A study on interrupted consumption: Effects on consumer's utility from positive experiences

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ABSTRACT

A study conducted by Nelson and Meyvis (2008) claims that interruptions in consumption affects a consumer's overall utility either positively or negatively, depending on its nature. While this research focused on empirical results based on a series of experiments, Loewenstein (1987) illustrated analytically how delayed consumption and anticipation affect future consumption. We now modify Loewenstein's (1987) model by adding another consumption period before the said delay in consumption to make it seem like the consumption was interrupted. Analytical results were then derived to assess if Nelson and Meyvis' (2008) arguments hold when it comes to positive experiences. In other words, the new model created was subjected through different cases wherein the length of the consumption and the break were manipulated to test if these had an effect on overall consumer utility. The effect of an interruption on negative experiences however were not considered in the study. Our results show that different lengths of interruption on positive experiences and varying lengths of periods of consumption do in fact increase consumer utility. With this information, producers can now manipulate how they market their products and services to the consumers to make it more appealing and at the same time be able to give them higher satisfaction.

JEL Classification: D11, D21, E03, E21
Keywords: anticipation, *consumption, delay, interruption, utility*

INTRODUCTION

Is the overall utility[1] of a consumer towards positive experiences, like goods and services, affected by an interruption[2] in consumption[3]? In a study done by Nelson and Meyvis (2008), it was found out through a series of experiments that

[1] Utility from an economists' perspective is the numerical indicator of a person's preference for different items, may it be products, jobs or leisure time. In an average scenario, the total utility of a person increases as he consumes more of the said good. However, his utility will increase at a slower pace as even more of the said good is consumed, which is the concept of diminishing marginal utility. Diminishing marginal utility happens when an individual gets less additional benefit upon increasing consumption of a particular good (Taylor & Weerapana, 2013).
[2] Interruption is a stop to a certain event (Hartung, 2009).
[3] Consumption is defined as the usage of products with the primary goal of satisfying one's desire to experience pleasure or derive enjoyment (Raghunathan & Irwin, 2001).

interrupting consumption disrupts adaptation[4] to hedonic experiences. However, the study did not consider the different lengths of consumption and interruption, and how this can have an effect to the consumer's overall utility. Furthermore, Marshall's (1891) work failed to consider the factor of expectation in determining a consumer's utility from consumption. This will be the primary concern of this study.

Statement of problem

Do interruptions on positive experiences have a positive effect on consumer utility? As was shown in Nelson and Meyvis (2008) results, interruptions on positive experiences do increase overall utility. However, these results exist from experiments and it is not sure if these hold true in general.

Objectives of study

To be able to see if Nelson and Meyvis' (2008) findings are true, Loewenstein's (1987) model will be modified to find out if:

1. Breaks increase a consumer's overall utility;
2. Prolonging a break will increase a consumer's overall utility further; and
3. Varying consumption lengths have an effect on a consumer's overall utility.

Significance of study

As businessmen and economists, it is important that we understand how a person responds to a particular stimulus, in this case an interruption, and be able to use it to our advantage. Through the findings of this study, industries and businessmen will be able to successfully market their products or services to the consumers to make it more appealing than it really is. Specifically, knowing how breaks enhance a consumer's total utility will allow producers of goods and services to maximize their potential benefits.

For instance in the stock market, by knowing how consumers respond to breaks and anticipation, a company can use this to make their stocks more appealing. They can manipulate these breaks in such a way that it will increase a buyer's perception of a particular stock thereby boosting potential value. On the other hand, if they anticipate that a stock's value will depreciate, they can sell it instantly instead of prolonging it so that buyers will no longer have time to anticipate or think about the possible loss.

Scope and limitations

Since there is no specific model available that fits Nelson and Meyvis' (2008) findings perfectly, a new intertemporal utility model based from Loewenstein's (1987) paper will be created. In his model, both desirable and undesirable consumption were taken into consideration. However, for the purpose of this study, only desirable consumption would be taken into account. Since there are numerous outside forces that can easily affect a consumer's utility

[4] Adaptation is defined as the process of increasing satiation of a consumer throughout the consumption.

from consumption, all things not included in the model are held constant.

REVIEW OF RELATED LITERATURE

Interruption of certain consumptions have several effects to the next consumption experience. In this section, we will first properly define the types of interruption. Then, we will discuss the reasons behind why consumers choose to delay consumption in the first place. Moreover, we will be stating several studies conducted to compare an interruption's positive and negative effects through a consumer and producer's perspective. Finally, Loewenstein's (1987) model, which is the basis of the new model, will be discussed.

A complete stop

The common notion of an interruption is a complete stop to the consumption of a good or a service before continuing further. In the study done by Nelson & Meyvis (2008), they used a massage chair product testing as an example. During the consumer's consumption or massage experience, they completely stopped or interrupted the massage in the middle, and then continued again after a few seconds. Another example was inserting a break in an enjoyable song. Instead of one continuous consumption, the song was divided into two by a pause in the middle. In both cases, results showed that consumers actually acquired higher utility when positive experiences were interrupted. On the other hand, the study also tackled how a complete stop will affect a negative consumption such as a loud noise. It showed that when consumers were interrupted in the middle of a negative experience, they tend to have lower utility.

Partitioning

Some experiences do not need to be completely disrupted but just seem discontinuous, which is the case of partitioning. This is the second type of interruption. Let's take the consumption of chips for example. Instead of getting your usual one large bag of chips which you easily consume until the end, you are given three small bags that will sum up to the same amount as the big bag, however partitioned into smaller packs. Will your consumption remain unchanged? Will your utility remain unchanged? This study conducted by Cheema and Soman (2008) has shown that resources like food and money were consumed at a slower rate when they were partitioned. This can be explained by the fact that instead of deciding once, a consumer ends up deciding several times because a resource is broken-up into several pieces. Instead of their moves being automatic, it transforms to being more deliberative. Applying this to our chips example, eating the next piece of chip is typically a thoughtless process, however opening a new bag of chips draws attention to the decision and therefore deliberation arises.

Reasons for delayed consumption

Now we know what interruptions are, why would a consumer even choose to delay consumption in the first place? One reason for procrastinating consumption is when a person wants to avoid it or if they have too many other things to do (Solomon & Rothblum, 1984). Instead of going straight to the consumption, they tend to delay it in order to finish other things. Another reason for procrastination is when a person has a negative emotional response to a certain experience and finds it unpleasant (Milgram & Sroloff et al, 1988). If a person had a negative experience of consuming the certain good or service from the past, it is likely that he will delay any future consumption because he is trying to avoid it. However, since this study focuses on the consumption of pleasurable goods and services, these two reasons are ruled out, and other reasons are considered. One reason why people delay their decision to consume is when they are uncertain about the resulting consequences (Hogarth & Michaud et al, 1980). More often than not, since they are uncertain of the future, they tend to find the need to obtain someone else's advice or assistance, in order for them to make the right decision (Amato & Bradshaw, 1985). Delay can also be made because of the possible regret they will get when they pay now and see the prices fall later (Simonson, 1992). This is precisely the reason why in this study, a consumer's wealth is held constant wherein all consumers are assumed to have equal ability of consuming a certain good or service. Lastly, a consumer delays consumption of new innovations or newly improved products because they are suspicious of its quality (Horsky, 1990) or expect that its quality will improve (Holak & Lehmann et al, 1987). Now after consumers have delayed enough for any of these reasons, they finally stop delaying and start consuming once that reason is addressed or superseded (Greenleaf & Lehmann, 1995).

