



Product differentiation in video games: A closer look at Fortnite's success

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Abstract

Fortnite is the most successful video game in terms of revenues generated. Since it belongs to the '*free-to-play games*', the company has to optimize the in-game-shop to generate revenues. Product differentiation is one possibility to optimize the profitability of the game. In this paper, we use a microeconomic approach in order to highlight the implications of product differentiation for the profit maximization problem.

Keywords: Fortnite, gaming, Freemium, product differentiation, market segmentation

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1 Introduction

In the field of business & economics, frequently, the assumption of a representative agent is used to model economic activity. However, people are different. People are different due to differences in age, gender, or their social status. Furthermore, people are heterogeneous because of the color of their skin, their language, or cultural background (Hofstede 1984). Due to these differences, companies also differentiate their products and offer goods in several varieties.

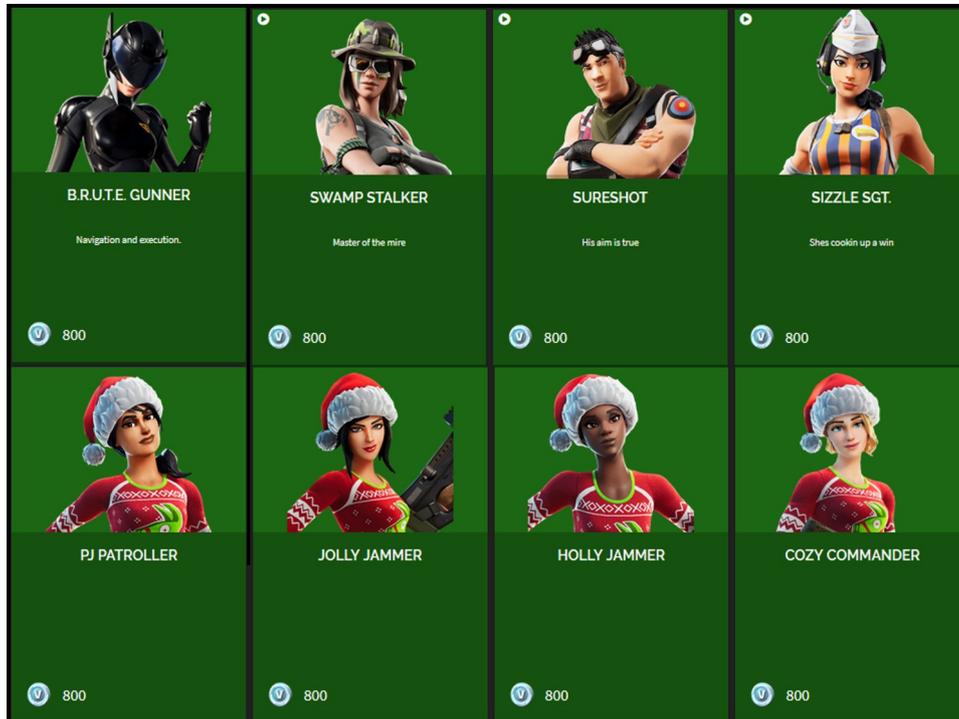
In this paper, we examine the product differentiation within the in-game-shop of a well known and very successful computer game – Fortnite. In this game, 100 players board a flying bus, jump out of the bus like a skydiver and use a glider to reach an island. Afterwards, the players collect weapons in order to eliminate each other.¹ The last man – or woman – standing wins an '*Epic Victory*' (see Anderson 2019 for an introduction to the game). Not only the victory is epic, but it is also an homage to Fortnite's developer, the company '*Epic Games Inc.*'.

While the game can be downloaded and played free of charge, an in-game-shop offers a variety of uniforms ('skins'), parachutes ('gliders'), or dance moves ('emotes'). An examination of the shop indicates that skins are sold within four different price categories.² Furthermore, within one price category, different varieties of skins are offered. One possibility of differentiation is, for example, the color of the skin (see Figure 1).

