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RESEARCH ARTICLE

Demand for 5G from residential customers in Germany: a quantitative online survey using the Van Westendorp method

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Abstract
To investigate the demand for 5G in Germany, we applied the Van Westendorp Method (VWM) to measure willingness to pay (WTP) and price sensitivity ($N = 504$). The results show that more than half already own a 5G smartphone and these customers are less price sensitive. The accepted price range for the monthly 5G surcharge ranges between 10.00 and 15.40 Euros. Two thirds want more transparency in 5G pricing, while price is the most crucial factor (4.2/5.0), followed by data volume (4.1/5.0) and network operator/coverage (4.0/5.0). The results are particularly interesting for providers as the target group for 5G is quite diverse.

Keywords Mobile communications · 5G · Consumer demand · Van Westendorp · Price Sensitivity Meter · German market

Introduction

The mobile industry is highly competitive (Karjaluoto et al. 2012). In Germany, market saturation and smartphone penetration are very high (as in other industrialized countries): 83 percent of households have at least one mobile plan, and 33 percent have purchased a phone within the last 12 months (RMS 2023). Mobile network operators (MNOs) worldwide are building 5G networks. One-quarter of the world's population will be covered by 5G by 2030, for 700–900 billion US $ (Grijpink et al. 2020). By 2028, five billion 5G mobile subscriptions will exist worldwide (Ericsson 2022a). In Germany, 5G has been available since September 2019.

5G offers high data rates, low latencies (real-time support), and a higher reliability (ETSI n. d.; Ghanem et al. 2021; Nokia 2021). Therefore, 5G is a key technology enabling innovation and supporting digital transformation (BMVI 2017). Current mobile technologies are increasingly reaching their limits because they do not support new applications like augmented/virtual reality (VR/AR), that will become established technologies within the next few years (Ericsson 2022b).

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Research background

5G technology

Compared to 4G, 5G offers (a) higher data transmission, (b) lower latencies, and (c) up to 1 million connected devices per km^2 (Fig. 1).

In Germany, network operators expect a significant increase in demand for 5G (Blöcher 2021). 69 percent of German smartphone users consider it essential that their next smartphone is 5G compatible (Haas 2022). However, 5G use cases, respectively, potential 'killer apps' (e.g., mobile gaming or streaming) in the consumer sector are still developing, which is why 5G pricing is a challenge (Grijpink et al. 2021) and more complicated than previous mobile communications standards (Ericsson 2019). Based on previous literature reviews, there is a lack of studies that look at consumer intent to use and pay for 5G (see also Irfan and Ahmad 2022). Therefore, this research will force 5G research in the B2C market.

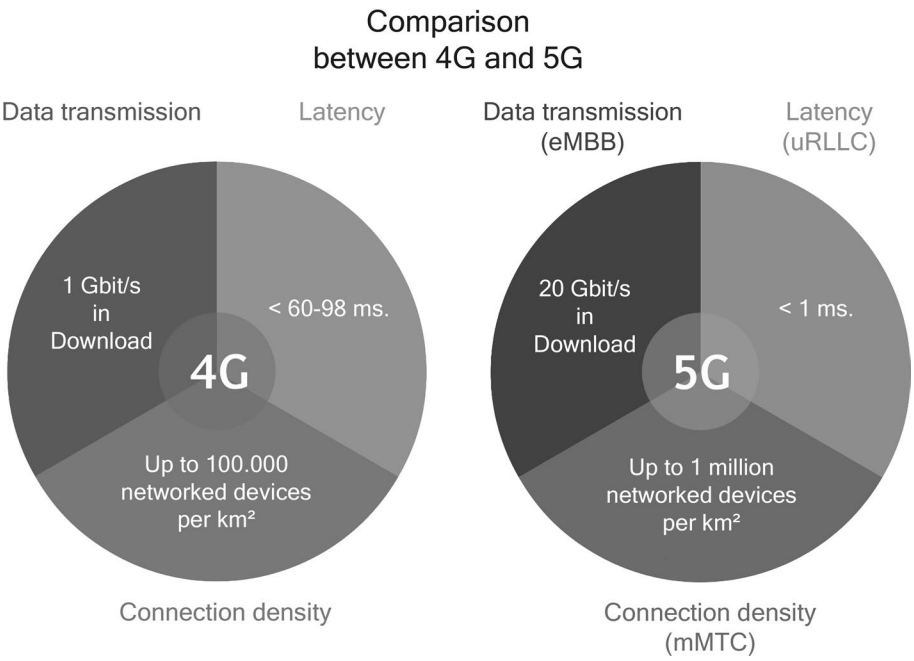

Fig. 1 Comparison of 4G & 5G. (Source: Own illustration based on ITU-R 2015, 14)

