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ORIGINAL EMPIRICAL RESEARCH

Pricing hybrid bundles by understanding the drivers of willingness to pay

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Abstract Many companies are increasingly selling hybrid bundles, which comprise one or more goods and one or more services. Hybrid bundle pricing depends on understanding consumer willingness to pay (WTP) for the bundle, which rests on trade-offs among the benefits from four key drivers: service autonomy, complementarity, service quality variability, and overall bundle quality (basic vs. premium). The effects of these drivers and their interactions on the WTP of hybrid bundles are unknown. The authors develop hypotheses and test them rigorously using incentive-aligned choice-based conjoint and hierarchical Bayesian analysis. The results offer important guidelines for developing appropriate hybrid bundles. If a typical firm under budget constraint has to offer either of two hybrid bundles, one with high complementarity or one with service autonomy, the results suggest that it should offer the bundle with high complementarity. Furthermore, contrary to the conventional wisdom of minimizing service quality variability for premium quality bundles relative to basic quality bundles, the results recommend lowering service quality variability for basic quality bundles but maintaining it for premium bundles.

Keywords Hybrid bundles · Conjoint analysis · Willingness to pay · Service quality

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Many traditional manufacturing firms and conventional service companies are increasingly selling hybrid bundles, which comprise at least a good and a service (Ulaga and Reinartz 2011). For example, in the B2B space, Otis offers a hybrid bundle of an elevator with maintenance service; in the B2C space, Lowe's offers a hybrid bundle of flooring and installation service.

A hybrid bundle fundamentally differs from a traditional bundle (that comprises all goods or all services); a hybrid bundle's components differ considerably in quality variability because quality variability for a service is typically much higher than that for a good (Meyer and Shankar 2016; Murray and Schlacter 1990). A typical good (e.g., wireless router) has a very low variance in quality because it is manufactured using stringent quality control methods. By contrast, the quality of the associated home wireless network setup service varies significantly because of differences in the location, time, and people performing the service.

This wide difference in service quality variability between the service and the good in a hybrid bundle has key implications for consumer[1] willingness to pay (WTP) for the bundle. Because consumer WTP is a fundamental basis for pricing (Ding et al. 2005), knowledge of the factors driving the mean and variance of *consumer-level* WTP for hybrid bundles is critical. Yet little research or managerial guidance on WTP or pricing of hybrid bundles exists.

Four factors, service autonomy, complementarity, service quality variability, and bundle quality (basic vs. premium), are important drivers of hybrid bundle design and consumer WTP (Meyer and Shankar 2016; Shankar et al. 2009). Consumers make trade-offs among the benefits of these factors. Service

[1] For expositional ease, we use the terms "customer" and "consumer" interchangeably throughout the paper.

autonomy is the extent to which the service is available and can be used separately from the good (Shankar et al. 2009).[2] Consumer WTP for the bundle will likely be lower if the service is non-autonomous from the good. Complementarity is the additional value a consumer receives by using the good and service together and can range from no to full complementarity (Shankar et al. 2009). Consumers will likely pay more for a high complementary than a low complementary hybrid bundle.

While the main effects of service autonomy and complementary are important, understanding the relationship between these two factors is essential. Importantly, will consumers pay more for a hybrid bundle with an autonomous but less complementary service than for a bundle in which the service is not autonomous from the good but is more complementary? How do consumers trade off service autonomy and complementarity in their WTP for a hybrid bundle? The answer to this question is key for many firms with limited resources as they can invest mostly in either autonomy or complementarity, but not both.

Service quality variability and bundle quality are also important drivers of WTP.[3] In a hybrid bundle, the good is tangible and is homogenous in quality, whereas the service is intangible and is heterogeneous in quality due to differences in human actors in the production of the service. This difference in quality variability between the good and the service affects consumer WTP for the hybrid bundle. With respect to bundle quality, we expect consumer WTP to be higher for a premium quality bundle than a basic quality bundle. But it is important to understand how these factors interact to affect WTP as firms trade off the costs of offering different bundles with differing quality variability and bundle quality. Is WTP higher for a premium quality bundle characterized by higher service quality variability than a basic quality bundle with lower service quality variability? Offering a premium hybrid bundle with lower service quality variability costs the firm more due to additional training and compensation for the human actors involved in the production of the service to ensure consistent performance of the service.

Moreover, managers need to know the effect of interaction between service quality variability and bundle quality on the *variance* in WTP for a hybrid bundle because of its implications for consumer segmentation. For example, if the WTP distribution for a premium bundle with high service quality variability is wider than that for a basic bundle, managers can offer multiple premium bundles at different price points but only one or a few basic bundles.

Prior bundling and services management literatures do not answer these important questions. Our research makes substantive and empirical contributions and fills the gaps by investigating these effects using choice-based incentive-aligned conjoint experimental studies estimated by hierarchical Bayesian analysis.

Our results offer key insights and valuable managerial implications. First, they show that service autonomy and complementarity can interact to raise consumers' WTP for the hybrid bundle. Faced with resource constraints that allow only one of two hybrid bundles, one with high complementarity and the other with service autonomy, managers should offer the high complementarity bundle. However, managers can get the highest price premium by offering hybrid bundles with highly complementary components and a service autonomous from the good. This insight challenges the popular notion that when the components are complementary, consumers typically value the bundle without regard to the autonomy between the components. Second, bundle quality and service quality variability interact to affect the mean and the variance of consumer WTP for the bundle in a surprising way. Contrary to conventional wisdom of minimizing service quality variability for premium bundles relative to basic bundles, managers should lower service quality variability for basic quality bundles but maintain it for premium bundles.

Relevant literature

Bundling research has a long history in economics and marketing. Extant research can be placed in two major buckets. The first bucket typically uses normative models to guide optimal pricing and/or design of bundles. For example, bundling can be used as a price discrimination tool to extract greater consumer surplus (e.g., Adams and Yellen 1976; Venkatesh and Mahajan 1993). Complementarity increases consumer reservation prices for the bundle relative to those for the sum of the individual components (e.g., Venkatesh and Kamakura 2003). Profits of bundles can be higher if component costs are sub-additive (e.g., Hanson and Martin 1990). The optimality of mixed bundling, pure bundling, and pure components pricing depends on factors such as cost and demand (e.g., Adams and Yellen 1976; Venkatesh and Kamakura 2003). Bundling can reduce competition through tie-in sales and entry deterrence (e.g., Carbajo et al. 1990). An increase in quality variability of the service in a hybrid bundle is associated with a higher optimal hybrid bundle price but a lower bundle profit (Meyer and Shankar 2016).

[2] In hybrid bundles, goods are almost always autonomous from the service. Therefore, the major managerial decision, and our focus, is on the autonomy of service from the good.

[3] We focus on service quality variability, not the service level, which are different. A firm's service level depends on its objectives and capabilities and may affect hybrid bundle quality (i.e., premium vs. basic). In contrast, service quality variability refers to variation in the actual service quality an individual consumer receives. It could be high or low regardless of the service level.

The second bucket is more behavioral in nature and explores consumer perceptions of bundling. Consumers subjectively evaluate each component within a bundle and combine them to obtain an overall evaluation (Gaeth et al. 1990). Bundling also induces consumers to purchase more items than if the products were offered individually (Drumwright 1992). Building on Thaler's (1985) transaction utility, Yadav and Monroe (1993) show that additional savings offered by a bundle largely influence consumer's transaction value, while maintaining the importance of savings on individual components. When consumers evaluate bundles, they start with an anchor of the most important attribute and make adjustments throughout their evaluation (Yadav 1994). With respect to bundle evaluation and pricing, a discount on the more preferred bundle component results in a higher bundle evaluation (Yadav 1995). With regard to complementarity, the greater the functional complementarity between components of a bundle, the more consumers will likely purchase the bundle (Herrmann et al. 1999).