¹Elimination – of course – could be interpreted as killing the opponent. However, in Fortnite, a player is 'beamed away' when an avatar receives too many hits. This beaming process is called 'despawn'. Hence, it becomes clear that Fortnite is not a typical killer game but also addresses a younger generation of players.

²Skins are sold at 2,000 V-Bucks, 1,500 V-Bucks, 1,200 V-Bucks, or 800 V-Bucks. Hence, uniforms are sold at different prices. V-Buck is the virtual currency used in the in-game-shop. 1,000 V-Bucks are sold at the price of 9.99 USD in the American shop or 9.99 EUR in a shop belonging to the Euro area.

Figure 1: Different degrees of product differentiation



Note: Skins in the upper row are differentiated to a larger extent than the ones in the lower row.

Source: <https://skin-tracker.com/>

In this paper, we examine why it makes sense for a company to differentiate products and offer them as different varieties. The remainder of the paper is structured as follows: Section 2 examines the role of skins in the virtual world. Section 3 solves the profit maximization problem, in case that a company differentiates the good and introduces several varieties. The last section concludes.

2 The role of skins in the virtual world

The success of video games can be measured in several dimensions: One measure could be the overall number of players or the overall number of downloads. Another measure is the number of active players within one month. In light of this paper, a very important dimension is the economic success. In this respect, Fortnite is outstanding (Goldman Sachs 2018). This might be to some extent surprising, because the basic game can be downloaded and played free of charge. The game belongs to the so called 'free-to-play' genre of video games. The top 'free-to-play' games are economically more successful than the most successful 'premium games'. In 2019, the average revenues generated by the top 10 free-to-play games were equal to 1,430 million US-Dollar (see Table 1). The average revenue of the 'top 10 premium games' was only 475.5 million. Hence, the average revenue of free-to-play games was about 300 % larger than the average revenue of the premium games.

– Insert Table 1 about here –

For Fortnite – or to be more precise – for the developer *Epic Games* the '*Freemium*' business model pattern is very important (Anderson 2008, Osterwalder/Pigneur 2010). This is the case because the basic product is given away for free in order to attract a large market share. Revenue is generated via the in-game-shops by selling the *Battle Pass*, *skins*, and other virtual equipments. Skins can be regarded as a kind of uniform worn by the virtual player.

Table 1: Top earnings 2019: Free-to-play versus premium games

Top earning free-to-play games 2019			
Rank	Game	Developer	Revenue
1	Fortnite	Epic Games	1800
2	Dungeon Fighter Online	Nexon	1600
3	Honour of Kings	Tencent	1600
4	League of Legends	Riot Games, Tencent	1500
5	Candy Crush Saga	KING Digital Entertainment	1500
6	Pokemon GO	Niantic	1400
7	Crossfire	SmileGate	1400
8	Fate/Grand Order	Aniplex	1200
9	Game for Peace	Tencent	1200
10	Last Shelter: Survival	Long Tech/im30.net	1100
		Average	1430
Top earning premium games 2019			
Rank	Game	Developer	Revenue
1	FIFA 19	Electronic Arts	786
2	Call of Duty: Modern Warfare	Activision Blizzard	645
3	Grand Theft Auto V	Take-Two Interactive	595
4	FIFA 20	Electronic Arts	504
5	Call of Duty: Black Ops IIII	Activision Blizzard 487	
6	NBA 2K19	Take-Two Interactive	370
7	Tom Clancy's The Division 2	Ubisoft	370
8	Tom Clancy's Rainbow Six: Siege	Ubisoft	358
9	Borderlands 3	Take-Two Interactive	329
10	Sims 4	Electronic Arts	311
		Average	475.5

Source: SuperData (2020, p. 11 and 13). *Revenue in USD million.