Consumer behavior and willingness to pay

This research contributes to the research field of consumer behavior. Changing user behavior can be seen (independent of 5G), as digital transformation is moving user experience away from text/picture to VR/AR (Attaran 2021), with an increase in video consumption, mobile data traffic, and the adoption of smartphones (Ericsson 2022b). Further, European operators reported that streaming traffic on mobile networks increased by 40 percent at the start of Covid (PwC 2020). 5G is expected to facilitate the changing demand by opening new apps and supporting technologies such as VR/AR through higher speed/reliability/bandwidth capacity and low latency (Attaran 2021).

Demand determination is strongly related to willingness to pay because the price is a key factor in the purchase decision process (Ali and Ali 2020; Biswas and Roy 2016; Stone et al. 2022). Based on our cross-industry literature review, the research on willingness to pay has a long tradition since the 1980s. It covers various topics, e.g., economy, environment/sustainability, nutrition, health, management, marketing, and energy. Especially from 2017 to 2022, many scientific papers examined willingness to pay. Research activities on socio-demographic determinants of willingness to pay, such as income (income effect; e.g., Amoah et al. 2022; Palmieri et al. 2022; Wen et al. 2022; Oduh and Oduh 2012), age (e.g., Chua et al. 2022; Kouakou and Poder 2022; Oduh and Oduh 2012), or gender (e.g., Al Mustanyir et al. 2021; Wang et al. 2021; Oduh and Oduh 2012), are the most widespread. Other 'consumer-related' influencing factors are information/knowledge (e.g., Götz et al. 2022; Palmieri et al. 2022; Hojnik et al. 2021) and recommendations by the social environment (e.g., family/friends; Püchel et al. 2020; Hsu and Shiue 2008). Therefore, we take these influencing factors into account in this study.

Related work, research objective, and methodology

The study focuses on WTP because the price is an essential indicator for developing demand (Braun et al. 2020). Although it is a rough indicator that may differ from actual purchasing power, providers should be aware of their customer's WTP (PwC 2018). Primarily, intangible products like 5G services differ only slightly from each other ('homogenous products'), so price becomes an important factor in the purchase decision. Based on a previous literature review (from 2016 to 2021) in the context of 5G, 19 studies investigated WTP for 5G services (Ebert 2022). In 58 percent of the studies, WTP for 5G services is low. However, hardly any factors influencing willingness to pay have been studied (except for age) (Ebert 2022). Moreover, higher data speeds act as a driver for a high WTP. Further, researchers found a higher WTP among gamers and tech enthusiasts. This may be because "real-time online gaming and VR" are enabled through 5G (Rao et al. 2019, 19). In contrast, the general customer base is already satisfied with mobile data speeds but not with coverage or price (Rao et al. 2019). As for the socio-demographic data, only 11 percent of the studies examined a correlation between age and WTP. In this respect, there is a lack of specific prices

on WTP for 5G services. Further, there is a lack of examining factors influencing WTP for 5G and the willingness to switch to a 5G provider. Regarding the German market, 5G mobile plan prices are low compared to other countries such as Austria, Finland, Switzerland, and the US (Bitkom and Tarifica 2022), so there might be an enormous potential for providers. Therefore, the research question is "What are the level of demand, WTP, and price sensitivity regarding 5G mobile services among residential customers in Germany?".

In February 2022, we surveyed residential customers in Germany aged 18 to 65 online. The questionnaire contained five sections: (a) interest in (5G) mobile communications, (b) mobile phone usage/plans, (c) technical features of 5G, (d) WTP for 5G, including VWM, and (e) the satisfaction with the current mobile provider and the willingness to switch.

