

Bundling and tying in smart living

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Abstract

Smart living is a trend promising more comfort, security, and energy efficiency in our everyday life through digitalization and the inter-connectivity of devices. From driverless cars to smart thermostats, from movable office to ecosystem of smart home, all of them are smart “objects” on which smart living and smart cities rely, involving original and innovative solutions aimed at making life more efficient, more controllable, economical, productive, integrated, and sustainable. Nowadays, these objects are not single products anymore but a series of integrated products, which can be tied or bundled. However, the bundling and tying are not traditional one, like ordinary merchandise or software tying in the landmark case Microsoft. It can be between software and hardware, as well as with a more complicated structure. For the smart objects the bundling and tying may be not limited in bilateral ones but also can be multilateral. This paper aims to discuss bundling and tying products in a smart city life, and mainly the commercial reality of such smart products on how the components are bundled and tied. After, it analyses the structure of bundling and tying in some smart products to confirm whether there is a main product, which can be either a hardware or a software, or net-shaped like in the ecosystem of smart home. Based on these commercial realities, this paper discusses whether multilateral bundling and tying related to smart objects may be a threat to a competition order and mainly to violate Articles 102 TFEU.

Keywords: multilateral bundling and tying, market power, abuse of dominance, smart objects.

1. Introduction

In the past, smart home was considered to be part of a luxurious lifestyle but today it becomes an important part of our lives. With the advent of technology every passing day, owning a smart home is becoming a necessity. A part of the internet of things (IoT), smart home systems and devices often operate together, sharing consumer usage data among themselves and automating actions based on the homeowners’ preferences.

The ecosystem of smart home can contain a large number of smart devices that can be grouped in the following main product categories: smart home appliances; smart home entertainment devices; comfort and lighting devices, and security devices, etc. Connecting such number of devices, the ecosystem of smart home is as a hub, which bundles and ties many different products. The products may have different functions supporting the whole ecosystem but each of them is a distinct product. Unlike traditional products, smart devices are more convenient and flexible. Smart devices can also be operated by users without smart functions; thus, they are relatively independent from the ecosystem. However, the applicability of smart functions of such devices depends entirely on the ecosystem. The realization of smart functions is considered a key factor when evaluating whether there is a bundling or tying case. Moreover, due to complexity of smart home ecosystem, for the

identification of bundling and tying should be take into account the possible structure of the ecosystem since each ecosystem can be different.

The bundling and tying can be bilateral or multilateral. The hub is always the IoT platform developed by the IT company but tied/bundled smart products can be various. Particularly, the voice assistant would be the most possible bundled service. Bundling and tying may also happen between hardware and software through technological compatibility. Even though the smart home ecosystem is characterized as “an integration”, it is actually a series of technological bundling and tying.

2. Commercial reality of products in smart living

2.1. General characteristics of smart home devices

EU Commission Preliminary Report defines several types of smart products, including voice assistant, smart home devices, wearable devices, consumer IoT services [17]. These smart products jointly contribute to the whole ecosystem of a smart home [17]. On one hand, each product is considered an independent product, which can be separately purchased in the market, however, on the other hand, they are components of the smart home ecosystem. The interactions between different component will determine the relationship of the product with the ecosystem of smart home.

Among the ecosystem of smart home, the related smart component can be classified into five categories, including hardware and software. Two of the categories are hardware, including smart physical components and smart controllers. Smart physical components are those terminal devices in home living, such as smart TV, smart air conditioner, curtain, and other home devices and appliances [17]. Smart controllers refer to devices that people use to control and operate terminal devices, like smartphone, tablet, and smart speakers. The three categories are software and refer to voice assistant, applications of smart components and the IoT system maintained by the platforms [17].