It becomes clear that Fortnite is a good example for the 'Free' as business model pattern – outlined by Anderson (2008) as well as Osterwalder/Pigneur (2010). In this business model pattern, revenue might be generated via three different channels:

1. Two-sided-markets: One side of the market subsidizes the other side of the market: A good example is '*Facebook*', which is available for private users free of charge. This market side of the private households is subsidized by companies, which pay for advertisements.
2. Bait-and-Hook: The razor is given away for free, but profits are generated via the blades. Another frequently used example is the combination of a printer and the ink cartridges. The printer is sold at a very low price, while the profits are generated via the ink.

3. Freemium: Many users use the basic version of the product for free, but the profit is generated via premium add-ons. A good example is *'Skype'*, where the basic product can be used free-of charge, but subscriptions for flat-rates are sold to also call landlines.

When it comes to free-to-play video games, some games use the Bait-and-Hook approach: One example is the game *'Candy Crush'* which is predominantly played on mobile phones. While the first levels are easy to master, some levels can hardly be solved without relying on 'boosters'. Of course, boosters can be earned with some effort within the game, but it is much more convenient to spend some money and buy the boosters. This is one element of the huge financial success of Candy Crush (Gaille 2015).

Fortnite, however, uses the Freemium approach: The game can be played – without any restrictions and limitations – free of charge. The revenues are generated via the in-game-shops where several add-on items are offered: Especially, virtual uniforms or avatars called 'skins' are very popular products. Other virtual items are parachutes (gliders) and dance moves (emotes). In the Fortnite game, all add-ons are just cosmetic items and do not influence players' strength and the gaming success. Hence, they are just *decorative* items.

Successful video games are developed in a way to maximize gamer's flow and loyalty. One component in this system is the attractiveness of the avatar. Liao et al. (2019) perform a questionnaire survey among online gamers. They use a *structural equation model* to examine how the avatar influences gamer's mood. They find that avatar attractiveness and customization are positively related to avatar identification. Avatar identification implies how the gamer identifies him- or herself with the virtual player. One result is that avatar identification influences flow and loyalty in a positive way. Therefore, this study highlights the importance of the virtual add-in items like skins in a video game.

Bae et al. (2019) examine the relationship between game items and mood management. They also perform an empirical study among gamers. They find that stressed users are more likely to purchase decorative items while bored users purchase functional items to manage their mood. Several managerial implications are derived how game developers should deal with the heterogeneity of gamers and what kind of items should be designed for the different groups of gamers (Bae et al. 2019, p. 324-325).

Skins also serve as a status symbol among the young generation (Linken 2019, Schoeber/Stadtmann 2020). The British 'Children's Commissioner' examined the online gaming behavior of children. One focus is on the role of in-game items for the social status. They conclude that: *"Children are scorned in games such as Fortnite if they are seen to wear the 'default skin' (the free avatar they receive at the start of the game). Children say they feel embarrassed if they cannot afford new 'skins', because then their friends see them as poor."* One quote of a ten year old girl (Fortnite player) brings it to the point: *"If you're a default skin, people think you're trash."* (Childrens Commissioner 2019, p. 2).