The bundling literature sans Meyer and Shankar (2016) focuses mainly on traditional bundles and examines the roles of neither quality variability nor service autonomy, two key drivers of a hybrid bundle's WTP. Furthermore, the role of complementarity has not been empirically explored for dissimilar components with big differences in quality variability (e.g., good and service). Prior research has also not empirically examined the effects of bundle quality and its interaction with service quality variability on WTP or its variance—which have heightened importance in hybrid bundles. A comparison of our research with related research appears in Table 1.

Research hypotheses

We now develop hypotheses about the effects of service autonomy, complementarity, service quality variability, and bundle quality on the mean and variance of WTP.

Autonomy of the service from the good

Our focus is on autonomy of the service from the good within a hybrid bundle. When the service offered in a hybrid bundle can be used only with the good in the bundle, consumer benefits are restricted. Consequently, consumer utility for that service is low. In contrast, if the service can be used with multiple goods, then consumers have greater opportunities to use the service and derive greater value (Shankar et al. 2009). This increase in utility due to service autonomy should be reflected by a higher WTP for the bundle. The effect of service autonomy on WTP is also related payment equity, which is the consumer's "perception of fairness of the exchange of payment for service usage" (Bolton and Lemon 1999). With an (non-) autonomous service consumers may believe they will use the service (less) more, which in turn leads to lower (higher) WTP. Therefore, we expect consumers to pay more for the bundle when the service is autonomous from the good in a hybrid bundle than when the service is not autonomous.[4]

Complementarity of the good and the service

Complementarity is "the degree to which the value to the customer increases when the product and the service are used together" (e.g., Shankar et al. 2009). Consumers derive positive utility by using complementary components together (Yalcin et al. 2013). This view is similar to the concept of super-additivity of reservation prices in the normative bundling research stream (e.g., Venkatesh and Kamakura 2003). Related research (e.g., Herrmann et al. 1999) views two components in a bundle as complementary when the components are functionally related. Based on these research streams, we argue that complementarity is positively related to WTP. Prior research suggests complementarity provides high value or utility.

Because the direct relationships between WTP and each of service autonomy, complementarity, service quality variability, and bundle quality are straightforward, we do not advance any formal hypotheses for the main effects of these factors on WTP.

Service autonomy and complementarity interaction

Service autonomy and complementarity may interact to significantly alter consumer WTP for the hybrid bundle. One line of reasoning suggests that as complementarity increases, consumers naturally want to use the bundle's components together. The idea here is similar to the convergence of mixed bundling and pure bundling under high complementarity because consumers strongly want to purchase the products together (e.g., Venkatesh and Kamakura 2003). Following this idea, under high complementarity, autonomy of the service from the good is less important, and the difference in WTP between service autonomy and no autonomy will be small. However, under low complementarity, consumer WTP for the hybrid bundle will be much greater when the service is autonomous from the good because consumers can derive a discernably greater value when they use each separately. Taken together, these arguments suggest a negative interaction such that we would expect to see a smaller difference in WTP between service autonomy and no autonomy under high complementarity than under low complementarity.

[4] We do not examine the effect of autonomy of the good from the service or of its interaction with any other driver of WTP on WTP as we do not have any theoretical reason to expect an effect.

Table 1 Comparison of our research with selected relevant research on bundling

Reference	Focus	Key findings/insights	Limitations
Venkatesh and Mahajan (1993)	Bundling strategy amid multiple consumer decision making criteria	• Mixed bundling is more profitable provided carefully chosen prices on the bundle and the components.	• Only considers goods • Does not consider quality variability differences
Jedidi et al. (2003)	Optimal product-line pricing policy	• Optimal product-line policy is contingent on the amount of heterogeneity in the reservation prices of the components and the bundle	• Only considers goods • Does not consider quality variability differences
Derdenger and Kumar (2013)	Dynamic effects of bundling of complementary products	• Mixed bundling is more effective because the bundle serves as a separate product to achieve more dynamic consumer segmentation	• Only considers goods • Does not consider quality variability differences
Chung and Rao (2003)	Pure bundling strategy with heterogeneous bundle components	• Comparability-based balance model is superior to models that do not consider comparability of attributes and heterogeneity among respondents.	• Only considers goods • Does not consider quality variability differences
Crawford (2008)	Testing the discriminatory incentives to bundle	• Product bundling reduces consumer heterogeneity, extracting consumer surplus similar to second-degree price discrimination.	• Only considers digital services • Does not consider quality variability differences
Meyer and Shankar (2016)	Hybrid bundle costs and pricing of components	• An increase in quality variability of the service is associated with a higher optimal hybrid bundle price and a lower optimal price of the good, but a lower overall bundle profit. • The optimal price of the service (good) in a hybrid bundle is higher (lower) when the good is more scalable than the service. • Higher unit costs incurred to achieve lower service quality variability can result in higher (lower) profits when the cost increase is low (high).	• No empirical analysis • Does not examine overall bundle quality • Does not consider competition
This article	Hybrid bundling strategy based on WTP for differences in service autonomy and service quality variability	• Service autonomy and complementarity interact to raise consumers' WTP for the hybrid bundle. • Bundle quality and service quality variability interact to influence the mean and the variance of a consumer's WTP for the bundle.	• Does not consider competition

However, two lines of reasoning suggest a positive interaction. First, when the service component of a hybrid bundle is autonomous from the good, consumers gain familiarity and expertise with the service by being able to use it in many situations (Alba and Hutchinson 1987). Increased familiarity and usage result in greater knowledge about the product and its attributes (Park and Lessig 1981). When the good and the service are complementary, this increased knowledge of attributes enhances the benefits of using the two components together. Due to the additional benefits, consumers will be willing to pay more for the hybrid bundle than otherwise. When the good and the service are not complementary, the increased familiarity and expertise with the autonomous service exacerbates the lack of benefits in using the two components together. Thus, consumer utility from using less complementary components is significantly muted when the service is autonomous than when it is not (Herrmann et al. 1999).

Second, a positive interaction between complementarity and service autonomy can also be shown analytically (see Appendix). Following this result, consumers of many hybrid bundles with highly complementary good and service components may significantly enhance their utilities if they can use the service across multiple goods. Consider a hybrid bundle containing a tablet computer and an app store service. If a consumer finds apps (say music sharing) highly complementary to the tablet, she is likely to benefit more if she can use the apps across multiple mobile devices such as a smartphone and a digital music player. Thus, complementarity is more useful when the service can be used autonomously.

Because of the analytical basis, we believe the reasoning for a positive interaction between complementarity and autonomy is stronger than that for a negative interaction, yielding H1.

H1: The difference in consumer WTP for a hybrid bundle between high and low complementarity conditions is greater when the service is autonomous from the good in a hybrid bundle than when it is not autonomous.

Service quality variability

Variability in quality is a key dimension of difference between services and goods that significantly influences consumer

WTP. The variability in the quality of the good is low because it is manufactured using stringent quality control methods. Therefore, consumer evaluation of the bundle's quality variability hinges on the quality variability of the service component. Service quality can vary over time and across customers because different people may perform the service at different times for different customers. Ultimately, variability in service quality occurs at the customer level when the customer experiences the service. However, this variability is sometimes known to the consumer through various sources (e.g., third party reviews, blogs, other social media). Consumers' WTP is generally higher when perceived risk is lower, and perceived risk is partially a function of quality variability (Hoffman et al. 2002). If service quality variability is low, consumers feel strongly assured of the expected benefits of the bundle and will be willing to pay more for the bundle. By contrast, if the variability in quality of the service is high, consumers are uncertain about the expected benefits of such a bundle and will be willing to pay less for the bundle. Interestingly, based on an analytic model, Meyer and Shankar (2016) show that when the quality variability for the service is high, a monopolist's optimal bundle price is high, but its optimal bundle profit is low. This result may be because price-sensitive consumers' (who constitute the majority of the market) WTP for high service quality variability may be low and they may not buy the hybrid bundle, so although price-insensitive consumers may pay a higher price for the bundle, the net profit across all consumers will be low. Therefore, we expect that the higher the quality variability of the service in a hybrid bundle, the lower the consumer WTP for the bundle.