Positive effects from a consumer's perspective

We now move on to the positive and negative effects of an interruption in a consumer and producer's perspective. Several studies have shown that waiting for pleasurable experiences derive positive outcomes (Nelson & Meyvis, 2008). This is due to the anticipation that arises while waiting for the next consumption (Caplin & Leahy, 2001). A research done by Loewenstein & Prelec (1993) supports this with the findings that people prefer to anticipate and savour enjoyable outcomes, before finally consuming them. Since future consumption impacts instantaneous utility or immediate wellbeing (Faria & Mcadam, 2013), when a person is asked to wait, especially for a positive experience, anticipation tends to increase and therefore making the overall consumption experience more pleasurable.

According to Nelson & Meyvis (2008), interruptions disrupt adaptation to a consumer's experience and therefore avoid diminishing marginal utility. In the theory of natural selection by Charles Darwin, it was stipulated that adaptation is a normal occurrence in order to survive. It is because of this reason that humans have an innate ability to adapt to anything but the most extreme circumstances. However, according to Alland's (1975) study, these extreme cases do not apply to goods and services. When adaptation occurs, especially swift hedonic adaptation, this destroys a consumer's lasting happiness (Lyubomirsky, 2014). Thus, a break would not only be interrupting consumption but also the adaptation to the said consumption.

Another reason why a consumer's utility increases with an interruption is due to the fact that when there is anticipation of a pleasurable consumption, mental images are formed and decisions are based on these imagery-related processes (Shiv & Huber, 2000). Since anticipation is influenced by visceral factors which are consumer emotions that are drive states, like a craving that result from biological feedback from the body, these factors come into play when there is vividness of the consumption experience (Nowlis & Mandel et al, 2004). In other words, the clearer the mental image is, the greater a person can anticipate it. After making consumers wait, with a clear image of what they are about to consumer placed in their head, their consumption resulted to a higher enjoyment since they were already clearly and vividly anticipating it.

As shown in the study by Nelson & Meyvis (2008), external agents may actually have the ability to improve a consumer's experience better than they do themselves which is why breaks showed an improvement in a person's consumption. However, the impact of the break or delay in consumption depends on the degree of the wait to consume and the anticipation of the pleasurable consumption (Nowlis & Mandel et al, 2004). Since interruptions have a lengthening effect on perceived durations of consumption, it prolongs the pleasure derived from the whole consumption process, and therefore improving the total consumption experience (Schiffman & Greist-Bousquet, 1992). Improving total consumption will then of course make the person happier, even for just a short while, and thus increasing total utility. Though, to make the increase in happiness sustainable, the added improvement must be resistant to adaptation (Hsee & Xu et al, 2008) and must not be a simple one-time burst of pleasure (Lyubomirsky, 2014).

Positive effects from a producer's perspective

After looking at the consumer's perspective, we now look at the producer's point of view. Research has shown that interruptions surprisingly cause people to perform their main task faster while maintaining the same level of quality of work (Zijlstra & Leonora et al, 1999). In the case of an employee, interruption of his main line of work with another line of work only makes him labour on the former faster while preserving its quality. This is more profitable for the company or employers since their workers are actually being more productive; doing more work and yet retaining their quality level.

Negative effects from a consumer's perspective

We now move on to the negative effects of interruptions from a consumer's point of view. When it comes to mundane, utilitarian activities wherein producing hedonic or visceral effects are unlikely, a break tends to have a negative impact on a consumer (Hirschman & Holbrook, 1982). One example is a study done by Loewenstein and Prelec (1992) wherein they point out that discounted utility theory, which assumes a positive discount rate, is the reason behind interruptions having a negative effect on a person's utility. This means that a consumer prefers to consume a certain product sooner than later. This argument tells us that consumers will not enjoy a product or service as much if you make them wait for it, or if you interrupt them in the middle of it. Adding to this is the fact that another study has found out that anticipated delay decreases the value of the rewards (Mischel & Grusec et al, 1969). If a consumer expects, and knows that there will be an interruption in his future consumption, its value in his mind decreases, and therefore decreasing overall utility. Furthermore, another study has shown that delays can result in anxiety and stress which could result to a negative consumption experience (Dellaert & Kahn, 1999). When placed in a position where a consumer has to wait for something, there is this uneasiness for making him wait and thus the postponement of consumption makes a person feel anxious because of the uncertainty of what may come.

On another note, a break may also have a negative effect on the consumer due to the fact that after an interruption, a consumer's preference for a high-quality-high-priced product increases (Liu, 2008). This presents to us the idea that consumers will always want to experience higher utility after a break and therefore they will choose a high-quality-high-priced product, believing that this will satisfy them. This is bad for consumers and good for producers since the former is now willing to pay more to the latter. Besides that, making a consumer 'want' a certain product or service can make them have impulsive choices and opt for a smaller sooner reward rather than a larger later reward. Making the consumer 'like' a certain product or service on the other hand makes them opt for a larger later reward instead of the smaller sooner reward (Lades, 2012). However, a consumer normally chooses something they can have now even if it has smaller benefits than waiting to consume something with larger benefits in the future (Kapteyn & Teppa, 2003). This proves to us that consumers are impatient, especially when they are not convinced enough of the added benefits of waiting to consume a certain product or service.

Another negative effect of interruption from a consumer's perspective is that once a certain consumption is interrupted, consumers are more likely to choose the highly desirable good or service even when it is the high-risk option rather than the highly feasible one (Liu, 2008). Moreover, if they do this repeatedly, habituation will arise. If at first consumers respond positively to portioning wherein they consume less, habituation decreases the amount of attention paid to partitions (Cheema & Soman, 2008). This is an application of adaptation because the consumers are slowly getting used to the partitions thus it does not affect their decision process anymore. When a consumer fails to anticipate adaptation, this results to a diminishing product or service enjoyment (Wang & Novemsky et al, 2009).

Negative effects from a producer's perspective

We now move on to the negative aspects of a delayed consumption from a producer's point of view. First of all, uncontrollable interruptions on a consumer's primary task decreases a consumer's willingness to pay, although it may increase the company's brand awareness and recognition (Acquisti & Spiekermann, 2011). The example given was pop-up ads. Yes, consumers are more aware of the product, but they only get irritated from being disturbed from whatever they were doing, and thus associate the product to a negative response.

Another is the fact that in a study by Cheema & Soman (2008), they showed that goods are consumed at a slower rate when they are partitioned. Adding to that is the fact that people consume even less when they have greater aversion for overconsumption. This is not advantageous for producers since their ultimate goal is for consumers to consume more of what they are offering.