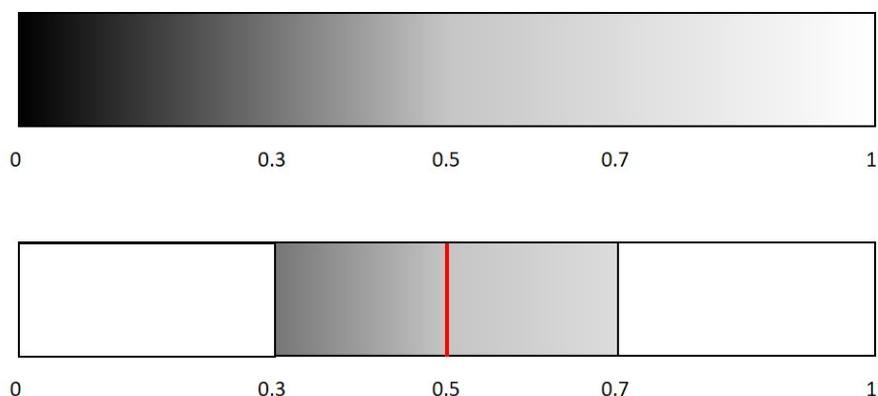
3 Differentiation of products

In this section, we examine the phenomenon of product differentiation in a theoretical model. We measure the success of the company, which developed the video game, in the dimension of profits generated. The approach is inspired by Hotelling's (1929, p. 45) *'Main Street'* model, where consumer preferences are different from each other, due to geographical preferences. Customers have preferences for a shop close to their homes due to transportation cost.

3.1 Assumptions

As can be seen in the upper part of Figure 2, preferences are distributed as a *continuum of colors*. Some households prefer a dark color (black) and some households have strong preferences for a light color (white). Others prefer a grey version of the good. The continuum runs from zero to one. Hence, the market size is restricted to one.

Figure 2: Distribution of preferences



Each household might buy only one good *or* no good at all. Whether a household buys or not depends on his preferences in relation to the characteristics of the good offered. We assume that a household buys, in case that the difference between the variety offered by the company (v_i) and the preferences of the individual (p_j) is smaller than *or* equal to t :

$$|v_i - p_j| \leq t \tag{1}$$

The variable t can be interpreted as the '*most tolerable deviation*', so that the household still buys the good. It is restricted to the range $0.5 \geq t \geq 0$. If $t = 0$, a household buys the good only, in case that the company exactly provides the preferred color ($v_i = p_j$). In case that $t = 0.5$, one variety – placed in the middle of the continuum – is sufficient to cover the whole

market. Furthermore, we assume that t is the same for all households.

In the lower part of Figure 2, a numerical example illustrates the assumptions: The company produces only one variety of the good. We assume that good number $i = 1$ was placed exactly in the middle ($v_1 = 0.5$). Furthermore, we assume that the most tolerable deviation is equal to $t = 0.2$. This is an arbitrary assumption and will be modified in several sensitivity analyses. As a consequence, all households – who are at most $t = 0.2$ units away from $v_1 = 0.5$ – buy the good. Therefore, all households with preferences between $p_j = 0.3$ and $p_j = 0.7$ buy. Households who have preferences in the range $0 - 0.3$ or $0.7 - 1.0$ do not buy, because the version offered is too far away from their preferences.

In the next section, we formalize the profit maximization problem.

3.2 The profit function

The profit function is given by revenues minus cost:

$$\Pi = R(n) - n \cdot c \tag{2}$$

Revenues (R) depend on the number of varieties offered (n). Furthermore, we assume that the introduction of a new variety costs c currency units. This cost originates from designing one variety of the good. After a good is designed, it can be sold to households without any further cost.

In case that only one good is created ($n = 1$), the profit is equal to $\Pi = p_1 \cdot q_1 - c$. With two versions of the good ($n = 2$), the profit is equal to $\Pi = p_1 \cdot q_1 + p_2 \cdot q_2 - 2c$. Let's assume that the prices for the goods are the same ($p_1 = p_2 = p$). With respect to the Fortnite game, we analyse the

behaviour within one price group. Therefore, the profit function is given by:

$$\Pi = p \cdot (q_1 + q_2) - 2c \quad (3)$$

When the price is normalized to one ($p = 1$), we get:

$$\Pi = q_1 + q_2 - 2c \quad (4)$$

3.3 Scenario analysis

We perform a scenario analysis: In Table 2, one dimension represents the cost for differentiation on the side of the company. The other dimension is the parameter t which represents households' most tolerable deviation. With respect to t , we differentiate the cases $t = 0.5$ and $t < 0.5$. In case that $t = 0.5$, one variety – placed in the middle – is sufficient to cover the whole market.

