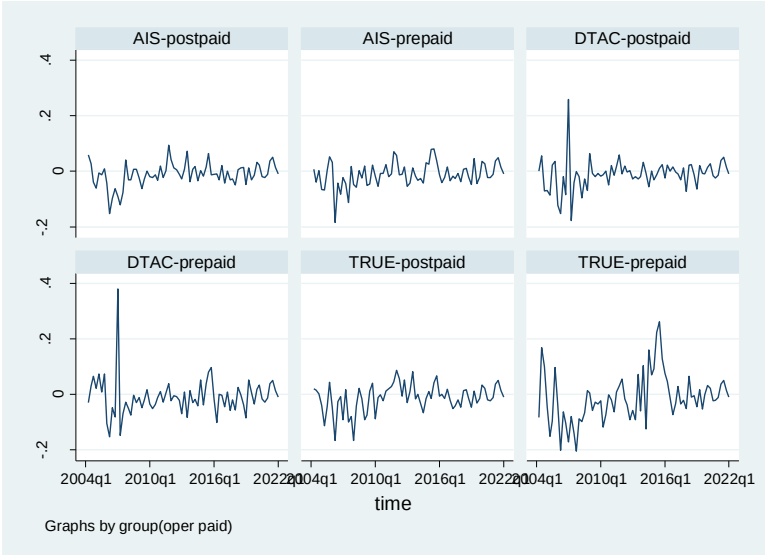

Figure 3 *depicts fluctuation in ARPU over time.*

In contrast, MoU, especially within the last few years, leveled and remained relatively constant; thus, forecasted MoU is computed as the average of the values from Q2 of 2021 to Q1 of 2022. *Likely* price in Q2 of 2022 for each operator and each type of service (prepaid or postpaid) is calculated from division of forecasted ARPU by forecasted MoU. The forecasted market price in Q2 of 2022 is then calculated as weighted sum of the forecasted prices where subscribers for each service as of Q1 of 2022 are used as weights. The average market price as of Q1 of 2022 was 2.087 THB/month/sub/min. The forecasted market price is 2.064, displaying merely 1.04% decrease in price. The average price for merging firms as of Q1 of 2022 was 1.890 THB/month/sub/min, while the forecasted price is 1.874. This indicates 0.85% decrease in price for the merging firms. The simpler approach is to calculate compound annual growth rate (CAGR) of the price from Q2 of 2021 to Q1 of 2022. We found that the CAGR for weighted market price is 1.82% per quarter, while CAGR for weighted price for merging firms is 1.87%. Computed percentage changes from AR(1) and CAGR differ greatly from those suggested by both MS and GUPPI; thus, we conclude that it is likely that the merging firms have strong incentive to increase their prices post-merger if left unregulated.

7. Conclusion and Recommendation

Overall, the increase in price is expected as the number of major mobile operators reduces from 3 to 2 despite the possible efficiency gain—measured as relative change in marginal cost. The result justifies retail tariff regulation to limit the negative impact on consumers. In fact, the NBTC has decreed a resolution, on October 20th of 2022, to have deliberately approved the merger (by majority) and required that the merger follow through several remedial policies, one of which is that the average retail price for the merging firms[4] must be lowered by 12%. This conditional sanction by the NBTC Commissioners potentially reflected their belief that the merger would benefit from synergy. To verify the extent to which the merger enjoys this cost saving, the board of the NBTC also required that the merging parties submit their accounting data periodically once they have officially merged. Typical requirements, as seen in other merger and acquisition cases, like offering network capacity to potential MVNOs were also part of the board's resolution. The merging parties in Thailand were not required to return their spectrum under the justification of leveling the playing field. This perhaps

[4] Weighted average price by actual users is given by $\frac{\sum w_i p_i}{\sum w_i}$, where w_i denotes number of users of promotion i, and p_i denotes the average price per unit proposed by promotion i.

reflects the fact that AIS likely maintains its position of a stronger player, as one can see from the spectrum portfolio (**Table 2**) where AIS's would be on par with combination of TRUE's and DTAC's.

This paper focuses on assessing potential impacts of the merger by using traditional methods: merger simulation and UPP. In the mobile industry, huge investment is required every 10 year or so due to technology advancement. Therefore, synergy concept should be considered by both telecom regulator and competition authority. Both agencies need to continue monitoring competition level in mobile-related markets as well. Periodic post-merger assessment is needed. Assessment exercises might include measuring general price level, quality of services, and innovation level.

What should be done next is the post-merger analysis regarding observable changes in price levels and close examination of the effectiveness of the implemented policies. There are many alternatives to detect those changes. One method is difference-in-difference, where variables of interest between the treated and the control groups are compared. There are fine points that one must be careful when choosing observations to constitute the control group (Maier et al., 2020). Another method is merger simulation, as suggested by Ormosi et al. (2015). Another alternative is translog cost function that allows computation of economy of scale and scope, but needs decently long time series to data that would reflect changes in cost structure pre- and post-merger (Bloch et al., 2001). Further examination on efficiency with forensic accounting of the merging firms would be beneficial as it would serve as tangible evidence. Additional analysis to empirically derive likely efficiency gain using observable data should be completed as well to verify whether the relative reduction in marginal cost of 10% is likely and possible within some specified timeframe.

8. Limitation of this study

One limitation for this study lies in the computation of price-cost margin and marginal cost using merger simulation. These theoretically derived values need not agree with explicit evidence like those derived from accounting reports. Implied results from merger simulation also heavily depend on the assumptions regarding the firm's interactions and characterization of competition. For example, the level of collusion between firms prior to the merger induced a significant change in post-merger pricing. Nevertheless, there are limitations to using data from elsewhere. For example, marginal cost should be calculated as incremental cost divided by moderate change in output. Accounting reports, however, may not provide data breakdowns that allow us to strictly follow this definition. Using EBITDA as a proxy of price-cost margin certainly is not perfect.

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