However, after a partition was broken, consumers tend to consume readily until they reach the next partition (Cheema & Soman, 2008). This shows that consumers do not care anymore about the consequences of their consumption of the next partition. Therefore once a producer breaks the barrier for the next consumption, they can now gain from a consumer's readiness to consume.

Having a break in between consumption gives a consumer time to think or decide. When this happens, accurately predicting how the experience will feel like after the break alters one's decision making on products and services (Wang & Novemsky et al, 2009). This makes the person hesitate whether to consume again or not. Moreover, when consumption is only imagined, the frustrating effects of the wait far outweigh the anticipated pleasure which results in a decrease in consumption enjoyment depending on the decision task (Nowlis & Mandel et al, 2004). This is again, not good for the producers because even though the interruption in consumption was meant to increase a consumer's overall utility, it makes a consumer doubt instead. Therefore, a producer must make sure that during the said interruption, a consumer will not hesitate to consume again.

Another negative effect of a delay for a producer is when you make a consumer wait for something they are already expecting. For customers, speed of service is important no matter what the circumstance may be. You cannot simply make them wait for a product or service. A customer waiting for something can feel rather dragging and could cause negative feedback (Taylor, 1994). The best thing the company providing the service can do is to make the wait pleasurable for the consumers or make the anticipation worthwhile. In the context of a restaurant, it is normal for a customer to wait in line for their turn to be seated. However, not all customers are patient enough to wait for their turn. One thing that the restaurant owner can do is to design their waiting area next to the kitchen where the sights and aromas of the food might arouse a consumer's anticipation (Nowlis & Mandel et al, 2004). This gives them a preview of what they can have if they wait for their turn, and therefore increases their anticipation and the clarity of their future consumption.

Loewenstein's model

Moving on to the model, in the study done by Loewenstein (1987), he assumes that an individual evaluates a delayed act of consumption according to the integral of discounted utility from anticipation and consumption that it yields. Thus, the present value *Y* (measured in dollars) of a delayed act of consumption is defined by:

$$U(Y) = \int_{t_0} \frac{\alpha}{\delta} U(x) e^{-\delta(T-t)} \left(1-e^{-\delta L}\right) e^{-r(t-t_0)} dt + \int_{T}^{T+L} U(x)\, e^{-r(t-t_0)}$$

The conclusions of Loewenstein are the following:

1. Delaying is more likely when α is large and δ is small. This means that a consumer is more likely to gain higher utility from delay when they have a clear picture of what they are consuming in their head.
2. Delaying is more likely when consumption is fleeting. Since the consumer only gets so much from a fleeting consumption, delaying this will prolong perceived duration of consumption and therefore give the consumer higher utility.

FRAMEWORK

The model to be presented explores the question of how an individual's utility changes when presented with a break in between consumption. As previously stated, we assume that the break to be inserted is a positive experience. Since we are trying to see if Nelson and Meyvis' (2008) results are true, we are adding another consumption period in Loewenstein's (1987) model. Thus, instead of just having anticipation and consumption, we now have the first period of consumption, a break, and the second period of consumption.

As depicted in figure 1, an individual at time T_1 to consume for the duration of L_1 wherein after, the break starts and anticipation of the consumption of good *x* occurs. After anticipation, the individual consumes again at T_2 for the duration of L_2. Consumption is assumed to yield a constant stream of utility, *U(x)*, beginning at time T_1 and continuing for duration L_1 and then another constant utility for consumption beginning at time T_2 and continuing for duration L_2, after which it drops to zero. In other words, T_1 is the beginning of the first consumption period and T_2 for the second. L_1 and L_2 are the lengths of consumption respectively, and *U(x)* is the satisfaction one experiences while consuming a certain good or service. Formally:

$$U_t^{c_1}(\text{x}, T_1, L_1) = U(\text{x}) \text{ for } T_1 \le t \le T_1+L_1, \quad (1)$$

$$U_t^{c_2}(\text{x}, T_2, L_2) = U(\text{x}) \text{ for } T_2 \le t \le T_2+L_2, \quad (2)$$

$$= 0 \text{ otherwise}$$

where $U_t^{c_i}$ for *i* = 1,2 indicates utility experienced at time *t* from consumption.

To illustrate:

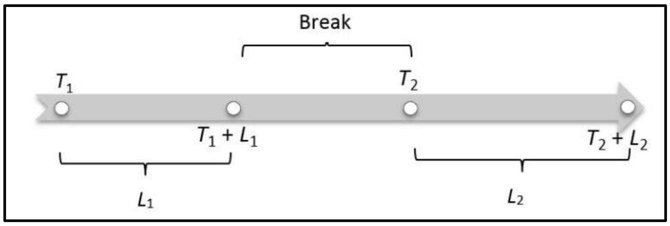

Figure 1. Timeline of consumption

At any time *t* between T_1+L_1 and T_2, the consumer derives utility from anticipation, U_t^B. Utility from anticipation is assumed to be proportional to the integral of utility from consumption at a discounted rate of δ. However, this is not the conventional discount rate because it is a measure of the degree to which the individual derives immediate utility from anticipated consumption.

Moving on to the break, utility at each point *t* can be due to savouring[5] of future consumption. Therefore, taking this into consideration and solving for utility at each point *t* is equal to:

$$U_t^B(\text{x}, T_2, L_2) = \alpha \int_{T_2}^{T_2+L_2} e^{-\delta(r-t)}\, U(x) dr \quad (3)$$

$$= \frac{\alpha}{\delta} U(x) e^{-\delta(T_2-t)}(1 - e^{-\delta L_2}) \quad (4)$$

This formulation has four desirable properties:

[5] Savouring is the positive utility derived from anticipation of future consumption.

(1) The intensity of the anticipation will be greater the longer the time period;
(2) The intensity of the anticipation will also be greater the more intensely one expects to enjoy it;
(3) The nearer the date of consumption, the greater the intensity of the pleasure from anticipation becomes; and
(4) The intensity of anticipation increases faster and faster as the time for consumption grows closer.

In the current formulation, utility from the break denoted as U_t^B is a positive function of L_2, the duration of the second consumption; a positive function of $U(x)$, the utility derived from consumption; and a negative function of $(T_2 - t)$, the time delay prior to the second consumption. Adding to that is that the second derivative of U^B with respect to $(T_2 - t)$ is positive, showing that utility from the break increases or decreases at an increasing rate.

Since overall utility of the consumer is derived from the utility they get from consuming before and after the break, plus the anticipation and the memory of past consumption, we now have the present value of *Y,* which is measured in dollars, to be defined by:

$$U(Y) = \int_{T_1}^{T_1+L_1} U(x)\, e^{-r(t-T_1)} dt + \int_{T_1+L_1}^{T_2} \frac{\alpha}{\delta} U(x) e^{-\delta(T_2-t)} \big(1 - e^{-\delta L_2}\big) e^{-r(t-T_1)} dt + \int_{T_2}^{T_2+L_2} U(x)\, e^{-r(t-T_1)} \qquad (5)$$

where $U(Y)$ is a ratio scale utility function with positive first and negative second derivative;

T_1 is the beginning of the first consumption;
L_1 is the length of the first consumption;
T_2 is the beginning of the second consumption;
L_2 is the length of the second consumption;
t is any point where a consumer derives utility;
r is the conventional discount rate used to discount future utility from all sources;
α is a measure of the vividness[6] of a particular outcome; and
δ is a measure of a consumer's preoccupation with the future.