Table 2: Scenario analysis

	$t = 0.5$	$t < 0.5$
$c = 0$	Scenario 1	Scenario 2
$c > 0$	Scenario 3	Scenario 4

- Scenario 1: In case that the monopolist introduces one version of the good ($n = 1$), all households buy. Nevertheless, since also the cost for product differentiation is zero, the number of varieties could also be equal to infinity without hurting the company's profit.
- Scenario 2: The number of differentiated products will definitely be larger than one ($n > 1$), so that every household buys. However, since cost of product differentiation is zero, the number of varieties is also ambiguous. The best way to explain this finding is by contradiction:

In case that number of versions would be equal to $n = 1$, the company would only serve the market space of $2 \cdot t$. Since we are in Scenario 2 where $t < 0.5$ it is obvious that $2 \cdot t < 1$ so that the company does not serve the whole market. Some parts of the spectrum – the corners – would not be served. Due to the fact that in Scenario 2 the cost of differentiation is zero ($c = 0$), the company can increase the variety so that the complete market is covered. The increase in the number of varieties does not influence cost and, hence, has no impact on the profitability. Therefore, the number of varieties will be larger than one ($n > 1$). However, the exact number of varieties is not determined.

- Scenario 3: When the company introduces one version of the good ($n = 1$), profits are equal to:

$$\Pi = p_1 \cdot q_1 - n \cdot c \quad \Rightarrow \quad \text{since } p = 1 \ \& \ n = 1 \quad \Rightarrow \quad \Pi = q_1 - c. \quad (5)$$

The company will only produce if profits are positive. This is the case, if the revenue is larger than the cost of introducing one product category ($q_1 > c$). The number of varieties will be either $n = 0$ or $n = 1$. We won't see two or more varieties of the good, because product differentiation comes with a cost, but households would always buy.

- Scenario 4: This is the most interesting³ scenario and is now examined in detail!

Each variety v_i can cover the distance of t to the left and to the right. Hence, the distance $v_i - t$ to $v_i + t$ can be covered by one variety, which is given by $2 \cdot t$. With n -varieties, the space of $n \cdot 2 \cdot t$ can be covered. Therefore, the quantity sold is equal to $q = n \cdot 2 \cdot t$. Since prices are normalized to $p = 1$, revenue is given by $n \cdot 2 \cdot t$.

³We think that this is the most interesting scenario, because the solutions in Scenario 1, 2, and 3 are easier to derive and easier to understand – compared to Scenario 4. Furthermore, the *exact* number of varieties (n) can be determined by the different components of the theoretical model. This was not the case in Scenario 1 and 2, where the number of varieties is ambiguous.

As a consequence, the profit function is

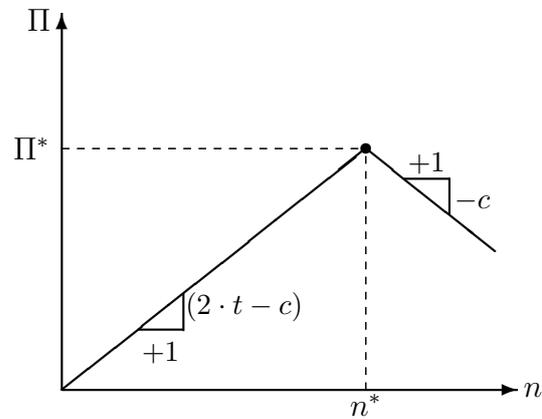
$$\Pi = n \cdot 2 \cdot t - n \cdot c. \quad (6)$$

Of course, some restrictions exist, because the space is defined between zero and one, so that the market size is limited to one. Taking n out of brackets yields:

$$\Pi = n \cdot (2 \cdot t - c) \quad (7)$$

Hence, it becomes clear that the profit is positive only if $2 \cdot t > c$. In case that this condition is fulfilled, the optimal solution is to increase n – *as much as necessary* – to cover the whole continuum.