We do not expect a significant effect of quality variability of the good on the WTP for the hybrid bundle because the quality variability of the good is substantially lower than that of the service, and there are no strong theoretical reasons for it to influence the WTP for the bundle.

Bundle quality–service quality variability interaction

The difference in WTP between two bundles is a function of the perceived quality gap between the bundles. When the perceived quality gap is high, the difference in WTP is high (Steenkamp et al. 2010). A premium quality bundle is one that provides more benefits to the consumer and often results in the consumer spending more money than a basic quality bundle (Chandon et al. 2000).

Bundle quality and service quality variability may interact to influence WTP by affecting the perceived quality gap between low service quality variability bundles and high service quality variability bundles. The bundle quality–service quality variability interaction can be mathematically analyzed as follows. Both bundle quality and service quality variability have a direct effect on a consumer's reservation price for the hybrid bundle. For simplicity, consider a hybrid bundle with a single price where the average valuation for the bundle is set to unity. A hybrid bundle can be either premium quality (P) or basic quality (B) with either low (L) or high (H) service quality variability, leading to four combinations: PL, PH, BL, and BH. Premium (basic) quality will increase (decrease) a consumer's reservation price by β where $\beta > 0$. Similarly, low (high) service quality variability will increase (decrease) a consumer's reservation price by ψ where $\psi > 0$.

Three possible scenarios relating to consumer sensitivity to risk and benefits exist: equal sensitivity to risk and benefits, greater sensitivity to risk, and greater sensitivity to benefits. If no interaction between bundle quality and service quality variability occurs, a consumer has equal sensitivity to benefits and risk, as shown in Fig. 1a. In this case, the difference between low and high service quality variability for both premium and basic quality bundles is 2ψ.

In the greater sensitivity to benefits scenario, the differences between low and high service quality for premium and basic quality bundles are $2\psi + \kappa_1$ and $2\psi - \kappa_2$, respectively, where κ_1, $\kappa_2 > 0$ represent the interaction of bundle quality and service quality variability. In this case, the quality of a basic bundle is already low and the upside is limited. Thus, the high variability in service quality may not have a significant influence on WTP for that bundle. For a premium bundle, however, high service quality variability could lead to some consumers not receiving the premium or high level of benefits that they expect. Therefore, one could argue that consumers will likely be more sensitive to the prices of premium hybrid bundles than basic hybrid bundles because of their sensitivity to the associated benefits. Figure 1b shows an interaction between bundle quality and service quality variability under this scenario.

In the greater sensitivity to risk scenario, the differences between low and high service quality for premium and basic quality bundles are $2\psi - \kappa_3$ and $2\psi + \kappa_4$, respectively, where κ_1, $\kappa_2 > 0$ again represent the interaction. Here, the already high perceived risk in the performance of a basic quality bundle is exacerbated by the difference in uncertainty between low quality variability and high quality variability. Consequently, consumer WTP will be much lower under high service quality variability than under low service quality variability. However, consumers' perceived risk of performance for premium quality bundles is low because they can be reasonably assured of the performance of the bundle. This situation alleviates the difference in consumer uncertainty between low service quality variability and high service quality variability. Research on positivity bias can also shed light on the direction of the interaction. Consumers often have a positivity bias, which causes them to underestimate the likelihood of negative events (e.g., Raghubir and Menon 1998). When presented with a premium bundle, positivity bias may reduce or eliminate the expected negative effect of higher service quality variability on WTP. However, when presented with a basic

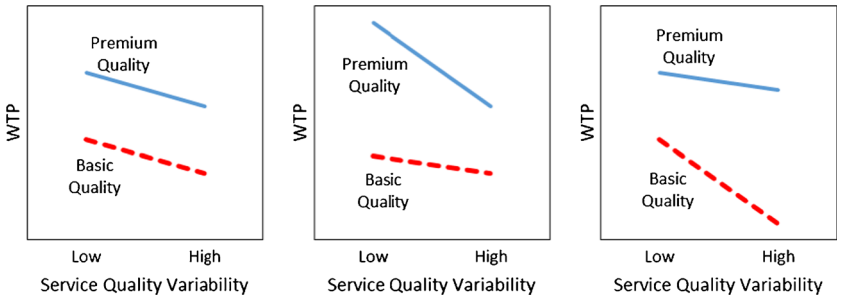


Fig. 1 Sensitivity to benefits and risk

(a) Equal Sensitivity to Benefits and Risk (b) Greater Sensitivity to Benefits (c) Greater Sensitivity to Risk

bundle and the lower benefits it entails, positivity bias may not overcome the negative effect of higher service quality variability. Therefore, service quality variability is less likely to influence WTP in premium quality bundles. Figure 1c shows an interaction between bundle quality and service quality variability under this scenario.

Social media may enable this interaction effect. Consumers learn about bundle quality and service quality variability through product reviews, blogs, or social network posts, and based their WTP on the interaction of bundle quality and service quality variability.

Most hybrid bundles are characterized by a reasonably high level of risk. For example, in the carpet and installation service hybrid bundle, the uncertainty in how a carpet will look and function and how well it will remain in place after installation is significantly high for most customers. Therefore, we believe that consumer sensitivity to risk will likely dominate sensitivity to benefits. This reasoning leads to the next hypothesis.

H2: The difference in consumer WTP for a hybrid bundle between high and low service quality variability is greater when bundle quality is basic than when it is premium.

Do bundle quality and service quality variability interact to also influence the distribution of consumer WTP? One line of reasoning, which we term *uncertainty avoidance*, is skeptical of an interaction effect. Under this reasoning, low service quality variability will likely have little effect on the distribution of consumer WTP regardless of overall bundle quality because it does not add much uncertainty. However, high service quality variability simply adds uncertainty to the benefits the consumer receives. If consumers are uncertainty avoiders, the increased uncertainty compresses the distribution of consumer WTP (Sonnier et al. 2007) regardless of bundle quality. Therefore, this reasoning suggests that no interaction effect exists.

However, a second line of reasoning, which we term *uncertainty asymmetry*, suggests that bundle quality and service quality variability may interact to significantly influence the distribution of consumer WTP. In particular, the effect of higher service quality variability on the distribution of consumer WTP will differ depending on bundle quality. First, consumers already expect to receive a low level of benefits for a basic bundle. Therefore, the added uncertainty with high service quality variability not only reduces consumers' WTP for the basic bundle, but also limits the risk consumers are willing to accept for the possibility of receiving poor service quality (Murray and Schlacter 1990). Consequently, consumers' WTP falls within a narrow band, resulting in a lower variance in the WTP for the basic hybrid bundle across consumers.

In a premium quality bundle, consumers are certain about the core benefits they would receive. While some consumers may be willing to take a chance on receiving excellent service quality, others may be reluctant to take such a chance (Herrmann et al. 1999). This situation results in a higher variance in the WTP for the premium hybrid bundle across consumers.

We believe that for a typical hybrid bundle, consumers are heterogeneous in their view of uncertainty. Therefore, we expect the uncertainty asymmetry line of reasoning to hold, leading to our next hypothesis.

H3: The difference in the variance of consumer WTP for hybrid bundle between basic and premium bundle quality is greater when service quality variability is high than when it is low.