This is the main model of the study. In this equation, the first term represents utility from the first consumption, the second term represents utility from the break and the third term represents utility from the second consumption. In the model, three things are considered:

(1) Memory of past consumption;
(2) Sensation of present consumption; and
(3) Anticipation of future consumption.

Setting T_1 = 0 for simplicity, and integrating:

$$U(Y) = U(x)[\tfrac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}(e^{-rT_2} - e^{-\delta T_2 + \delta L_1 - rL_1})(1 - e^{-\delta L_2}) + \tfrac{1}{r} e^{-rT_2}(1 - e^{-rL_2})]^7 \qquad (6)$$

δ and α define to the relationship between U^B and U^C. A consumer with a low δ savours outcomes even if they will occur in the distant future. On the other

[6] Vividness is how clear a person can picture a certain consumption in his mind
[7] See appendix for calculations of all equations

hand, a large α means that the consumer has a clear picture of the consumption formed in his head. Factors that increase α or decrease δ raise the utility from savouring. Since a rational person will take into account future outcomes, like saving up for their retirement, even when they do not instantly savour or dread those outcomes, it is assumed that $\delta > r$. (7)

Conditions

Since interruptions are controlled by the producer, the model only works with the assumption that the break or interruption in consumption is welcomed by the consumer. If consumers are given the choice to consume again or not, producers can no longer apply the model to manipulate the consumption experience and make it more pleasurable. Therefore, the consumer is assumed to always consume again after the first consumption. It is also assumed that consumers are not under any budget constraint and will not consider anything monetary during the whole consumption experience. Finally, an interruption would be ideal at the point before a consumer reaches satiation as to prevent possible irritation from disruption of consumption while a consumer is climbing up the utility curve.

RESULTS AND ANALYSIS

The model works under the condition in which people will prefer to delay desired consumption as much as possible. Desired consumption will be delayed when ($\partial Y/\partial T_2$) > 0. In other words, desired consumption will be delayed when the net present value of consumption, taking into account both savouring and consumption itself, increases as a function of time delay. Since $U(Y)$ is monotonically increasing, this condition is the same with $\partial U(Y)/\partial T_2 > 0$.

Differentiating the integrated model with respect to T_2:

$$\frac{\partial U(Y)}{\partial T_2} = U(x)[\frac{1}{r}(1-e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{-\delta T_2+\delta L_1-rL_1} - re^{-rT_2}\right)\left(1-e^{-\delta L_2}\right) - e^{-rT_2}(1-e^{-rL_2})]$$

The first term in the brackets is the sensation of the present consumption. The second term on the other hand is the marginal benefit from savouring delayed consumption. Lastly, the third term is the marginal cost of delay, in terms of increased discounting of consumption.

Consumption will be deferred when $\partial U(Y)/\partial T_2$ is positive for $T_2 = 0$. Setting $T_2 = 0$:

$$\left.\frac{\partial U(Y)}{\partial T_2}\right|_{T_2=0} = U(x)\frac{1}{r}(1-e^{-rL_1}) + U(x)\frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1-e^{-\delta L_2}\right) - U(x)(1-e^{-rL_2}) \quad (8)$$

A necessary and sufficient condition for delaying desired consumption is therefore,

$$\frac{1}{r}(1-e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1-e^{-\delta L_2}\right) > (1-e^{-rL_2}) \quad (9)$$

We already know that $\delta > r$ and that α, δ and r are $\in (0, 1)$. However, we do not know exactly what L_1 and L_2 are. Therefore, there exist three assumptions when consumption will be deferred when $\partial U(Y)/\partial T_2$ is positive for $T_2 = 0$.

Proposition 1

If $L_1 \geq L_2$, then $\partial U(Y)/\partial T_2 > 0 \; \forall \; \alpha \in (0 , 1)$. When the first period of consumption is longer than or equal to the second, the consumer's overall utility increases due to the increase in the length of the break, regardless if consumption is vivid or not. In the case of the massage chair, the guitar lessons, basketball practice, salon pampering and even teambuilding activities, this is all assuming that L_1 is greater than or equal to L_2. In these scenarios, an increase in the length of interruption would always lead to a higher utility for as long as the second period of consumption is equal, or shorter than the first.

During a massage, for let us say an hour, the masseuse decides to take a break to divide the massage into two, thirty minute parts. This proposition tells us that this in turn gives the consumer a higher utility since it disrupts a person's adaptation and they are able to anticipate the next part of the massage before continuing further. Therefore, since the consumer is now expecting the second part of the massage and already has an idea of how good it feels, there is added utility during the wait.

The same goes for guitar lessons and basketball practice. In these scenarios, people don't usually imagine what's going to happen next, they just go with the flow until it is over. Thus, inserting a break in between will increase their utility because of anticipation of a pleasurable experience.

However, the salon pampering and teambuilding activities work better when L_1 is greater than L_2. Since a consumer derives pleasure from salon pampering but is not really imagining or picturing what the second consumption would look like, therefore low vividness, then the second consumption must be shorter than the first for there to be an increase in utility when there is an interruption.

Whenever one goes to a salon to have a pampering session like having your nails done or getting your hair cut, there is a small chance that you are imagining the whole process. Thus, for there to be an increase in utility when a break is inserted during the pampering session, the second part of the session must be shorter than the first. This is due to the fact that although the person derives utility from both sessions, a person has lower patience now on the second consumption since there was no clear picture of what was going to happen. Furthermore, although anticipation was present, it is not that much.

When it comes to team building events, a break would also increases utility only if the second consumption is shorter than the first because these are not the type of events that a consumer creates vivid images of in his head. These are the types of events where a person just goes with the flow.

Therefore, when the producer or company wants to interrupt services like salon pampering and teambuilding activities, they must make sure that the second consumption will be shorter so that their consumers will still derive higher utility. Also, they must make sure that consumers are not in a hurry and are having a pleasurable break for this proposition to work.

Proposition 2

If $L_2 > L_1$ and α is large, then $\partial U(Y)/\partial T_2 > 0$. When the second period of consumption is longer than the first, the consumer's overall utility only increases from the increase in the length of the break when vividness of consumption is high. Examples of events or consumption that make a consumer create vivid images in his head are shows, video games and dance music, as pointed out in the background of the study. This is the case assuming L_1 is less than L_2.

Shows like Broadway plays and musicals are good examples of consumption wherein a consumer creates a clear picture in his head. In these events, there are intermissions which are usually inserted before the climax of the story. Thus, during the break, consumers have this high anticipation for what is going to happen next since they have already created a vivid image in their minds of what is going to happen next. In these types of events, since a consumer has a clear picture, the producers can make the second part of the production longer than the first and the consumers will still derive higher utility from the break.