Figure 3: Relationship between profit (Π) and the number of varieties (n)



We created Figure 3 to highlight the relationship between profit and the number of varieties. In this graph it is assumed that n is a continuous variable. In the left part of the diagram, profit function increases with the slope of $(2 \cdot t - c)$. After the market is fully covered at n^* , one additional

variety would not generate additional revenues, but would only increase cost. Therefore, after point n^* is reached, profit function decreases by $-c$ with each additional variety of the good. Profits decrease after n^* is reached.

The overall market size is limited to one. Therefore, the number of varieties which maximizes profits is given by:

$$n^* = \frac{\text{market size}}{2 \cdot t} = \frac{1}{2 \cdot t} \quad (8)$$

In case that the most tolerable deviation is equal to $t = 0.2$, the optimal number of varieties is equal to $n^* = 2.5$. If, however, the number of varieties should be an integer, either $n^* = 2$ or $n^* = 3$ is optimal. The marginal revenue of a third variety is given by the '*decimal place*' (here: 0.5) times $2 \cdot t$. The marginal revenue has to be compared with the marginal cost of introducing the third variety (c). In case that marginal revenue is larger than marginal cost, the third variety will be introduced.

A detailed numerical example helps to understand the logic:

- For example, if $t = 0.2$ and $c = 0.1$: With $n = 2$ varieties, the first variety could be placed at $v_1 = 0.2$, which covers the range $0 - 0.4$. The second variety, placed at $v_2 = 0.6$, covers the range $0.4 - 0.8$. Hence, the range $0.8 - 1.0$ is not served yet. Therefore, the company covers the space $n \cdot 2 \cdot t = 0.8$ of the space. A space of the size 0.2 is not covered! Since prices are normalized to one, revenue is equal to $n \cdot 2 \cdot t \cdot p = 0.8$, cost is equal to $n \cdot c = 0.2$. Profit is equal to $\Pi = 0.6$.
- Does it make sense to add one additional variety so that also the remaining part of the space is covered? Yes, of course: By incurring additional cost of $c = 0.1$, the company can earn 0.2 in additional revenues. Therefore, the optimal number of varieties is $n^* = 3$ and profit is $\Pi = 1 - 3 \cdot 0.1 = 0.7$.

3.4 Some further explorations and refinements

3.4.1 Variations in the cost of differentiation

In this section, we explore the stability of the results and suggest some refinements. Especially, we examine the role of the cost of differentiation (c). Until now, we assumed that this variable is exogenously given and constant. However, we could also argue that the cost of differentiation varies with the degree of differentiation. The more different two products from each other, the larger the cost of differentiation. Figure 1 helps to make this argument.

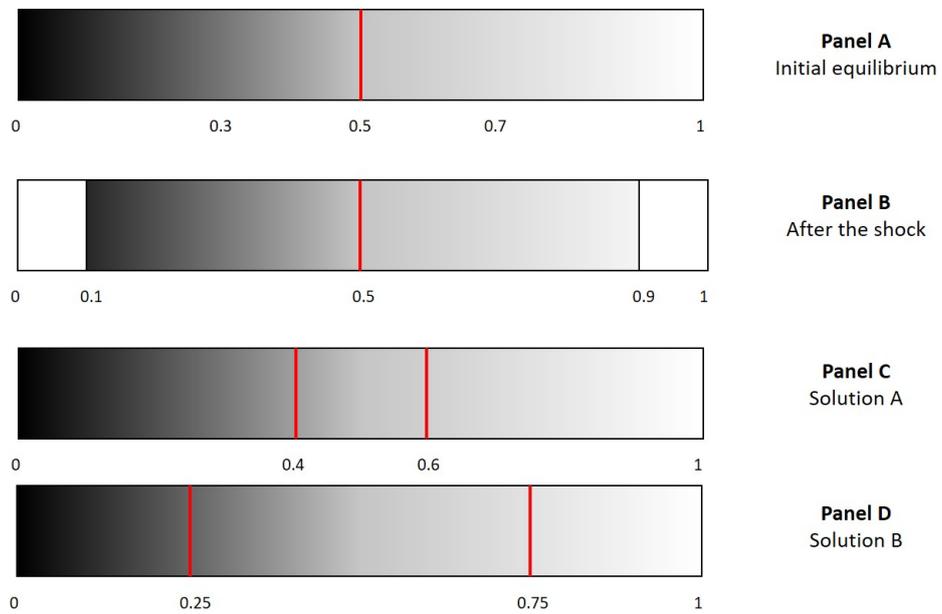
The upper row indicates skins that are differentiated to a larger extent than the ones in the lower row. Hence, it makes sense to assume that the cost to design and to program the skins in the upper row will be higher than the cost to create the skins in the lower row.