We expect the hypotheses to be robust across different types of services in the hybrid bundle. The service in the hybrid bundle can be digital or physical (performed by humans). The service quality variability for a digital service is typically lower than that for a physical service. However, it is still likely to be greater than it is for the good in the bundle. For example, in a hybrid bundle comprising an e-reader and e-book, even an e-book can have variability in service quality due to the availability and speed of Internet connection, whereas the e-reader is unlikely to have any variability in its performance. The service can also be one-time (e.g., installation) or repeated (e.g., subscription or maintenance). Even in this case, the variability in the quality of the service will likely

be more than that for the good. For example, the human variability in installation service for a router will likely be higher than the variability in the router performance. Similarly, the variability in the quality of access and speed of the subscription service for Internet connection will be greater than that in the performance of the router. Furthermore, periodic maintenance service (e.g., air conditioner maintenance) provided by humans will vary much more in quality than that of the good in the bundle (e.g., air conditioner). The degree of service quality variability may be lower in a digital service than in a human service and that might affect the magnitude of the effect of service quality variability on the variance in WTP rather than the direction of the effect.

Measuring willingness to pay

Consumer choice among different hybrid bundles involves trade-offs. Consumers must decide among the benefits derived from different combinations of the levels of the attributes of the bundles. Consequently, consumer WTP can be best measured using choice-based conjoint analysis (Kohli and Mahajan 1991; Jedidi and Zhang 2002; Jedidi et al. 2003; Sonnier et al. 2007; Iyengar and Jedidi 2012). Therefore, we use a choice-based surplus maximization conjoint methodology for estimating consumer WTP (e.g., Jedidi and Zhang 2002). We provide details on our WTP model development and estimation in Technical Appendix.

We estimate the model parameters through a Bayesian estimation procedure using Markov Chain Monte Carlo (MCMC) methods (e.g., Venkatesan et al. 2007). The estimation consisted of 40,000 iterations with the first 20,000 iterations for burn-in and the remaining 20,000 iterations for parameter inference.

Willingness to pay is typically measured in terms of reservation price (e.g., Ding 2007; Ding et al. 2005).[5] Consistent with prior research (Jedidi and Jagpal 2009; Jedidi et al. 2003), we define WTP as the indifference reservation price; that is, the price at which a consumer is indifferent between purchasing and not purchasing a bundle. It provides the maximum amount a consumer is willing to pay given the consumer's other purchase options and budget (Jedidi and Jagpal 2009). At the price that the consumer is willing to pay, the consumer extracts the same surplus with or without purchase—zero.

To avoid cognitive overload for respondents and to minimize experimental design complexity, we test all the hypotheses through two different studies. In Study 1, we test the effects of service autonomy and complementarity. In Study 2, we test the effects of bundle quality and service quality variability. To ensure that the results are insensitive to the relative prices of the good and the service in the bundle, across these studies, we test for different good to service price ratios, ranging from 0.35 to 9.33, in our stimuli.

[5] In this paper, we use the terms "willingness to pay" and "reservation price" interchangeably.

Study 1

Study design

Study 1 focuses on the first hypothesis. A total of 400 undergraduate students at a U.S. university participated in a conjoint study for class credit. The conjoint study uses a hybrid bundle comprising a tablet computer (the good) and unlimited app store (the service). We selected this hybrid bundle based on a pretest (n = 84) in which the interest and knowledge about portable high technology products (similar to Apple iPad) and services (similar to an app store) were high. The bundle had four non-price attributes and a price attribute, although the prices for the good and service components were presented separately. The tablet was described as "a mobile touchscreen computer running an operating system." The non-price attributes for the good were screen size (7″, 8.5″, and 10″) and internal storage (8GB, 16GB, and 32GB). The price attribute for the good comprised three levels ($299.99, $499.99, and $699.99) and included a sufficiently broad range of reasonable prices (Haaijer and Wedel 2007). The unlimited app store was described as "a service that allows you to download and install an unlimited number of apps for your tablet for a onetime fee." Smart phone access to the unlimited app store ("Yes" and "No") and number of apps (25,000, 100,000, and 175,000) were the service component attributes presented. The price attribute for the service also comprised three levels ($74.99, $124.99, and $174.99) with a sufficiently broad range. We varied the prices around these levels by a small amount. Brand was not included as an attribute because of the "new-to-the-world" nature of the hybrid bundle created by the unlimited app store.

The phone access attribute represented service autonomy. If the unlimited app store could also be used with a smartphone in addition to the tablet, the service was autonomous. Otherwise, the service was not autonomous. We determined the price points for both the good and the service by examining similar product categories and through the use of the pretest. Although not a focal point for Study 1, we also manipulated service quality variability by presenting the following scenario to the respondents: *Consumer Reports had nine experts rate the quality of the tablet computer and the unlimited app store service. After using the combination for one month, the experts rated the quality using a scale between 1 and 10, where 1 is Very Low Quality and 10 is Very High Quality.* Respondents were randomly assigned to either the low service quality variability condition (Fig. 2a, 191 respondents) or the high service quality variability condition

Fig. 2 Service quality variability manipulation. Note: Each tick mark respresents an "expert" rating. The mean for both distributions of expert ratings is 7

(Fig. 2b, 209 respondents). Because goods are manufactured using stringent quality control methods, quality variability of the good was low for all respondents.[6]

We selected a choice-based conjoint design, which presented each respondent with 14 random choice tasks and two fixed choice holdout tasks. Each choice task consisted of three hybrid bundle choices, along with a choice not to select any of the three. We selected the 14 random choice tasks using the balanced overlap method that allows the same level of a given attribute to be present multiple times in a given choice task without duplicating hybrid bundle profiles in a single choice task (Vriens et al. 1998). If a respondent always selects bundles with a particular attribute level, his choices will not provide much information. The balanced overlap method allows for additional overlap to account for these situations. A sample choice task appears in Fig. 3. We calculated the WTP for each respondent as described earlier.

Analytical bundling research defines complementarity as a ratio comparing a consumer's reservation price for the bundle to the sum of the reservation prices for the bundle's components (e.g., Venkatesh and Kamakura 2003). However, experimental research on bundling often uses discrete levels of complementarity, such as complementary or not complementary (e.g., Harlem et al. 1995) or very complementary, somewhat complementary, or not at all complementary (e.g., Herrmann et al. 1999). We measured complementarity between the good and the service for each respondent following the completion of the choice tasks. Respondents were asked about the additional benefit gained from using the components of the hybrid bundle together, and we placed respondents into discrete categories of high and low complementarity based on a median split. As a robustness check, we subsequently tested for any negative consequences of treating complementarity as a dichotomous variable (Irwin and McClelland 2003).

[6] For this study and Study 2, the correlations among the drivers were either zero (for drivers that were orthogonal by design) or low (.06–.11 for those measured by consumers' responses), allowing us to accurately estimate the effects of all drivers. Furthermore, in this study, we do not formally test the effect of service quality variability on WTP but use the corresponding result as a pretest for Study 2.

Results

We specify a WTP function (Appendix, Eq. 6), capturing the impact of non-price attributes through indicator variables. In particular, our model contains two variables for each of screen size, internal storage, and number of apps and one indicator variable for the unlimited app store. Our model estimation provides estimates of both population-level parameters $(\bar{\theta}, \Sigma)$ and individual-level part-worths (θ_i). We test the hypotheses using individual-level part-worth estimates to determine the WTP for different types of hybrid bundles. The estimates of population-level parameters are available from the authors upon request.[7]

For each respondent, we calculate the WTP for two hybrid bundles identical on all attributes except service autonomy. We use the predicted WTP as the dependent variable in a linear mixed model with fixed effects for service autonomy (Yes/No), complementarity between the good and service (High/Low), service quality variability (High/Low), and the service autonomy–complementarity interaction. Note that autonomy of the service from the good is a within subjects, repeated measure; that is, we calculate a respondent's WTP for a hybrid bundle twice, once with and once without service autonomy. Thus, we cannot assume that the random errors for the same respondent are independent. In addition, measurements on the same respondent may have different variances. Therefore, we include a respondent-specific effect that allows for correlation between the two measurements and heterogeneous variances. Recall that to avoid cognitive overload for participants and to simplify the experimental design, we do not examine the effects of bundle quality in Study 1. Instead, we use WTP measures for a medium quality hybrid bundle comprised of 8.5″ screen size, 16 GB memory, and 100,000 apps in the app store. We examine additional bundles to show the robustness of our results.