The relationship between the products and ecosystem describes how they are connected and organized. Some manufacturers may develop all categories of smart products, but others may develop only some categories. The IT giants like XiaoMi, Apple, Google, Huawei, or Amazon, which have a significant share on the market and worldwide presence, do not only develop and maintain the IoT platform but also different categories of smart devices. For instance, XiaoMi produces all five categories of smart products, including XiaoAi (the voice assistant), IoT platform, the application Mi Home, XiaoMi smartphones and smart speakers, and a large varieties of smart home devices, such as like XiaoMi TV, XiaoMI air cleaner, floor-sweeping robots, and other devices [16]. This situation allows XiaoMi to build its own smart home ecosystem only from XiaoMi products. However, XiaoMi also allows third-party manufacturers to connect their smart products to their IoT system [34]. From the perspectives of products, these third-party manufactures are only allowed to connect terminal devices and their own applications to monitor smart home devices [33]. Other manufacturers may produce only several categories of products. For example, Apple does not manufacture its own smart devices, such as air conditioner but

allows third party to connect such device to its HomeKit [3]. Google also does not produce many smart home devices but only IoT system, voice assistance, and some accessories [20]. Amazon also plays a role as a hub of smart home rather than produce large types of smart home devices [2]. Huawei even does not produce IoT system but only a small ecosystem that can connect all Huawei devices together [23], therefore its smart home is not a comprehensive smart living project. Huawei Artificial Intelligence (AI) life services was not expanded to all scenarios in smart living ecosystem, such as cooking or taking shower. From the analysis of what type of product, the IT companies provide in the market, it can be found that the most connected smart products are the IoT system, voice assistant, and smart controllers. Smart home devices and related apps are optional for those IoT system developers.

2.2. The structure of smart home ecosystem

The IoT system stands in the center of the ecosystem of smart home even though the smart controller, usually smartphones or tablet, has a central position only visually. The reason is that in the smart ecosystem may be more than two smart controllers. For example, each family member can use his/her own smartphone to monitor other smart devices. There may be no smartphones in the room, but people can use smart speakers to control smart devices via voice assistant.

Voice assistant and smart monitor are distinct product. Voice assistant, like Siri of Apple, can be independently installed on the AI chips in a smart speaker without the help of cloud and smartphone [25][27]. An eloquent example is that the voice assistant of Amazon is installed in Amazon-manufactured smart speakers [25][27]. Theoretically, it is possible for voice assistant developers to sell voice assistant chips to third-party manufacturers of smart speakers. It can also be independently installed on smartphones in the format of software, like Siri on iPhones, XiaoAi on XiaoMi smartphones, and Amazon Alexa on any smartphones [1][6][9]. The independent installation of voice assistant on smart speakers also demonstrate that voice assistant can be separated from the operation system of smartphones. Its interaction with the IoT system can avoid smartphone operating system. Even though those IT companies have been not allowed yet third parties to embed their voice assistants, it is obvious that there are no technical obstacles for realizing it. Moreover, smart speakers manufactured by voice assistant developers are different from common speakers. Common speakers without voice assistant chips can also be connected to smartphones via Bluetooth and trigger the work of voice assistant in the smartphones through its microphone. In such scenarios, the speakers must rely on the smartphone to become a component of the smart controller of the smart home ecosystem.

The way how the third-parties' smart home devices and IoT system are connected is an important element on identifying whether the two products are distinct. As components of smart home system, devices' smart functions are the core elements of these products. It is certain that these devices are physically distinct from the IoT platform, but the physical independency does not mean separability. Some smart home devices, like smart air conditioners or smart ovens, can work without being connected to the IoT platform. However, the smart functions cannot be realized if smart devices are used as ordinary home

appliances. In the scenarios of smart home living, the smart functions of smart home devices are essential. Using smart home devices in an ordinary way does not fit the significance of “smart” so that it will leave the ecosystem of smart home in this situation. When discussing about bundling and tying in smart living, the smart functions of smart home devices shall be taken into consideration. If they cannot be considered smart devices, there is no doubt that the sale will constitute bundling and tying if the undertaking sells the two products at the same time. Then, there will be no question about the IoT platforms providers using technologies to bundle and tie two products.