Figure 4 illustrates, why this detail is important for the profit maximization problem and the degree of differentiation in the equilibrium.

The initial scenario is characterized as follows: We assume $t = 0.5$ and the company has introduced one variety in the middle of the space ($v_1 = 0.5$). Since $t = 0.5$, all households buy the product (see Panel A of Figure 4).

Due to an exogenous shock, the most tolerable deviation t decreases to the level $t = 0.4$. This implies that customers become less tolerable with respect to difference of the version offered by the company and the individual preferences of the consumer. In case that the company would still produce the same variety, the households in the two corners would not buy the good anymore. In Panel B of Figure 4, this is represented by the distance $0 - 0.1$ as well as $0.9 - 1.0$.

Figure 4: Sensitivity analysis



Since one variety does not cover the whole market, the company could introduce $n = 2$ varieties. However, it is questionable where the company places its products (see Panel C and D of Figure 4).

- Solution A could be to place one good at $v_1 = 0.4$ and the other one at $v_2 = 0.6$. In this solution, the relationship $|v_i - p_j| \leq t$ is fulfilled for all customers.
- Solution B could be to place one good at $v_1 = 0.25$ and the other one at $v_2 = 0.75$. Also in this solution, the relationship $|v_i - p_j| \leq t$ holds.

Solution A implies a relatively low degree of differentiation between variety 1 and 2 ($v_2 - v_1 = 0.6 - 0.4 = 0.2$). In Solution B, the two versions are differentiated to a larger extend ($v_2 - v_1 = 0.75 - 0.25 = 0.5$).

It becomes clear that if the cost of product differentiation does not vary with the degree of differentiation, good 1 could be placed in the range $[0.1 - 0.4]$ and good 2 in the range $[0.6 - 0.9]$. If the two products are placed in these ranges, the company could serve the whole market.

How does the optimal solution look like, in case that the cost of differentiation increases, the more the products have to be differentiated from each other? The answer is clear-cut: The company would opt for Solution A, in order to minimize the cost of differentiation. For example, if the cost of differentiation are given by

$$C = c + \alpha \cdot |v_2 - v_1|, \tag{9}$$

the cost of Solution A would be equal to $C_A = c + \alpha \cdot |0.6 - 0.4| = c + 0.2 \cdot \alpha$ while the cost of Solution B would be equal to $C_B = c + \alpha \cdot |0.75 - 0.25| = c + 0.5 \cdot \alpha$. Since the cost of differentiation is lower in Solution A, the company would opt for a lower degree of differentiation.

This solution, however, is not optimal for the consumers. The optimal scenario for households would be Solution B. This will be elaborated in the next subsection.

3.4.2 Implications for the utility of households

Until now, we assumed that the company is just using the profitability as its decision criterion. In order to examine the effects for the consumers, one has to specify the utility function. Let's assume that the utility function of a household j is given by:

$$U_j = t - |v_i - p_j| \tag{10}$$

In case that the company offers exactly the skin preferred by household j the term $v_i = p_j$ is zero, so that the utility is equal to t . The utility decreases with the absolute difference between v_i and p_j , which implies that the utility of one household is the lower, the further away the offered variety from his preferences is. In the appendix, we show that the Solution B is optimal for the consumer. This solution generates the highest utility for the average household.