Study findings and implications

Descriptive statistics

70 percent are (very) interested in new developments in mobile communications, and 14 percent state that they are very well informed about 5G. One-quarter became aware of 5G through advertising, 17 percent through social media/podcasts, and 14 percent by the social environment. More than half already own a 5G smartphone. Another 12 percent own at least other 5G devices. Focusing on non-users, 48 percent are considering buying a 5G smartphone, while 40 percent are unsure. Regarding brands, Samsung dominates (41 percent) ahead of Apple (38 percent). 22 percent did not know their smartphone model. 24 percent use Vodafone, followed by O2/Telefónica (20 percent) and Telekom (15 percent). Almost 70 percent use postpaid plans. 5G plans are already used by two thirds. Of these, again, two thirds would generally recommend them to family/friends. 44 percent use mobile plans for devices other than smartphones. Mainly, mobile data are used for messengers (13 percent), media (11 percent), and e-mail (11 percent). Considering all performance features of mobile plans, price is rated as the most important (4.2/5.0), ahead of data volume (4.1/5.0) and network provider/coverage (4.0/5.0; Fig. 2). In terms of costs, 83 percent pay 5.00–39.94 euros/month for mobile plans. Regarding WTP for a 5G smartphone, 57 percent would pay a maximum of 500 euros. 70 percent rate their data volume as sufficient (65 percent use 3–19 GB/month). Consumers rate higher data speeds (34 percent), better network availability (29 percent), and networked devices (17 percent) as the greatest 5G benefits. 1/3 are very satisfied with the current provider. However, 1/3 are unsure whether their provider sufficiently informs them about 5G. Overall, two thirds want more transparency in 5G pricing.

Van Westendorp method

The Van Westendorp Method, respectively, the so-called Price Sensitivity Meter (Van Westendorp 1976), is applied, for example, by the European market research company GfK to identify acceptable price ranges for (new) products (Breidert et al. 2006). By using the VWM, we asked which monthly 5G surcharge the study participants considered to be (a) too expensive, (b) expensive, (c) cheap, or (d) too cheap (Fig. 3). The results show that the accepted price range for

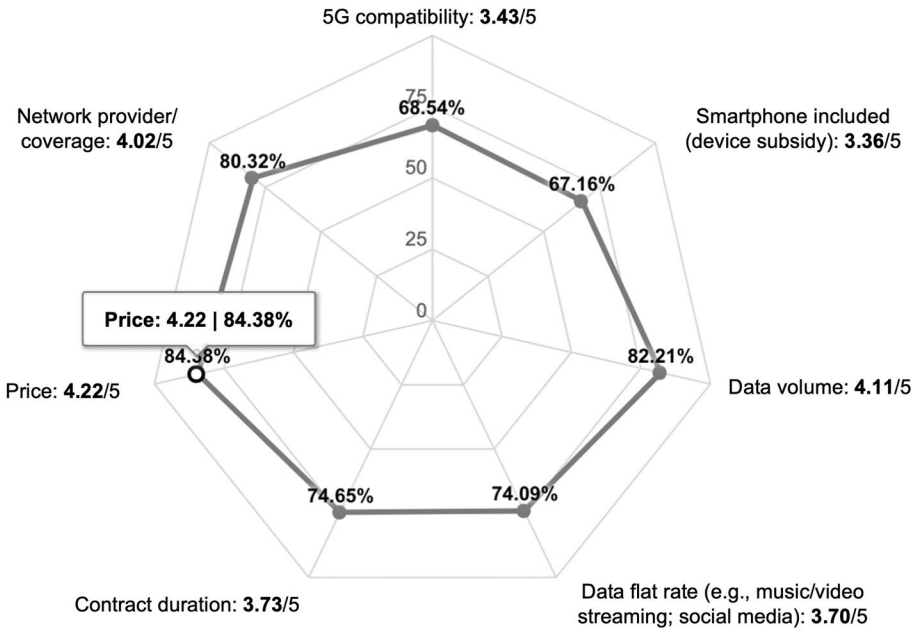

Fig. 2 Importance of various components of a mobile plan. (Source: Own illustration)