The connection of smart home devices and smart home ecosystem is the essential to identify how the integration is realised. For the present paper, we are going to analyse XiaoMi case. XiaoMi IoT platform provides two modalities for third-party developers to connect their product into XiaoMi smart home ecosystem. There are methods via IoT module or via Cloud. XiaoMi IoT platform provides three advantages if the connection is realized via IoT module: low cost, availability of other IoT platforms and controllability on smart devices via application of the third-party manufacturer [33]. The connection via IoT module also has different scenarios regarding different types of products. For smart home devices which can be independently purchased, like air conditioner, cleaning robots, or cameras is suggested to use WiFi to integrate them in the Xiaomi smart home ecosystem [33]. Particularly, smart home devices without operating system or with RTOS, Linux or Android systems can be connected the IoT platform via WiFi using MCU computer module, SDK computer module. Wearable devices, some smart devices like smart lock, and some products on cars, can be connected to the IoT platform via Bluetooth [33]. However, it is not available for Bluetooth products to be controlled by voice assistant of XiaoAi. Devices like lights and switches, fans, charger, and massager can use BLE Mesh module to connect the smart home ecosystem. Different methods of connection are available for some key functions, like voice assistant so that the structure of smart home ecosystem is different, depending on the connected smart devices. Therefore, if there are bundling and tying in the whole smart home ecosystem, it will be multilateral for some smart devices and bilateral for others.

XiaoMi also allows smart home devices to be connected to its smart home ecosystem via cloud-to-cloud method [32]. If the third-party manufacturer of smart devices has its own cloud service or IoT system, it can apply to have connections or coordination with two clouds [32]. This method is not as stable as that through IoT module, thus XiaoMi does not recommend it for connection [32]. However, some smart devices like cleaning robots or camera, can only use this method to connect in the ecosystem due to IoT module method is not available technologically for them [32]. XiaoMi claims that the technology of direct connection through IoT platform of these smart devices is still under development. Even though it claims that the solution is under development, it is still possible for XiaoMi to prohibit third-party smart devices to use specific connection method or ask for higher connection fees. Besides, the smart home devices connected through clouds cannot be controlled through XiaoMi Home application and they are only allowed to use XiaoMi voice assistant service rather than all smart functions of the ecosystem of XiaoMi smart home [32].

As was stated, smart home devices rely on the IoT platform to maximize its smart functions. To realize all the smart functions, the devices are necessary to be connected to the XiaoMi platform through certain methods. It means such smart devices and specific smart functions are bundled through technology. This also means that XiaoMi has ability to block those smart functions. Meanwhile, in order to gain more smart functions, those third-party smart devices rely more on XiaoMi's platform. When there are more third-party smart devices in the ecosystem, it is not profitable for a single third-party manufacturer to leave the ecosystem because its competitors may join the ecosystem as well and increase the competition.

Even though at present XiaoMi does not require or force third-party smart devices manufactures to exclusively use XiaoMi IoT system, smart devices with XiaoMi brand may be the risk that it cannot use other IoTs [31]. Besides, when the reliance of third-party smart devices on XiaoMi's IoTs system reach certain level, XiaoMi company actually controls the platform and bundle the smart home devices and its IoT system.

The same situation may also appear in the scenario of Apple HomeKit and other IoT developers. Particularly, Apple HomeKit is a closed system because it only allows Apple smart controllers to participate in the ecosystem [21]. Siri, the voice assistant developed by Apple company is the only voice assistant in the ecosystem. Apple shows the list of compatible accessories with HomeKit smart ecosystem on its official website [5]. There is a very limited quantity of smart devices compatible with HomeKit. Even though third-party smart home devices can be connected to Apple devices through its own app, it seems that such smart devices are not the components of the HomeKit Apple ecosystem [28]. Different from the openness of XiaoMi IoT platform, HomeKit does not allows smart home devices manufacturers to use its IoT modules freely to connect their devices to the ecosystem, but they must have a cooperation agreement with the Apple company [4][7]. In this context, the practices of bundling and tying seems to be more likely to appear in the scenario of Apple since voice assistant, IoT system, and smart controllers are all produced by Apple.

In the ecosystem of smart home, the unique component is the IoT platform since it is the hub of all other devices and services. Voice assistant is also an element that connects almost all other components. However, voice assistant is not a necessary part of the home ecosystem. As the assistant of smart controllers, voice assistant can be replaced by other means of controlling, usually be directly operated from the smart phones. If there are more than one voice assistant devices in the ecosystem of smart home, each such device can replace others. Other components are also replaceable because a new similar smart device can be purchased and connected to the ecosystem. The IoT platform is the only permanent component, which cannot be replaced.