When it comes to adventure type of video games, placing a mini game before the longer part of the adventure also gives the player higher utility since they have already formed a clear picture in their mind of what they are playing with, just like the Broadway musicals.

Lastly, EDMs are the type of music that have drops in them. A drop is when the part of the song you can dance to begins. Before the drop, there is usually a build-up wherein the anticipation of the listener greatly increases as it comes near the drop because the music tends to get louder and more intense. The build-up can be considered as the "break" in EDMs. Therefore, as the break increases, the utility of the listener increases even if the second part of the song is longer than the first because they have already created a clear picture of what is going to happen due to the build-up before the drop. After the drop, listeners can now enjoy uninterrupted dance music.

Therefore, to be sure that an interruption in consumption would increase overall utility, a consumption experience must be clearly imaginable so that it can be looked forward to by the consumer.

After knowing the different effects of an increase in the length of the break considering the different lengths of L_1 and L_2, we now move on to the effects of an increase in the length of the first and second consumption, holding the break constant.

Proposition 3

$\partial U(Y)/\partial L_1$ and $\partial U(Y)/\partial L_2$ are both > 0. An increase in the length of the first and second consumption increases a consumer's overall utility, holding the break constant. This is already a known fact and can be applied anywhere, may it be consumption of food, beverages, services, etc. Of course, when a customer is given more to consume, his utility will increase, as long as the point of satiation is not reached.

Proposition 4

If $\delta - r$ is large, then $\partial U(Y)/\partial L_2 > \partial U(Y)/\partial L_1$. An increase in the length of the second consumption has a greater effect than an increase in the length of the first consumption when consumers consider future outcomes more than the present. An example would be Chinese restaurants. In these types of restaurants, customers are first given appetizers like dim sum, for example, and then made to wait long before the main course is brought out. Here, the first consumption are the appetizers and the second consumption is the main course. Chinese restaurants know that customers want the main course more than the appetizers which make them more future oriented. Therefore, increasing the main course over the appetizers will lead to a greater increase in customer utility and satisfaction.

Further Analysis

We now move on to the cross partial derivative of $U(Y)$ with respect to the lengths of consumption L_i for i = 1, 2 and T_2.

Proposition 5

$\partial^2 U(Y)/\partial L_1 \partial T_2 > 0$

Proposition 6

If α is large, then $\partial^2 U(Y)/\partial L_2 \partial T_2 > 0$

CONCLUSION

The theoretical model was able to show the effects of varying magnitudes of interruption, placed on different points of consumption experiences. We have verified that interruptions in consumption disrupt adaptation, prolong perceived duration of consumption and raise anticipation. It is only a matter of how we can manipulate this information for our benefit.

The paper has proven three main points:

1. An interruption will always be beneficial if the first consumption is longer than the second;
2. The reverse will only be beneficial if the second consumption can be vividly imagined by the consumer; and
3. Increasing the second part of the consumption will always be better than increasing the first if the consumer is future oriented.

Given the findings above, we can readily see how this can be applied to real life scenarios. For example, in marketing let us say a particular brand of chips, a company can manipulate the taste test to make the consumption pleasurable for the consumer. Instead of giving the consumer one whole bag of chips to try out, it can give him three smaller packets so that he will have a break in between consumption. This will unknowingly make the consumer enjoy the chips more than if he were given one full bag. The company can also form vivid images for the consumer to imagine so that his overall utility would further increase. It can show videos of other customers enjoying its product, such as how rich and flavourful it looks in good lighting.

Whenever a particular circumstance involves a consumption for a duration of time, a producer or a capitalist can maximize potential gains either by managing both the breaks and anticipation present in the entire consumption experience or creating a vivid mental image. The manner of which is to be determined by the type of products or the objectives of the producer. By effectively applying these principles, the producers will be able to give their consumers a higher satisfaction and as a result will increase their willingness to pay. This in turn will lead to an increase in the producer's profit.

RECOMMENDATION FOR FUTURE RESEARCH

Since the research is only focused on the results and implications of positive experiences, a possible extension to this paper will be to find out the results for negative experiences. We already know that when it comes to a negative experience, a consumer will want it to be over with quickly. However, the reasons behind this were not tackled in this study. Another possible extension is to have an empirical test to prove our model. Since the paper is a theoretical extension to Nelson and Meyvis' (2008) empirical research, a few empirical extensions to our model will also prove useful.

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APPENDIX A

Proposition 1

If $L_1 \geq L_2$, then $\partial U(Y)/\partial T_2 > 0 \ \forall \ \alpha \in (0, 1)$

Proof

Assuming $L_1 = L_2$ in equation (8) then

$$-rL_1 = -rL_2 \rightarrow$$
$$(1 - e^{-rL_1}) = (1 - e^{-rL_2})$$

We know that $r \in (0, 1)$ then

$$\frac{1}{r}(1 - e^{-rL_1}) > (1 - e^{-rL_2}) \rightarrow$$
$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) > (1 - e^{-rL_2}) \rightarrow$$
$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) - (1 - e^{-rL_2}) > 0$$

∴ If $L_1 = L_2$, then $\partial U(Y)/\partial T_2 > 0$

Assuming $L_1 > L_2$ in equation (8) then

$$rL_1 > rL_2 \rightarrow$$
$$e^{-rL_1} < e^{-rL_2} \rightarrow$$
$$(1 - e^{-rL_1}) > (1 - e^{-rL_2})$$

We know that $r \in (0, 1)$ then

$$\frac{1}{r}(1 - e^{-rL_1}) > (1 - e^{-rL_2}) \rightarrow$$
$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) > (1 - e^{-rL_2}) \rightarrow$$
$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) - (1 - e^{-rL_2}) > 0$$

∴ If $L_1 > L_2$, then $\partial U(Y)/\partial T_2 > 0$ □

Proposition 2

If $L_2 > L_1$ and α is large, then $\partial U(Y)/\partial T_2 > 0$

Proof

Assuming $L_1 < L_2$ and α is large in equation (8) then

$$rL_1 < rL_2 \rightarrow$$
$$e^{-rL_1} > e^{-rL_2} \rightarrow$$
$$(1 - e^{-rL_1}) < (1 - e^{-rL_2})$$

We know that α is large then

$$\frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) > (1 - e^{-rL_2}) \rightarrow$$
$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) > (1 - e^{-rL_2}) \rightarrow$$
$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) - (1 - e^{-rL_2}) > 0$$

∴ If $L_1 < L_2$ and α is large, then $\partial U(Y)/\partial T_2 > 0$ □

Proposition 3

$\partial U(Y)/\partial L_1$ and $\partial U(Y)/\partial L_2$ are both > 0

Proof

Differentiating the integrated model with respect to L_1:

$$\frac{\partial U(Y)}{\partial L_1} = U(x)[\frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - \delta e^{-\delta T_2+\delta L_1-rL_1} + re^{-\delta T_2+\delta L_1-rL_1}\right)\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 - e^{-rL_2})] \quad (9)$$