The mean and standard deviation of WTP measures for each condition appear in Table 2, and the estimates of fixed effects appear in Table 3. We begin by analyzing the results for

[7] For the low (high) service quality variability condition, the calibration hit-rate is 87.7s (88.2%).

Fig. 3 Study 1 sample choice tasks

If you were in the market to buy a tablet computer and unlimited app store combination today and these were your only options, which would you choose?

Other than what is listed below, everything else about the three options is exactly the same.

Tablet	**Tablet**	**Tablet**	
• 7 inches	• 8.5 inches	• 10 inches	
• 8 GB	• 32 GB	• 16 GB	
• $499.99	• $699.99	• $299.99	
Unlimited App Store	**Unlimited App Store**	**Unlimited App Store**	NONE: I wouldn't choose any of these.
• Only the tablet can download unlimited apps for the one-time fee	• Unlimited apps can also be downloaded to one phone for the same one-time fee	• Only the tablet can download unlimited apps for the one-time fee	
• 175,000 apps	• 100,000 apps	• 25,000 apps	
• $124.99 one-time fee	• $174.99 one-time fee	• $74.99 one-time fee	

the main effect of service autonomy on consumer WTP. The service autonomy main effect is significant ($\beta = 51.90$, $p < 0.001$) and is represented by the vertical separation between the two lines in Fig. 4a (under low service quality variability) and in Fig. 4b (under high service quality variability). The patterns are similar in both Fig. 4a and b.

We now turn to the results for the main effect of complementarity on consumer WTP. The complementarity main effect is significant ($\beta = 116.79$, $p < 0.001$) and is represented by the slope of the lines in Fig. 4a and b. Again, the pattern is similar for both the conditions.

Next, we examine the interaction between service autonomy and complementarity on consumer WTP. H1 posits a positive interaction effect. The results show a positive and significant ($\beta = 64.59$, $p < 0.001$) interaction effect, which is represented in Fig. 4 by the steeper slope of the line between low and high complementarity when the service is autonomous versus not autonomous. Thus, H1 is supported.

Finally, although not the focus of this study, the service quality variability main effect is significant in the opposite direction ($p < 0.05$). This finding is contrary to our expectation.

To check the robustness of our results, we estimated alternative linear mixed models. First, to rule out any negative consequences of treating complementarity as a dichotomous factor (Irwin and McClelland 2003), we treat complementarity as a continuous variable. However, because of multicollinearity induced by the inclusion of the interaction term, we mean-center the complementarity variable and estimate the alternative model. The results are nearly identical, with all effects still significant ($p < 0.05$) and in the same directions.

Next, we use the WTP estimates from a lower quality bundle (7″ screen, 8GB memory, 25,000 apps) and a higher quality bundle (10″ screen, 32GB, 175,000 apps) as the dependent variables. For both bundles, the results are nearly identical, with all effects still significant ($p < 0.05$) and in the same directions.

Finally, to be stringent in sample selection, we remove respondents who failed to identify the service quality variability condition to which they were assigned after the conclusion of the choice tasks. This process removed 52 (88) respondents from the low (high) quality variability condition. The results for service autonomy, complementarity, and their interaction are nearly identical, with all three effects still significant ($p < 0.001$) in the same directions. However, the significance of service quality variability diminishes ($p = 0.190$). Overall, the results are robust.

Discussion and managerial implications

As expected, consumer WTP for the hybrid bundle is significantly greater when the service is autonomous from the good than when it is not. Consumers receive more direct benefit from the service if they can use it separately from the good. While not a formal hypothesis, our findings are the first to confirm that having the service autonomous in usage from the good increases the WTP for the bundle even within a pure

Table 2 Study 1 WTP mean and standard deviation for service autonomy and complementarity combinations

Service autonomy	High service quality variability		Low service quality variability	
	High complementarity ($n = 144$)	Low complementarity ($n = 65$)	High complementarity ($n = 150$)	Low complementarity ($n = 41$)
Yes	982.65 (311.80)	804.83 (279.12)	1012.25 (411.22)	850.38 (270.18)
No	889.64 (244.36)	758.80 (247.14)	873.22 (309.99)	789.19 (223.65)

Standard deviation in parentheses; based on a bundle consisting of 8.5″ screen size, 16 GB memory, and 100 K apps

Table 3 Study 1 estimates of fixed effects of service autonomy and complementarity on WTP

Parameter	Estimate (Std. Error)	*p*-value
Intercept	789.61 (27.75)	< 0.001
Service Autonomy (SA) (Yes = 1)	51.90 (11.50)	< 0.001
Complementarity (COMP) (High = 1)	116.79 (30.75)	< 0.001
SA x COMP	64.59 (13.41)	< 0.001
Service Quality Variability (High = 1)	49.27 (23.33)	0.035

Note: Based on a bundle consisting of 8.5″ screen size, 16 GB memory, and 100 K apps.

bundle setting. This finding is also useful for practitioners. Managers of hybrid bundles need to be aware that autonomous services result in higher WTP for the bundle. For example, suppose Best Buy offers a pure bundle of a personal computer and Geek Squad service for problems that may arise. If the Geek Squad service can be used with any computer the customer owns, Best Buy could likely charge a price premium for this added service autonomy.

With respect to complementarity, our findings show that WTP for the bundle is significantly higher with higher levels of complementarity. From a practitioner viewpoint, these findings provide further support for highly complementary components within a hybrid bundle.

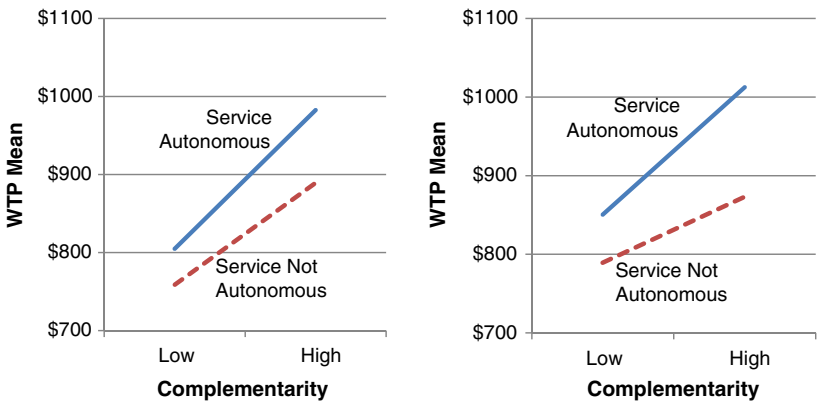
Importantly, the hypothesis on the interaction between complementarity and service autonomy is supported. While prior research suggests that higher levels of complementarity may dampen the optimality of mixed bundling, our findings are different. The difference in WTP for the hybrid bundle when the service is autonomous versus not autonomous is significantly higher under high complementarity than under low complementarity. This finding offers new theoretical insights into how complementarity and service autonomy interact. We believe that service autonomy allows the consumer to use the service in more situations, increasing the familiarity with the component. This increased familiarity magnifies the benefits of complementarity between the components. To extract a higher price premium for the hybrid bundle, managers could make the service autonomous of the good, while raising complementarity.