The consumer IoT platform is an on-premises software suite or a cloud service that monitors and may manage and control various types of endpoints. They represent underlying technological solution for integrating consumer IoT services and smart devices in a connected system. Smart home services are always in the format of an application like Mi Home or Apple HomeKit. Such applications have already been installed on the smartphones or tablet when users purchase them. Meanwhile, it would be impossible for

users to initiatively delete such applications from smartphones. If the smart controller is a smart speaker, the IoT platform service can be directly used through voice assistant embedded in the AI chip inside the speaker. IoT platform service and the smart controller are integrated because IoT platform service cannot be used if there is no smart controller from the perspective of users. However, it is questionable why such IT companies do not allow users to control the ecosystem of smart home through smart controllers of other manufacturers. If there are no technological barriers for realization of such possibility, there is no reason that such applications are exclusively installed on their own smartphones or smart speakers.

Another factor that should be taken into consideration is relate to smart functions. As mentioned, any smart home device can be used without the connection to IoT platform but in this case the device cannot be named “smart” since it is not in the mode of smart home use. Smart functions require that the device must be connected into IoT platform system and be a part of the ecosystem of smart home. Even though smart home devices are physically independent from the IoT platform service, they are bundled with related virtual service if the access of such kind of service rely on the connection to IoT. The same logic is applied in case of voice assistant; if voice assistant is not bundled with IoT platform, its basic function is only to give some orders when operating a smartphone instead of accessing it manually.

3. The application of competition law to tying and bundling in smart living

3.1. General notions on tying and bundling

From competition law prospective, tying occurs when the supplier makes the sale of one product (the tying product) conditional upon the purchase of another distinct product (the tied product) from the supplier or someone designated by the latter [18]. Only the tied product can be bought separately, however not the tying product.

Bundling refers to a situation when a package of two products or services is offered together as a single sale.

At the basic level “pure bundling” occurs when two or more products can only be purchased together. “Mixed bundling” is where both or more products can be purchased separately but purchasing them together is cheaper. This is what the Commission also defines as “commercial tying”.

The European Commission recognises that tying and bundling are widespread practices that often have no anticompetitive effects. All companies, with and without market power, may engage in tying and bundling in order to provide their customers with better products or cost saving offerings. However, tying and bundling can lead to the following possible anticompetitive effects: foreclosure, price discrimination and higher prices. This article deals only with the potential foreclosure effects of tying and bundling.

Almost any doctrine of competition law has been modified more significantly by digitization than tying and bundling. Originally, the concept was developed for the combined sale of two products, however later the concept was applied to cases like the prioritized display in search engine rankings or integration of two softs. Therefore, this paper has as aim to provide some aspects of the concept of tying and bundling, which are also have been evolving in the digital context.

In the last decade, the concept of tying and bundling was frequently raised in the digital markets, and this may be result of the strong incentives for the dominant undertaking, such as Microsoft, Meta (Facebook) or Google, to increase their dominance relying on respective strategies. In fact, digital markets are more susceptible to leveraging, therefore tying and bundling practices are more prevalent in the digital setting than in another environment.

The proponents of the Chicago School concepts questioned that the intuitive theory of tying and bundling results in a transfer of market power [8][15][26][29], claiming that a monopoly profit can be realized just once. Therefore, in their understanding monopolists do not have an incentive to engage in tying and bundling practices. However, more recently, many economists have shown that an undertaking may have the ability and the incentive to leverage its market power from the tying to the tied market [10][11][30]. They claim that an undertaking with dominance on the tying market would have the ability to exclude rivals on the tied market, as tying can deprive competitors on the tied market of the benefits, and subsequently the consumer of their choice. Thus, these scholars argue that digital markets are particularly vulnerable to tying and bundling practices. Carlton and Waldmann showed in their model that an undertaking dominant in the market may engage in tying and bundling in order to prevent future entry into the dominated market and claiming the anticompetitive effects of such practices in the dominated market [10]. According to Choi and Stefanadis, the practices of tying and bundling may reduce the incentives to innovate for rival competitors in the non-dominated markets [11]. This led to a broadening of the scope of the doctrine of tying and bundling, since it may be applied to all cases where consumers are prone to demand a supplementary product, thereby foreclosing the market for this supplementary product [22].