We know that

$$\frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - \delta e^{-\delta T_2+\delta L_1-rL_1} + re^{-\delta T_2+\delta L_1-rL_1}\right)\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 - e^{-rL_2}) > 0$$

$\therefore \partial U(Y)/\partial L_1 > 0$

Differentiating the integrated model with respect to L_2:

$$\frac{\partial U(Y)}{\partial L_2} = U(x)[\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - e^{-\delta T_2+\delta L_1-rL_1}\right)\left(1 + \delta e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 + re^{-rL_2})] \quad (10)$$

We know that

$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - e^{-\delta T_2+\delta L_1-rL_1}\right)\left(1 + \delta e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 + re^{-rL_2}) > 0$$

$\therefore \partial U(Y)/\partial L_2 > 0$ □

Proposition 4

If $\delta - r$ is large, then $\partial U(Y)/\partial L_2 > \partial U(Y)/\partial L_1$

Proof

We know that the first term of $\partial U(Y)/\partial L_1 > \partial U(Y)/\partial L_2$

$$\frac{1}{r}(1 + re^{-rL_1}) > \frac{1}{r}(1 - e^{-rL_1})$$

We also know that the third term of $\partial U(Y)/\partial L_1 < \partial U(Y)/\partial L_2$

$$\frac{1}{r}e^{-rT_2}(1 - e^{-rL_2}) < \frac{1}{r}e^{-rT_2}(1 + re^{-rL_2})$$

Assuming $\delta - r$ is large then the second term of $\partial U(Y)/\partial L_1 < \partial U(Y)/\partial L_2$

$$\frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - \delta e^{-\delta T_2+\delta L_1-rL_1} + re^{-\delta T_2+\delta L_1-rL_1}\right) < \frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - e^{-\delta T_2+\delta L_1-rL_1}\right)\left(1 + \delta e^{-\delta L_2}\right)$$

$$\therefore \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - e^{-\delta T_2+\delta L_1-rL_1}\right)\left(1 + \delta e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 + re^{-rL_2}) > \frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - \delta e^{-\delta T_2+\delta L_1-rL_1} + re^{-\delta T_2+\delta L_1-rL_1}\right)\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 - e^{-rL_2})$$

$\therefore$ If $\delta - r$ is large, then $\partial U(Y)/\partial L_2 > \partial U(Y)/\partial L_1$ □

Proposition 5

$\partial^2 U(Y)/\partial L_1 \partial T_2 > 0$

Proof

Differentiating the integrated model with respect to L_1 and T_2:

$$\frac{\partial^2 U(Y)}{\partial L_1 \partial T_2} = U(x)[\frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta^2 e^{-\delta T_2+\delta L_1-rL_1} - \delta re^{-\delta T_2+\delta L_1-rL_1} - re^{-rT_2}\right)\left(1 - e^{-\delta L_2}\right) - e^{-rT_2}(1 - \quad (11)$$

$e^{-rL_2})]$

Consumption will be deferred as the increase in L_1 increases $U(Y)$ when $\partial^2 U(Y)/\partial L_1 \partial T_2$ is positive for $T_2 = 0$. Setting $T_2 = 0$:

$$\left.\frac{\partial^2 U(Y)}{\partial L_1 \partial T_2}\right|_{T_{2=0}} = U(x)\frac{1}{r}(1 + re^{-rL_1}) + U(x)\frac{\alpha}{\delta(\delta-r)}\left(\delta^2 e^{L_1(\delta-r)} - \delta r e^{L_1(\delta-r)} - r\right)\left(1 - e^{-\delta L_2}\right) - U(x)(1 - e^{-rL_2})] \quad (12)$$

A necessary and sufficient condition for delaying desired consumption as the increase in L_1 increases $U(Y)$ is therefore,

$$\frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta^2 e^{L_1(\delta-r)} - \delta r e^{L_1(\delta-r)} - r\right)\left(1 - e^{-\delta L_2}\right) > (1 - e^{-rL_2})$$

We know that

$$\frac{1}{r}(1 + re^{-rL_1}) > (1 - e^{-rL_2}) \rightarrow$$

$$\frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta^2 e^{L_1(\delta-r)} - \delta r e^{L_1(\delta-r)} - r\right)\left(1 - e^{-\delta L_2}\right) > (1 - e^{-rL_2}) \rightarrow$$

$$\frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta^2 e^{L_1(\delta-r)} - \delta r e^{L_1(\delta-r)} - r\right)\left(1 - e^{-\delta L_2}\right) - (1 - e^{-rL_2}) > 0$$

$\therefore \partial^2 U(Y)/\partial L_1 \partial T_2 > 0$ □

Proposition 6

If α is large, then $\partial^2 U(Y)/\partial L_2 \partial T_2 > 0$

Proof

Differentiating the integrated model with respect to L_2 and T_2:

$$\frac{\partial^2 U(Y)}{\partial L_2 \partial T_2} = U(x)[\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{-\delta T_2 + \delta L_1 - rL_1} - re^{-rT_2}\right)\left(1 + \delta e^{-\delta L_2}\right) - e^{-rT_2}(1 + re^{-rL_2})] \quad (13)$$

Consumption will be deferred as the increase in L_2 increases $U(Y)$ when $\partial^2 U(Y)/\partial L_2 \partial T_2$ is positive for $T_2 = 0$. Setting $T_2 = 0$:

$$\left.\frac{\partial^2 U(Y)}{\partial L_2 \partial T_2}\right|_{T_{2=0}} = U(x)\frac{1}{r}(1 - e^{-rL_1}) + U(x)\frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1 + \delta e^{-\delta L_2}\right) - U(x)(1 + re^{-rL_2}) \quad (14)$$

A necessary and sufficient condition for delaying desired consumption as the increase in L_2 increases $U(Y)$ is therefore,

$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1 + \delta e^{-\delta L_2}\right) > (1 + re^{-rL_2})$$

Assuming α is large then

$$\frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1 + \delta e^{-\delta L_2}\right) > (1 + re^{-rL_2}) \rightarrow$$

$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1 + \delta e^{-\delta L_2}\right) > (1 + re^{-rL_2}) \rightarrow$$

$$\frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1 + \delta e^{-\delta L_2}\right) - (1 + re^{-rL_2}) > 0$$

$\therefore$ If α is large, then $\partial^2 U(Y)/\partial L_2 \partial T_2 > 0$ □

APPENDIX B

Solution for (6):

Setting T_1= 0 and integrating, we now have:

$$\int_0^{L_1} e^{-rt}dt + \int_{L_1}^{T_2} \frac{\alpha}{\delta} e^{-\delta(T_2-t)}\left(1-e^{-\delta L_2}\right)e^{-rt}dt + \int_{T_2}^{T_2+L_2} e^{-rt}dt$$

(A) (B) (C)