Contrary to our expectations, the effect of service quality variability on WTP is positive (albeit at the 0.05 level), such that lower service quality variability decreases WTP. This finding may have resulted from two factors. First, when we removed respondents who did not pass a simple manipulation check regarding service quality variability, the significance in the opposite direction disappeared. Therefore, some respondents may not have been paying close attention to service quality variability. Second, the nature of the service in this hybrid bundle may have caused respondents to question whether the quality of the app store would actually vary as presented. Taken together, these two factors make a strong case for an incentive-aligned conjoint experiment where the variation in the quality of the service component of the hybrid bundle is more believable and has high external validity.

Study 2

Study design

The second study focuses on our last two hypotheses, H2 and H3. To boost external validity, we use an incentive-aligned conjoint study, consistent with Ding (2007) and Dong et al. (2010), focusing on WTP within a hybrid bundle setting. To implement incentive alignment, we told each respondent that



(a) Low Service Quality Variability (b) High Service Quality Variability

Fig. 4 Study 1 results. Notes: The WTP is for a bundle consisting of 8.5" screen size, 16 GB memory, and 100K apps. The vertical distance between the lines represents the difference in WTP between autonomous and not autonomous conditions. The positive slope of the lines represents the difference in WTP between low complementarity and high complementarity conditions. The difference in slopes represents the effect of interaction between service autonomy and complementarity on WTP

his or her responses would be used to train a state-of-the-art computer model that will infer preferences for each feature of the hybrid bundle. Once all studies were concluded, a lottery would choose one respondent, and the computer would predict the hybrid bundle combination the lottery winner will like the most from a list of possible combinations. The selected combination would be bought for the lottery winner, and the price of the combination subtracted from $300, with the lottery winner receiving both the hybrid bundle and the cash balance. A sample of 245 undergraduate students at a U.S. university participated in this conjoint study for class credit.

Study 2 uses a hybrid bundle containing a wireless router (the good) and home network setup (the service). We chose this hybrid bundle based on the same pretest of high technology goods and services as in Study 1. As in Study 1, the bundle had four non-price attributes and a price attribute, although the prices for the good and service components were presented separately. Therefore, each hybrid bundle profile consisted of six attributes. The wireless router was described as a product that "allows multiple electronic devices to communicate with each other and share a common Internet connection without the devices being physically connected to each other with a cord." For the good, the first non-price attribute was the router speed, which had three levels: 100 Mbps, 300 Mbps, and 500 Mbps. The second non-price attribute was the brand, which had three levels: Netgear, D-Link, and Belkin. The price attribute for the good consisted of three levels ($49.99, $99.99, and $149.99) with a sufficiently wide range to cover reasonable prices (Haaijer and Wedel 2007). We varied the prices around these levels by a small amount. The home network setup service was described as "a service where a professional technician installs the wireless router and creates a secure home network that allows files and media to be shared between connected devices." For the service, the first non-price attribute was the number of devices the technician will automatically connect to the user's home network, which had three levels: 2, 3, and 4 (premium level). The second non-price attribute was whether there was a telephone troubleshooting helpline, which had two levels: yes (premium level) and no. Thus, the premium quality bundle combinations included both premium good and premium service. The price attribute for the service also consisted of three levels with a sufficiently wide range: $59.99, $99.99, and $139.99. We determined the price points for the service and the good by looking at similar product categories and through the use of the pretest.[8]

In the choice-based conjoint design, we presented each respondent with 14 random choice tasks and two fixed choice holdout tasks. Each choice task consisted of three hybrid bundle choices, along with a choice not to select any of the three. As with Study 1, we selected the 14 random choice tasks using the balanced overlap method. To manipulate service quality variability, we presented a scenario similar to Study 1: *Consumer Reports had an expert rate the quality of nine separate home network setups from the professional technicians. After each home network setup, the expert rated the quality using a scale between 1 and 10, where 1 is Very Low Quality and 10 is Very High Quality.* For the high (low) service quality variability condition, the "expert" ratings ranged from 4 to 10 (6 to 8) with a mean of 7 for each condition. In contrast to Study 1, this study uses a service based on human labor, which should lead to a more effective manipulation. The digital service in Study 1 may have created a situation in which respondents did not believe variability in service quality actually exists, resulting in a less effective manipulation. Respondents were randomly assigned to either the low service quality variability condition (122 respondents) or the high service quality variability condition (123 respondents).

A sample choice task appears in Fig. 5. To control for potential difference in results created by current ownership of a wireless router, we asked if the respondent owned a router. If respondents owned a router, high interest in replacing their router was required to participate in the conjoint study. We estimated the part-worth utilities and WTP in a manner similar to Study 1.

Results

We specify a WTP function (Appendix, Eq. 6) where we capture the impact of non-price attributes using indicator variables. In particular, our model contains two variables for brand, two variables for router speed, two variables for the number of devices and one indicator variable for the helpline. We test H2 using a linear mixed model as in Study 1. For each respondent, we use the individual-level part-worth estimates (θ_i) to calculate a WTP for a premium quality hybrid bundle and a WTP for a basic quality hybrid bundle. The estimates of population-level parameters are available from the authors upon request.[9]

A basic quality bundle was classified as a 100 Mbps DLink router with only two devices connected during the installation and without a telephone helpline. A premium quality bundle was classified as a 500 Mbps Netgear router with four devices connected during the installation and with a telephone helpline. We use the estimated WTP as the dependent variable, with fixed effects for bundle quality (Premium/Basic), service quality variability (High/Low), and the bundle quality–service quality variability interaction. Bundle quality is a within subjects, repeated measure; that is, we calculate the WTP for a single respondent twice, once with a premium

[8] In this study, we use complementarity as a control variable as we have already tested Hypothesis 1 (relating to complementarity) in Study 1.

[9] For the low (high) service quality variability condition, the calibration hit-rate is 82.7% (88.2%).

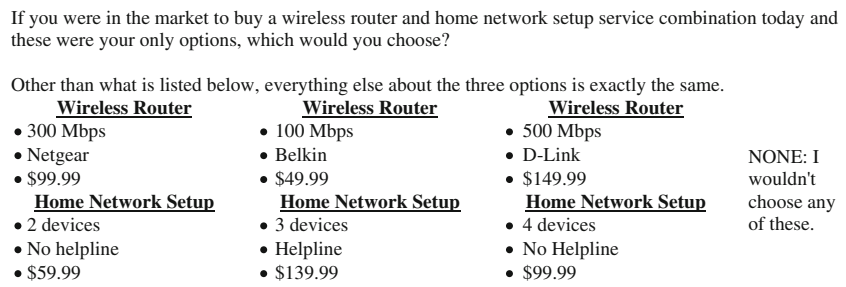


Fig. 5 Study 2 sample choice tasks

quality bundle and once with a basic quality bundle. Thus, we cannot assume the random errors for the same respondent are independent. In addition, measurements on the same respondent may have different variances. Therefore, we include a respondent-specific effect that allows for correlation between the two measurements and heterogeneous variances.

The mean and standard deviation of WTP measures for each condition appear in Table 4, and the estimates of fixed effects appear in Table 5.[10] We begin by analyzing the results for the main effect of service quality variability on consumer WTP, which is significant ($\beta = 39.00$, $p < 0.001$). Unlike in Study 1, the effect is in the expected direction, likely due to the incentive alignment and the believability of the service that can vary greatly in quality.

The main purpose of Study 2 is to examine the interaction between the overall quality of the hybrid bundle and the quality variability of the service component. The negative interaction effect on WTP is significant ($\beta = -42.96$, $p < 0.01$), supporting H2. The effect of the interaction between bundle quality and service quality variability on WTP is represented in Fig. 6a by the opposite slopes of the lines between low and high service quality variability when the bundle is premium quality versus basic quality.