Tying, as one of the listed behaviour in Article 102 TFEU practices, is one example of the abuse of a dominant position. According to this article, the practice is abusive when “the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their very nature or according to commercial usage, have no connection with the subject of such contracts” [14][19]. The European Commission Discussion paper on the application of Article 102 TFEU, make difference between contractual tying, according to which the dominant undertaking by contract deprives its customers of the choice to obtain the tying product without the tied product, and technical or technological tying, which occurs when the tied product is physically integrated in the tying product [18]. Such products are therefore offered together, and the producers claim that there is no possibility of separation of these products since technically it will affect their functionality. Because of the complex nature of such tying, for the competition authorities it is very difficult to find that such tied products consist of two separate products.

3.2. Tying and bundling in the digital market

The landmark case of technological tying is considered *Microsoft I case*, according to which Microsoft was selling its Windows operating system with an enclosed media player - the Windows Media Player 11 (WMP) Customers who bought the operating system had already installed the media player [24]. The Commission considered that given that Windows was installed on more than 90% of all PCs, the integration of WMP into the Windows guaranteed Microsoft WMP's dominance in the market [12]. The practice of tying allowed Microsoft to strengthen its dominant position and significantly reduced the competition in the market for media players. Since other rival media players had to be downloaded, they were considered less efficient and less used, therefore they could not reach same popularity. The Commission considered that WMP player had a competitive advantage since content providers and software developers look to installation and usage shares of media players when deciding based on which technology to develop their complementary software [13].

In the light of Microsoft's very high market shares, the practice of tying created barriers to future entries, as it significantly weakened the market entry of manufacturers of similar media players. The Commission concluded that such product integration might be deemed an abuse of market dominance. For establishing such abuse, the Commission has developed a five-part test for establishing the violation of Article 102 TFEU by means of tying arrangements, which was later confirmed by the General Court's judgement in *Microsoft I* case.

The five-pronged test applied to establish an infringement of Article 102 TFEU by such practice, require the following elements to be met: (i) dominance of the seller in the market for the tying product; (ii) existence of a tied product that is separate from the tying product; (iii) coercion, i.e. conduct forcing customers to buy the tied product together with the tying product; (iv) a restrictive effect on competition for the tied product; and (v) absence of an objective and proportionate justification for the coercion [13]. Thus, under this test the Commission identifies those tying practices that warrant intervention under Article 102 TFEU, encompassing the different elements necessary for a finding of abuse and which serve to distinguish anticompetitive from harmless practices.

With the advent of digitization and the increase of use by the consumers of IoT products, the practices of tying and bundling became also inherent to the new markets, although the question whether foreclosure has to be shown is quite hypothetical. This is due to the requirement that the theory of harm has to include all relevant circumstances - especially if they were raised by the defendant.

As a part of digital sector, the market of the ecosystems of smart home are quite prone to application of tying and bundling practices, especially taking into account that at the moment, most of the home ecosystem are actually "closed".

In the consumer IoT sector, interoperability is the key element and refers to the ability to interconnect and communicate between the hardware and software elements of various consumer IoT products and/or services. Interoperability requires technical and business engagement among consumer IoT players in order to provide meaningful integration and smooth functioning of smart devices, consumer IoT services, voice assistants and smart device operating systems. Therefore, interoperability is essential to deploy fully the variety of possibilities offered by consumer IoT products and services, enabling and ensuring consumer choice. The technical integration processes are generally based on application programming interfaces (APIs), which are either developed or made available by one of the parties, and which allow exchange of data and functionalities through software interfaces [17]. Requirements and processes to achieve interoperability are largely determined by the presence of the leading consumer IoT technology platform providers, such as XiaoMi, Apple, Google, Huawei, and Amazon. These providers govern the integrations with their products by imposing certification processes, which they control unilaterally. The Commission found that partnership negotiations and case-by-case integration arrangements are also present in the market, but in most of cases only between the leading technology platform providers and counterparties with sufficient bargaining power to negotiate, or in situations where the leading technology platforms are not involved [17]. In practice, leading technology platforms hold bottleneck positions in the consumer IoT sector. To achieve interoperability with those technology platforms, smart device manufacturers and consumer IoT service providers need to follow certification processes to gain approval for their customized integrations and abide to the, mostly non-negotiable, terms and conditions of these platforms. All these circumstances create a favorable environment for the proliferation of tying and bundling practices, especially in the situations when IoT technology platform providers are also manufacturers of smart devices.