3.4.3 Further ideas

In this subsection, we briefly discuss how relaxing the one or the other assumption affects the equilibrium.

Until now, we assumed that the price is exogenously given and normalized to one. One could also link household's willingness-to-pay to the difference between the characteristics of the good offered and household's individual preferences: *The lower the difference, the higher the willingness-to-pay.* This refinement would lead to a larger degree of product differentiation in equilibrium.

Another idea could be to modify equation (9) which symbolizes the cost of differentiation. In case that this function is convex

$$C = c + \alpha \cdot (v_2 - v_1)^2, \quad (11)$$

it might be the case that the company does not cover the whole market. Maybe, some households in the corners of the continuum would not be served.

4 Summary and conclusion

Fortnite is the most successful video game in terms of revenues generated. Since it belongs to the '*free-to-play games*', the company has to optimize the in-game-shop to generate revenues. Product differentiation is one possibility to optimize the profitability of the game. In this paper, we use a microeconomic approach in order to highlight the implications of product differentiation for the profit maximization problem.

The insights generated in this subsection can be summarized as follows: Differentiation has at least two dimensions: The number of different products offered (n) as well as the degree of differentiation of two varieties $|v_i - v_{i+1}|$.

The degree of differentiation will be the larger,

- the lower the cost of differentiation on the side of the company,
- in case that the company also considers the heterogeneity of customers at least as a subordinated decision criterion.

The theoretical model uses only the color of the skins as the variable of differentiation. In Fortnite's in-game-shop, skins are also differentiated with respect to gender, since male and female characters are sold. Furthermore, one could distinguish between *human* and *fantasy* characters. Hence, it becomes clear that skins can be differentiated in several dimensions – besides

color.

Future research could examine the heterogeneity of players and skins in an empirical analysis. One research question could be whether the gender of the player has implications for the willingness to buy a male or a female skin.

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Appendix

In this appendix, we show that the utility for the average household is larger in Solution B compared to Solution A. This can be proven by calculating the overall loss in utility of the households:

- Loss in Solution A:
 - Good 1 is placed at $v_1 = 0.4$. All households to the left, that means, in the range $0 - 0.4$ buy good 1 and the *average* loss in utility for *one* household is equal to $|0.4 - 0.2| = 0.2$.
 - All households which are in the range $0.4 - 0.5$ also opt for good 1. The loss of an average household is equal to $|0.4 - 0.45| = 0.05$.
 - Therefore, the overall loss in utility for all households which buy good 1 is equal to $0.4 \cdot 0.2 + 0.1 \cdot 0.05 = 0.085$. The values 0.4 and 0.1 serve as the weights for the left (0.4) and right (0.1) side of the market of good 1.
 - The same considerations hold for good 2 so that the overall loss in utility is equal to $2 \cdot 0.085 = 0.17$.
- Loss in Solution B:
 - Good 1 is placed at $v_1 = 0.25$. All households to the left, that means, in the range $0 - 0.25$ buy good 1 and the *average* loss in utility for *one* household is equal to $|0.25 - 0.125| = 0.125$.
 - All households which are in the range $0.25 - 0.5$ also opt for good 1. The loss of an average household is equal to $|0.25 - 0.375| = 0.125$.
 - Therefore, the overall loss in utility for all households which buy good 1 is equal to $0.25 \cdot 0.125 + 0.25 \cdot 0.125 = 0.0625$. The two values of 0.25 serve as the weights for the left and right side of the market of good 1.
 - The same considerations hold for good 2 so that the overall loss in utility is equal to $2 \cdot 0.0625 = 0.125$.