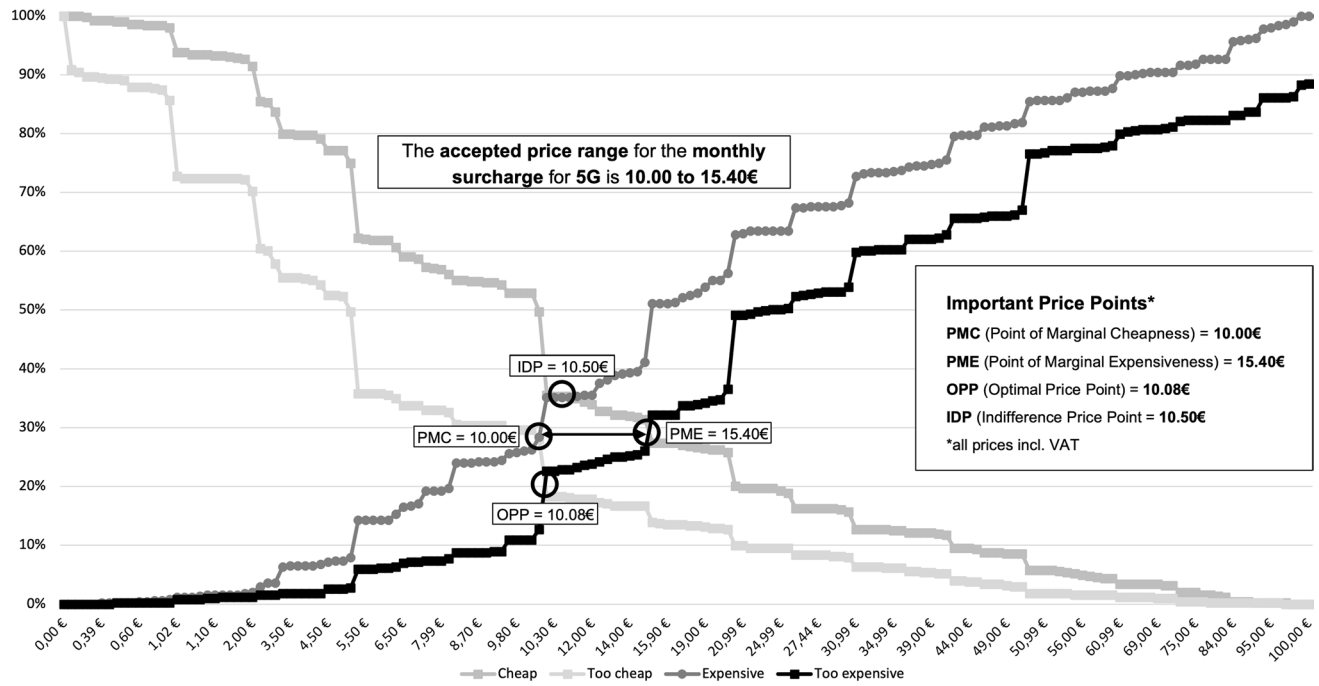

Fig. 3 Results of the Van Westendorp Method. (Source: Own illustration)

a monthly 5G surcharge is between 10.00 and 15.40 euros. Moreover, the optimal price point (=highest sales) is 10.08 euros, at which the same percentage consider the price either too expensive or too cheap. Price sensitivity is relatively high because the gap between the indifference price of 10.50 euros (=balanced price; the intersection between expensive and cheap) and the optimal price is relatively small.

Correlation analyses

We examined approx. 4700 correlations, yielding 19 (highly) significant correlations (interpreted according to Cohen 1988). The age of users plays only a subordinate role (Table 1, section I), so 5G providers should target all age groups. The influence of different variables was investigated regarding possible correlations of interest/knowledge level about 5G. Section II shows the broad target group that 5G providers should address, so there is immense market potential. Section III provides an overview of variables related to the importance of 5G. This means that 5G offers should include smartphones, with price playing only a minor role. In addition, 5G users are generally not multipliers (in terms of recommending 5G within their social environment). Therefore, providers need to advertise 5G actively. Based on other correlations (section IV), 5G providers could improve their customer approach/communication regarding price transparency. Moreover, price-sensitive attach importance to data volume, contract duration, and network provider/coverage. On top, providers can increase customer satisfaction by offering sufficient information about 5G.