Finally, Study 2 examines the effect of the interaction between bundle quality and service quality variability on the distribution of WTP. As no formal procedure exists to test the effect of an interaction on the distribution of the dependent variable, we inductively arrive at our conclusion using two one-way ANOVA analyses with the Levene (1960) test for equality of variances. First, we use the Levene test to examine the effect of service quality variability on the distribution of WTP for a premium quality bundle. The results show that the distribution for high service quality variability is marginally higher than for low service quality variability ($F[1, 243] = 2.53$, $p = 0.11$). Second, we use the Levene test to examine the effect of service quality variability on the distribution of WTP for a basic quality bundle. The results show that the distribution for high service quality variability is significantly lower than for low service quality variability ($F[1243] = 46.88$, $p < 0.01$). Taken together, the two tests clearly show that a significant interaction effect exists on the distribution of WTP between bundle quality and service quality variability.

It is possible that the difference in WTP distribution is a function of the differences in mean WTP. To check the robustness of our results, we use the coefficient of variation, which is a standardized measure of dispersion, and calculate 95% confidence intervals following Kelley (2007) for each service quality variability condition for both premium and basic hybrid bundles. We see similar results using the coefficient of variation. That is, for premium bundles the coefficient of variation for high service quality variability (0.36) is higher than for low service quality variability (0.30), although not significantly so. For basic bundles, however, the coefficient of variation for high service quality variability (0.31) is significantly lower than for low service quality variability (0.60). Thus, our results support H3. The effect of the interaction between bundle quality and service quality variability on the distribution of consumer WTP is represented in Fig. 6b by the opposite slopes of the lines between low and high service quality variability when the bundle is premium quality versus basic quality.

To check the robustness of our results, we remove respondents who failed to correctly identify the service quality variability condition to which they were assigned when the choice task ended. This process removes 13 (33) respondents from the low (high) quality variability condition. The result for the interaction effect on the distribution of WTP is nearly identical, with the effect still significant ($p < 0.01$) and in the

Table 4 Study 2 WTP mean and standard deviation for service quality variability and bundle quality combinations

Bundle quality	Service quality variability	
	High ($n = 123$)	Low ($n = 122$)
Premium	390.92 (140.54)	388.43 (118.37)
Basic	98.10 (30.88)	138.57 (82.78)

Standard deviation in parentheses; a premium (basic) quality bundle consists of a Netgear (DLink) router, a router speed of 500 (100) Mbps, a home network setup service for a maximum of 4 (2) devices, and telephone support (no telephone support)

[10] It is not uncommon to see WTP estimates higher than the tested prices in the conjoint (e.g., Jedidi and Zhang 2002; Iyengar and Jedidi 2012).

Table 5 Study 2 estimates of fixed effects of service quality variability and bundle quality on WTP

Parameter	Estimate (Std. Error)	*p*-value
Intercept	69.40 (11.95)	< 0.001
Service Quality Variability (SQV) (High = 1)	- 39.00 (7.90)	< 0.001
Bundle Quality (BQ) (Premium = 1)	292.82 (11.22)	< 0.001
SQV x BQ	42.96 (15.90)	0.007

Premium bundle quality = Netgear, 500 Mbps, 4device setup, telephone support

Basic bundle quality = DLink, 100 Mbps, 2 device setup, no telephone support

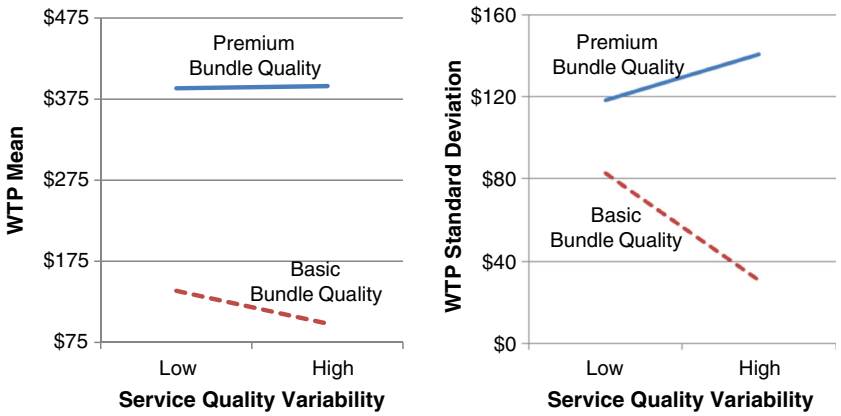
same direction. The bundle quality–service quality variability interaction effect on WTP is in the expected direction, but only marginally significant with a one-sided test (p = 0.057). Overall, the results are robust.

Discussion and managerial implications

The results have important substantive implications. As expected, our findings show that WTP for the hybrid bundle is significantly higher with low service quality variability. This finding differs from Study 1, likely due to the incentive-aligned setting and a service component that relies on human labor. Even more interesting, however, are the results from Study 2 that support our hypotheses on the interaction between bundle quality and service quality variability.

To our knowledge, this research is the first to examine the effects of service quality variability on WTP. Service quality variability has a direct effect on the WTP for a hybrid bundle. Furthermore, it interacts with the overall hybrid bundle quality to affect WTP. When managers offer a basic bundle, consumers already expect a high level of risk in the benefits they will receive. When the uncertainty of high service quality variability is added, consumers are willing to pay even less. However, when managers offer a premium bundle, this effect disappears because consumers are reasonably assured of the benefits they will receive and their perceived risk is low. The added uncertainty of high service quality variability does little to discount this assurance. Therefore, if managers are offering hybrid bundles with basic features, it is important to reassure consumers that service quality variability will be low.

This research is also the first to examine the effects of service quality variability on WTP distribution. Service quality variability also interacts with hybrid bundle quality to affect the distribution of WTP. The intuition behind this finding is as follows. When a service has a wide distribution of quality, an individual consumer is more likely to get either a high or a low quality service than when it has a narrow distribution of quality. When managers offer a basic bundle, consumers already have high levels of perceived risk about the benefits. Therefore, when high service quality variability is also present, most consumers are only willing to pay a low price, leading to a narrower distribution of WTP. However, when managers offer a premium bundle, consumers have low levels of perceived risk about the benefits they will receive. In this case, when high service quality variability is present, some consumers are willing to pay more on the chance they will get the high quality service, while others will be willing to pay less on the chance they will get the low quality service, leading to a wider distribution of WTP.



(a) WTP Mean (b) WTP Standard Deviation

Fig. 6 Study 2 results. Notes: A premium (basic) quality bundle consists of a Netgear (DLink) router, a router speed of 500 (100) Mbps, a home network setup service for a maximum of 4 (2) devices, and telephone support (no telephone support). In panel (**a**), the difference in slopes represents the effect of the interaction between bundle quality and service quality variability on mean WTP. In panel (**b**), the difference in slopes represents the effect of the interaction between bundle quality and service quality variability on the WTP distribution, as measured by the WTP standard deviation

The wider WTP distribution for high quality variability services in a premium bundle indicates that there is greater heterogeneity across customers in prices for the hybrid bundle. This finding suggests that managers may offer premium hybrid bundles to different customer segments at different prices to extract more consumer surplus. However, the narrower WTP distribution in a basic bundle means there is lesser heterogeneity across customers in reservation prices for the hybrid bundle. This finding suggests that managers may want to offer one price to a large segment that seeks basic features. If they want to offer basic hybrid bundles at different prices to different segments, it is important to minimize service quality variability.

Theoretical and managerial implications

Table 6 shows a summary of the findings across the two studies. We find support for all of our formal hypotheses, covering four factors: service autonomy, complementarity, service quality variability, and bundle quality. These findings offer valuable substantive contributions. Table 7 offers a summary of managerial implications of the key findings with suitable examples.

Our result on service autonomy shows that the ability to use the service component within a hybrid bundle separately from the good commands a higher WTP. This direct effect is important because our research sheds light on a previously unexplored aspect of bundling—consumer ability to the use the components separately—and suggests that hybrid bundle managers must recognize the importance of autonomy of the service component in use.