4. The application of the Commission's five-pronged test for assessment of bundling and tying in smart home ecosystem

Further, applying the Commission five-pronged test we will evaluate if the practices of tying and bundling may have negative effect on competition in relation to Smart Home ecosystems.

4.1. *The requirement of dominance*

The dominance it is a necessary condition to find an abuse under Article 102 TFEU, since only a dominant undertaking through its practice has the power to exclude the competitors. Therefore, such condition requires dominance in the tying market, in the case of tying, while, in the case of mixed or pure bundling, there should be dominance in at least one of the product markets that are part of the bundle. In order to assess this properly it is necessary to define the relevant market(s) on which both the tying and the tied product are sold. There are several IT companies with worldwide presence, which are also leading consumer IoT technology platforms (such as Google, Amazon and Apple) that control and determine access to relevant voice assistants and smart device operating systems. These providers impose specific contractual and technical requirements on smart device manufacturers and

consumer IoT service providers, through certification processes governing the integration of devices and services on their technology platforms.

In the Preliminary report on sector inquiry into consumer IoTs, the Commission pointed at the perspective of competing for integration with, for example, smart home devices, consumer IoT services or voice assistants [17]. A large number of respondents, across all consumer IoT segments, point out that the main obstacle to developing new products and services is the lack of ability to compete with Google, Amazon and Apple, due to their dominance in the market, but also on interoperability issues [17]. These players have become the leading technology companies and built their own ecosystems within and beyond the consumer IoT sector by combining their own, and integrating third-party, products and services into a branded consumer offering with a large number of users. Through their ecosystems, combining voice assistants with search and/or marketplaces, and/or operating systems and/or app stores, Google, Amazon and Apple have a unique position in the consumer IoT sector. However, in the context when some IT companies do not only develop and maintain the IoT platform, but also other categories of products, the risk of market foreclosure using tying and bundling is really high.

4.2. Existence of a tied product that is separate from the tying product

The products to be tied or bundled should be distinct in the market. The Commission proposes a demand test to identify whether customers have independent demands for each product, which means that what can be considered as distinct products is determined by the demand of the customers. According the Commission, two products are distinct if, in the absence of tying or bundling, from the customers' perspective, the products are or would be purchased separately. However, the Commission do not require that the two products shall belong to two separate product markets.

In the smart home ecosystem it is obvious that the IoT platform, with its own operating system is the hub and the main product, which also may include voice assistant, smart home devices, wearable devices, consumer IoT services. All of them can be considered distinct product, since can be separately purchased in the market. Typically, these groups of devices are built by the same company or by close partner companies. However, on the market there are also other manufacturers, which produce similar products. Besides demand test, the Commission rely as well on supply test, which determine weather there are smaller competitors offering the products separately or weather are there manufacturers specialising in the production of the tied goods only.

For instance, regarding voice assistant, which are voice-activated pieces of software that can perform a variety of tasks, the question is if a consumer can purchase the voice assistant separately from the IoT platform, according its own preference? There are voice assistants of general-purpose, as they enable users to access a broad range of functions, such as playing music, videos, listening to the radio, podcasts, news, or audiobooks on the smart device itself or on other devices; controlling smart home devices, such as switches, light, outlets and thermostats, smart displays; providing information; helping in planning and executing daily routines. However, there are other voice assistants that can be described as

specialised voice assistants and are usually provided by consumer IoT service providers or smart home device manufacturers and have limited functionality, mainly relating to the service provider's or device manufacturer's own services and/or devices. Since at the moment there are only a few providers of such voice assistance, the market is clearly dominated by the incumbents, however in the context of emerging of smaller developers the question of tying and bundling of voice assistants will definitely come out, since the consumer choice and fair competition are at the core of EU competition law.

The same logic applies to smart home devices, which encompass a very large group of devices that can be grouped in the following main product categories: smart home appliances; smart home entertainment devices; comfort and lighting devices, and security devices.

4.3. Coercition as a conduct forcing customers to buy the tied product together with the tying product

Coercion is considered a key element of tying abuse, since in the absence of such element the tie could not have impact on competition.