Conclusion, limitations and outlook

Overall, this study among residential customers in Germany shows age, income, and interest/ knowledge level regarding 5G have a minor influence on WTP for 5G, so the target group is quite diverse. The price plays a subordinate role. Providers should offer 5G plans as a package with a smartphone and can increase customer satisfaction by offering sufficient information about 5G. However, they should be aware that it is challenging to convince non-users with information. In contrast to the research theory (see chapter 2), 5G users tend not to be multipliers in their social environment. Therefore, it is even more critical for providers to promote 5G.

Regarding the transferability of this study to the German population, male respondents are slightly overrepresented (52 percent compared to 49 percent for the total population; Destatis 2022). Further, there is an overrepresentation of age groups between 20 and 39 years (66 percent compared to 26 percent for the total population; Destatis n. d.). In addition, 5G, as a relatively new technology, might have been complex for the participants to grasp due to the intangibility of the product. Consequently, it is unclear whether the introductory text about 5G vs. 4G was sufficient for the test group to subsequently define specific prices. Lastly, the study does not represent an actual purchase situation,

Table 1 Results of the correlation analyses (Source: Own illustration)

Variable	Method	Significance	Correlation coefficient	Correlation interpretation
I. Age-related correlations				
Evaluation whether current data volume is sufficient	Eta	–	$\eta^2 = .096^2 = .009216$	None
Type of tariff currently used	Eta	–	$\eta^2 = .005^2 = .000025$	None
Ownership of 5G smartphone	Eta	–	$\eta^2 = .124^2 = .015376$	(Negligible) small
Importance of network provider/coverage	Kendall Tau-b/ Spearman-Rho (K./S.)	< .001	.148/.179	Small +
WTP for a 5G smartphone	Pearson	< .001	− 2.33	Small −
Use of a 5G tariff	Eta	–	$\eta^2 = .224^2 = .050176$	Small-medium
II. Correlations with interest/knowledge level				
Residential location	K./S	.045	Knowledge: − .071/− .090	None
WTP for a 5G smartphone by non-users ($n = 214$)	K./S	< .001	Interest: − .267/− .301 Knowledge: − .308/− .353	Small-medium −
Income	K./S	Interest: .002 Knowledge: < .001	Interest: .113/.137 Knowledge: .131/.160	(Negligible) small +
WTP for a 5G smartphone	K./S	< .001	Interest: .186/.221 Knowledge: .202/.240	Small +
Interest AND knowledge among each other	K./S	< .001	.287/.332	Small +
III. Importance of 5G compatibility in a mobile tariff				
Importance of the price	K./S	.049	.077/.088	None
Recommendation of 5G services to family, friends, etc	K./S	< .001	− .225/− 251	Small −
Importance of device subsidy	K./S	< .001	.303/.356	Small−medium +
IV. Other correlations				
Income—WTP for a 5G smartphone	Pearson	< .001	.217	Small +
Feeling sufficiently informed about 5G by current provider—Wish for more 5G price transparency	K./S	< .001	.201/.239	Small +
Importance of price—importance of data volume	K./S	< .001	.312/.346	Medium +
Importance of price—importance of contract duration	K./S	< .001	.378/.428	Medium +
Importance of price—network provider/ coverage	K./S	< .001	.321/.357	Medium +
Satisfaction with current provider—feeling sufficiently informed about 5G by current provider	K./S	< .001	.311/.371	Medium +

as there is no obligation to purchase (Müller et al. 2022). According to Schmidt and Bijmolt, this hypothetical bias is around 9 percent (2020).

In future studies, it could be useful to integrate a control variable or to conduct an experiment with two groups, where only one receives detailed information in advance. Moreover, comparing similar diffusion developments of other technologies could be helpful. Regarding factors influencing WTP, investigations of other factors besides technology (e.g., brand image) could follow. In terms of methodology, a conjoint analysis might also be useful (see Maeng et al. 2020; Chiambaretto 2021; Klein and Jakopin 2014). From a theoretical perspective, it would be fruitful to further investigate the hypothetical bias to identify, measure, and thus be able to reduce it. The results are not only relevant to the (global) mobile industry. In addition, recommendations for managers/marketers from other industries can be derived, especially for companies (a) selling digital or homogeneous products or services to consumers or (b) in highly competitive or saturated markets.

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