A: 1. $\int e^{-rt}dt$ $\quad u=-rt; du=-r\,dt; dt=\left(-\frac{1}{r}\right)du$

$= \int e^u \left(-\frac{1}{r}\right)du$

$= -\frac{1}{r}\int e^u du$ $\quad \int e^u du = e^u$

$= -\frac{1}{r}e^u$ $\quad u=-rt$

$= -\frac{e^{-rt}}{r}$

2. $\lim_{t\to L_1}(-\frac{e^{-rt}}{r}) - \lim_{t\to 0}(-\frac{e^{-rt}}{r})$

$= -\frac{1}{r}\lim_{t\to L_1} e^{-rt} - -\frac{1}{r}\lim_{t\to 0} e^{-rt}$

$= -\frac{e^{-rL_1}}{r} - -\frac{1}{r}$

$= \frac{1-e^{-rL_1}}{r}$

$= \frac{1}{r}(1-e^{-rL_1})$

B: 1. $\int \frac{\alpha}{\delta} e^{-\delta(T_2-t)}(1-e^{-\delta L_2})e^{-rt}dt$

$= \int \frac{\alpha}{\delta}(1-e^{-\delta L_2})e^{-\delta T_2+\delta t-rt}dt$ $\quad u=-\delta T_2+\delta t-rt;$

$du = \delta - r;$

$dt = \frac{1}{\delta-r}du$

$= \int \frac{\alpha}{\delta}\left(1-e^{-\delta L_2}\right)e^u\left(\frac{1}{\delta-r}\right)du$

$= \frac{\alpha}{\delta}(1-e^{-\delta L_2})(\frac{1}{\delta-r})\int e^u du$ $\quad \int e^u du = e^u$

$= \frac{\alpha}{\delta}(1-e^{-\delta L_2})(\frac{1}{\delta-r})e^u$ $\quad u=-\delta T_2+\delta t-rt$

$= \frac{\alpha}{\delta(\delta-r)}(1-e^{-\delta L_2})e^{-\delta T_2+\delta t-rt}$

$= \frac{\alpha(1-e^{-\delta L_2})e^{-\delta T_2+\delta t-rt}}{\delta(\delta-r)}$

2. $\lim_{t\to T_2}[\frac{\alpha(1-e^{-\delta L_2})e^{-\delta T_2+\delta t-rt}}{\delta(\delta-r)}] - \lim_{t\to L_1}[\frac{\alpha\left(1-e^{-\delta L_2}\right)e^{-\delta T_2+\delta t-rt}}{\delta(\delta-r)}]$

=

$\frac{\alpha}{\delta(\delta-r)}\left(1-e^{-\delta L_2}\right)\lim_{t\to T_2}\left(e^{-\delta T_2+\delta t-rt}\right) - \frac{\alpha}{\delta(\delta-r)}(1-e^{-\delta L_2})\lim_{t\to L_1}(e^{-\delta T_2+\delta t-rt})$

$= \frac{\alpha}{\delta(\delta-r)}\left(1-e^{-\delta L_2}\right)e^{-\delta T_2+\delta T_2-rT_2} - \frac{\alpha}{\delta(\delta-r)}\left(1-e^{-\delta L_2}\right)e^{-\delta T_2+\delta L_1-rL_1}$

$= \frac{\alpha}{\delta(\delta-r)}\left(1-e^{-\delta L_2}\right)(e^{-\delta T_2+\delta T_2-rT_2} - e^{-\delta T_2+\delta L_1-rL_1})$

$= \frac{\alpha}{\delta(\delta-r)}(e^{-rT_2} - e^{-\delta T_2+\delta L_1-rL_1})\left(1-e^{-\delta L_2}\right)$

C: 1. $\int e^{-rt}dt$ $\quad u=-rt; du=-r\,dt; dt=\left(-\frac{1}{r}\right)du$

$= \int e^u\left(-\frac{1}{r}\right)du$

$= -\frac{1}{r}\int e^u du \qquad\qquad \int e^u du = e^u$

$= -\frac{1}{r}e^u \qquad\qquad u = -rt$

$= -\frac{e^{-rt}}{r}$

2. $\lim_{t\to T_2+L_2}(-\frac{e^{-rt}}{r}) - \lim_{t\to T_2}(-\frac{e^{-rt}}{r})$

$= -\frac{1}{r}\lim_{t\to T_2+L_2} e^{-rt} - -\frac{1}{r}\lim_{t\to T_2} e^{-rt}$

$= -\frac{e^{-r(T_2+L_2)}}{r} - -\frac{e^{-rT_2}}{r}$

$= \frac{e^{-rT_2} - e^{-rT_2 - rL_2)}}{r}$

$= \frac{1}{r}e^{-rT_2}(1 - e^{-rL_2})$

$U(Y) = \frac{1}{r}(1 - e^{-rL_1}) +$ (A)

$\frac{\alpha}{\delta(\delta-r)}\left(e^{-rT_2} - e^{-\delta T_2+\delta L_1 - rL_1}\right)\left(1 - e^{-\delta L_2}\right) +$ (B)

$\frac{1}{r}e^{-rT_2}(1 - e^{-rL_2})$ (C)

Solution for (7):

$\frac{\partial U(Y)}{\partial T_2} = \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left[\frac{d}{dT_2}(e^{-rT_2}) - \frac{d}{dT_2}\left(e^{-\delta T_2+\delta L_1-rL_1}\right)\right]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}\frac{d}{dT_2}(e^{-rT_2})(1 - e^{-rL_2})$

$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left[e^{-rT_2}\frac{d}{dT_2}(-rT_2) - e^{-\delta T_2+\delta L_1-rL_1}\frac{d}{dT_2}(-\delta T_2 + \delta L_1 - rL_1)\right]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}\frac{d}{dT_2}(-rT_2)(1 - e^{-rL_2})$

$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left[e^{-rT_2}(-r) - e^{-\delta T_2+\delta L_1-rL_1}(-\delta)\right]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(-r)(1 - e^{-rL_2})$

$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{-\delta T_2+\delta L_1-rL_1} - re^{-rT_2}\right)\left(1 - e^{-\delta L_2}\right) - e^{-rT_2}(1 - e^{-rL_2})$

Solution for (8):

$\left.\frac{\partial U(Y)}{\partial T_2}\right|_{T_2=0} = \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{-\delta(0)+\delta L_1-rL_1} - re^{-r(0)}\right)\left(1 - e^{-\delta L_2}\right) - e^{-r(0)}(1 - e^{-rL_2})$

$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left(\delta e^{L_1(\delta-r)} - r\right)\left(1 - e^{-\delta L_2}\right) - (1 - e^{-rL_2})$

Solution for (9):

$\frac{\partial U(Y)}{\partial L_1} = \frac{1}{r}\left[1 - \frac{d}{dL_1}(e^{-rL_1})\right] + \frac{\alpha}{\delta(\delta-r)}\left[e^{-rT_2} - \frac{d}{dL_1}\left(e^{-\delta T_2+\delta L_1-rL_1}\right)\right]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 - e^{-rL_2})$