As was mentioned, previously, ecosystems of connected devices can be "open" and "closed". They are "open" where users are unrestricted in adding devices according to their preferences and having access to various applications and content. In the open ecosystems it can be added any device, not only the devices that company supports. However, at the moment, most of the home ecosystem are actually "closed". This means the user will run into struggles getting new devices to work with the existing ecosystem if they are not part of it. The user also misses out many features that work between devices since the problem of interoperability always arises between third party devices and smart home technology platform. For example, getting a new device working with Apple's HomeKit, it is a serious undertaking that most users likely could not do. Whereas getting a new device working with Amazon and Google is possible for most users.

In case of smart home with closed circuits, the consumer is obliged to buy only devices built by the same company or by close partner companies, excluding other manufacturers from the market, even they provide similar products. This fact means that consumer is prevented to choose the device that he/she wants to connect. Therefore, coercion arises if the dominant undertaking denies customer the realistic choice of buying the tying product without the tied one, which can be manifested in contractual clause, refusal to supply the product separately, or even financial tying, when the manufacturer offers a package with a discount, which makes the buying of the product commercially nonconvenient to buy the product separately.

4.4. The restrictive effect on competition for the tied product

Article 102 TFEU can be applied when it can be shown the potential adverse effect on competition. In case of a tying practice applied by a dominant undertaking, foreclosure effects may arise as demand is shifted away from competitors. The assessment of the

foreclosure effect on the tied market can be considered to consist of two parts. First, to establish which customers are “tied” in the sense that competitors to the dominant company cannot compete for their business. Second, to establish whether these customers “add up” to a sufficient part of the market being tied. Market distorting foreclosure becomes more likely if tied customers represent a large proportion of the tied market. Also for the assessment of foreclosure effect are relevant scale economies, network effects and barriers to entry in the tied market.

Since the leading consumer IoT technology platforms are generally vertically integrated companies (Google, Amazon, Apple) that also offer first-party smart devices and consumer IoT services in competition with third parties present on their technology platforms, they may have incentives to restrict the operability of third-party products and services by limiting their access to the full functionalities of their technology platforms, thus influencing the functionalities and user experience they are able to provide. In this context, the restriction of operability will serve as a facilitating strategy for the application of their tying or bundled practices.

Therefore, the competitors, which do not have sufficient bargaining power and also are manufacturers of smart home devices can be precluded to enter the market, since their devices can be incompatible to work with the existing smart home ecosystem. For instance, Apple’s HomeKit, which sell their smart devices in bundle, as a rule, do not allow the operability of other devices from other manufacturer.

Smart home device manufacturers use different communication standards, data models and system architectures, however most smart home systems are built around the leading consumer IoT technology platform providers and, in particular, around a few general-purpose voice assistants, namely, Google Assistant, Alexa and Siri, that allow for centralised control of smart devices from different brands and access to a variety of consumer IoT services.

5. Conclusion

In the ecosystem of smart home may be several de facto bundling and tying between different constituent parts. It would rather to be said that the ecosystem itself is a “super bundled integration”. The internal relationship of the integration is “tight” but it is only because that all smart devices and controllers, including the voice assistant, must rely on the IoT platform to realize their service. Even though the developer of the IoT platform provides the access to the third-party developers of smart home devices in connection to the ecosystem, actually, such developers do not have to much freedom since they have limited functionalities on consumer IoT technology platforms. From a technical perspective, consumer IoT technology platform providers allow fewer capabilities and features to third-party smart devices and consumer IoT services, compared with their first-party products and services, by exposing less functionalities through the APIs available for third parties. Meanwhile, technology platform providers have unrestricted access to their own APIs, which makes interoperability with their first-party products more reliable and

enables a richer user experience and smoother functioning. This situation offers an competitive advantage in relation with their rival on the market, which face barriers to entry.

The application of barriers to entry, which are related to lack of interoperability, coupled with tying and bundling would suggest that there is an increased likelihood of positions of entrenched market power, compared to certain traditional industries. Taking into account the issue of interoperability and the fact that leading technology platforms hold bottleneck positions in the consumer IoT sector, the practices of tying and bundling performed by the dominant undertaking may have a total foreclosure effect for other competitors.

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