$= \frac{1}{r}[1 - e^{-rL_1}\frac{d}{dL_1}(-rL_1)] + \frac{\alpha}{\delta(\delta-r)}[e^{-rT_2} - e^{-\delta T_2+\delta L_1-rL_1}\frac{d}{dL_1}(-\delta T_2 + \delta L_1 - rL_1)](1 - e^{-\delta L_2}) + \frac{1}{r}e^{-rT_2}(1 - e^{-rL_2})$

$= \frac{1}{r}(1 + re^{-rL_1}) + \frac{\alpha}{\delta(\delta-r)}\left[e^{-rT_2} - e^{-\delta T_2+\delta L_1-rL_1}(\delta - r)\right]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(1 - e^{-rL_2})$

$$= \frac{1}{r}\left(1 + re^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left[e^{-rT_2} - \delta e^{-\delta T_2 + \delta L_1 - rL_1} + re^{-\delta T_2 + \delta L_1 - rL_1}\right]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}\left(1 - e^{-rL_2}\right)$$

Solution for (10):

$$\frac{\partial U(Y)}{\partial L_2} = \frac{1}{r}\left(1 - e^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left(e^{-rT_2} - e^{-\delta T_2 + \delta L_1 - rL_1}\right)[(1 - \frac{d}{dL_2}\left(e^{-\delta L_2}\right)] + \frac{1}{r}e^{-rT_2}[1 - \frac{d}{dL_2}\left(e^{-rL_2}\right)]$$

$$= \frac{1}{r}\left(1 - e^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left(e^{-rT_2} - e^{-\delta T_2 + \delta L_1 - rL_1}\right)[(1 - e^{-\delta L_2}\frac{d}{dL_2}(-\delta L_2)) + \frac{1}{r}e^{-rT_2}[1 - e^{-rL_2}\frac{d}{dL_2}(-rL_2)]$$

$$= \frac{1}{r}\left(1 - e^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left(e^{-rT_2} - e^{-\delta T_2 + \delta L_1 - rL_1}\right)\left[1 - e^{-\delta L_2}(-\delta)\right] + \frac{1}{r}e^{-rT_2}[1 - e^{-rL_2}(-r)]$$

$$= \frac{1}{r}\left(1 - e^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left(e^{-rT_2} - e^{-\delta T_2 + \delta L_1 - rL_1}\right)\left(1 + \delta e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}\left(1 + re^{-rL_2}\right)$$

Solution for (11):

$$\frac{\partial^2 U(Y)}{\partial L_1 \partial T_2} = \frac{1}{r}\left(1 + re^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}[\frac{d}{dT_2}\left(e^{-rT_2}\right) - \delta\frac{d}{dT_2}\left(e^{-\delta T_2 + \delta L_1 - rL_1}\right) + r\frac{d}{dT_2}\left(e^{-\delta T_2 + \delta L_1 - rL_1}\right)]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}\frac{d}{dT_2}\left(e^{-rT_2}\right)\left(1 - e^{-rL_2}\right)$$

$$= \frac{1}{r}\left(1 + re^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left[e^{-rT_2}\frac{d}{dT_2}(-rT_2) - \delta e^{-\delta T_2 + \delta L_1 - rL_1}\frac{d}{dT_2}(-\delta T_2 + \delta L_1 - rL_1) + re^{-\delta T_2 + \delta L_1 - rL_1}\frac{d}{dT_2}(-\delta T_2 + \delta L_1 - rL_1)\right]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}\frac{d}{dT_2}(-rT_2)\left(1 - e^{-rL_2}\right)$$

$$= \frac{1}{r}\left(1 + re^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}[e^{-rT_2}(-r) - \delta e^{-\delta T_2 + \delta L_1 - rL_1}(-\delta) + re^{-\delta T_2 + \delta L_1 - rL_1}(-\delta)]\left(1 - e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(-r)\left(1 - e^{-rL_2}\right)$$

$$= \frac{1}{r}\left(1 + re^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left(\delta^2 e^{-\delta T_2 + \delta L_1 - rL_1} - \delta re^{-\delta T_2 + \delta L_1 - rL_1} - re^{-rT_2}\right)\left(1 - e^{-\delta L_2}\right) - e^{-rT_2}\left(1 - e^{-rL_2}\right)$$

Solution for (12):

$$\left.\frac{\partial^2 U(Y)}{\partial L_1 \partial T_2}\right|_{T_2 = 0} = \frac{1}{r}\left(1 + re^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left(\delta^2 e^{-\delta(0) + \delta L_1 - rL_1} - \delta re^{-\delta(0) + \delta L_1 - rL_1} - re^{-r(0)}\right)\left(1 - e^{-\delta L_2}\right) - e^{-r(0)}\left(1 - e^{-rL_2}\right)$$

$$= \frac{1}{r}\left(1 + re^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left(\delta^2 e^{L_1(\delta - r)} - \delta re^{L_1(\delta - r)} - r\right)\left(1 - e^{-\delta L_2}\right) - \left(1 - e^{-rL_2}\right)$$

Solution for (13):

$$\frac{\partial^2 U(Y)}{\partial L_2 \partial T_2} = \frac{1}{r}\left(1 - e^{-rL_1}\right) + \frac{\alpha}{\delta(\delta - r)}\left[\frac{d}{dT_2}\left(e^{-rT_2}\right) - \frac{d}{dT_2}\left(e^{-\delta T_2 + \delta L_1 - rL_1}\right)\right]\left(1 + \delta e^{-\delta L_2}\right) + \frac{1}{r}\frac{d}{dT_2}\left(e^{-rT_2}\right)\left(1 + re^{-rL_2}\right)$$

$$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}[e^{-rT_2}\frac{d}{dT_2}(-rT_2) - e^{-\delta T_2 + \delta L_1 - rL_1}\frac{d}{dT_2}(-\delta T_2 + \delta L_1 - rL_1)]\left(1 + \delta e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}\frac{d}{dT_2}(-rT_2)(1 + re^{-rL_2})$$

$$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left[e^{-rT_2}(-r) - e^{-\delta T_2 + \delta L_1 - rL_1}(-\delta)\right]\left(1 + \delta e^{-\delta L_2}\right) + \frac{1}{r}e^{-rT_2}(-r)(1 + re^{-rL_2})$$

$$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{-\delta T_2 + \delta L_1 - rL_1} - re^{-rT_2}\right)\left(1 + \delta e^{-\delta L_2}\right) - e^{-rT_2}(1 + re^{-rL_2})$$

Solution for (14):

$$\left.\frac{\partial^2 U(Y)}{\partial L_2 \partial T_2}\right|_{T_2=0} = \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{-\delta(0) + \delta L_1 - rL_1} - re^{-r(0)}\right)\left(1 + \delta e^{-\delta L_2}\right) - e^{-r(0)}(1 + re^{-rL_2})$$

$$= \frac{1}{r}(1 - e^{-rL_1}) + \frac{\alpha}{\delta(\delta - r)}\left(\delta e^{L_1(\delta - r)} - r\right)\left(1 + \delta e^{-\delta L_2}\right) - (1 + re^{-rL_2})$$