The interaction between service autonomy and complementarity has received little attention in the literature, so our findings related to this interaction open up a new avenue in bundling research. We argued that the difference in WTP between high complementarity and low complementarity would be greater when the service is autonomous from the good than when it is not. This finding points to a positive interaction effect. Marketers of hybrid bundles can extract a high price premium when the components are highly complementary by making the service autonomous from the good. This finding is directly applicable in industries where the hybrid bundle contains an autonomous digital service. For example, Ooma sells a hybrid bundle comprising its Telo hardware (i.e., VoIP router and handset) and phone service. While the phone service and hardware are highly complementary, the phone service can be used on other devices, such as an Amazon Echo and even mobile devices, increasing the benefits the user receives. However, other industries can adopt the findings as well. For example, Otis' Gen 2 hybrid bundle of an elevator and maintenance service commands a premium price because customers derive a high value for its service engineers' expertise with Otis elevators although clients could purchase and use the elevator and the service (even from different providers) separately. The findings is also be applicable to industries such

Table 6 Summary of results

Factor(s)	WTP difference (Hypothesis)	Study 1	Study 2	Finding
Service autonomy	$\mu_{SA} > \mu_{NSA}$	+	NA	Autonomy of the service in a hybrid bundle from the good is associated with a higher WTP for the bundle.
Complementarity	$\mu_{HC} > \mu_{LC}$	+	NA	Complementarity between the service and good in a hybrid bundle is positively related to WTP for the bundle.
Interaction of service autonomy and complementarity	$\mu_{SA,HC} - \mu_{NSA,HC} > \mu_{SA,LC} - \mu_{NSA,LC}$ (H1)	+	NA	When the service is autonomous from the good in a hybrid bundle, the greater the complementarity between the components, the higher the WTP for the bundle.
Service quality variability	$\mu_{LSQV} > \mu_{HSQV}$	NS	-	The lower the service quality variability, the higher the WTP for the hybrid bundle.
Interaction of bundle quality and service quality variability	$\mu_{B,LSQV} - \mu_{B,HSQV} > \mu_{P,LSQV} - \mu_{P,HSQV}$ (H2)	NA	+	Higher service quality variability results in a significantly lower WTP in basic hybrid bundles, but not in premium hybrid bundles.
	$\sigma^2_{B,\mathrm{LSQV}} - \sigma^2_{B,\mathrm{HSQV}} > 0; \quad \sigma^2_{P,\mathrm{LSQV}} - \sigma^2_{P,\mathrm{HSQV}} < 0$ (H3)	NA	+	Higher service quality variability results in a significantly narrower WTP in basic bundles and a significantly wider WTP in premium bundles.

+ = $p < 0.01$ (positive relationship). - = $p < 0.01$ (negative relationship). *NS* Not Significant, *NA* Not Applicable, σ^2 WTP variance μ WTP mean, *SA* Service autonomy, *NSA* No service autonomy, *HC* High complementarity, *LC* Low complementarity, *LSQV* Low service quality variability, *HSQV* High service quality variability, *B* Basic hybrid bundle quality, *P* Premium hybrid bundle quality

Table 7 Summary of key managerial implications

Finding	Managerial implication	Example
Autonomy of the service in a hybrid bundle from the good is associated with a higher WTP for the bundle.	To command a premium price for a hybrid bundle, keep the components in a hybrid bundle autonomous from one another.	The storage service in IBM's SAN (Storage Area Network) hybrid bundle can be purchased and used separately from the hardware. That is, IBM's data storage service can be used with a device from another provider. Thanks to this service autonomy, IBM's SAN is perceived to be highly valuable, commands a high price, and enjoys a high market share.
Complementarity between the service and good in a hybrid bundle is positively related to WTP for the bundle.	To command a premium price for a hybrid bundle, improve the benefits of using the good and service together and charge a higher price for the bundle.	"Oracle on Demand" is a hybrid bundle that comprises the Oracle database system and its consulting service. By making the database and the consulting service highly synergistic, Oracle is able to command a high price for its service and hybrid bundle.
When the service is autonomous from the good in a hybrid bundle, the greater the complementarity between the components, the higher is the WTP for the bundle.	To command a premium price for a hybrid bundle, keep its components autonomous but improve the benefits of using the components together.	The elevator and maintenance service in Otis' Gen 2 hybrid bundle are autonomous (i.e., they can be purchased and used separately). Yet Otis offers improved value for using its elevator and maintenance service together through the deep expertise of its service engineers with its own elevators. Consequently, it is able to charge higher prices for Gen 2.
Higher service quality variability results in significantly lower WTP in basic hybrid bundles, but not in premium hybrid bundles.	To command a price premium for basic quality hybrid bundles, ensure that the service component has low service quality variability.	McDonald's offers basic hybrid bundles of fast food and service with low service quality variability by having standardized practices. Therefore, McDonald's is able to enjoy a slight price premium over its competitors.
Higher service quality variability results in a significantly narrower WTP distribution in basic bundles and a significantly wider WTP distribution in premium bundles.	To market premium quality hybrid bundles at different price points to multiple segments, allow for greater service quality variability across the segments. To market basic quality hybrid bundles at different prices points to multiple segments, ensure lower service quality variability.	By offering service guarantees, Best Buy is able to signal low service quality variability and offer different price points on its bundles of basic equipment and Geek Squad setup services.

as automobile dealers. A hybrid bundle of a used car and roadside assistance is complementary. However, if the roadside assistance could be used on other vehicles as well, the benefit to the consumer is greater.

Service quality variability, an overlooked aspect in pricing of services in general and hybrid bundles in particular, can have important implications on WTP and for pricing of hybrid bundles. Although services are often higher in quality variability that goods, efforts can be taken to reduce the variance associated with the service. Firms can utilize the gaps model of service quality (Zeithaml et al. 1990) to examine the factors that affect service quality. Service blueprinting can also be used to first identify customer pain points and then to reduce the likelihood of the pain point occurring (e.g., Bitner et al. 2008). Our findings show that higher quality variability of a service within a hybrid bundle is associated with a lower WTP for the bundle across consumers when the service depends more on human labor. By itself, this finding suggests that managers of hybrid bundles with low service quality variability may be able to extract a small price premium when the service is performed by humans.

However, variability in service quality has an even greater effect when it interacts with the overall quality of the hybrid bundle. The interaction effects on WTP and its variance have critical implications for designing and pricing hybrid bundles. For basic quality bundles, if service quality varies a lot, consumers are willing to pay much less to take on the added uncertainty regarding the service component. However, when service quality variability is low, consumers are willing to pay more for the positive assurance that the bundle will work. Therefore, marketers of basic quality bundles should focus on reducing service quality variance to extract a price premium. Similarly, the result that for premium quality bundles, greater service quality variability is associated with wider variance in WTP suggests valuable opportunities for marketers of premium bundles. These marketers can identify and target segments willing to pay significantly more for an assured quality.

The bundle quality–service quality variability interaction findings are directly applicable in industries containing hybrid bundles where the service is an installation. For example, when a carpet store offers a bundle of basic carpet and

installation, consumers will be willing to pay more for an assurance of the installation quality. Similarly, marketers of high end electronic or computing goods such as Best Buy who offer installation or repair services can charge a premium for those willing to pay more by providing service guarantees that mitigate risks in service quality variation. Other industries where the good may be considered more valuable or longer lasting component can adopt the findings as well. For example, McDonald's basic hybrid bundles (basic breakfast/lunch + service) focus on minimizing the variability in service quality by having standardized practices across its outlets. Consequently, it is able to have a slight price premium over other fast food chains that are not perceived as having low service quality variance. Furthermore, consider again automobile dealers. The quality of a bundle comprised of a new car with routine maintenance service will largely depend on the quality of the car. For a high quality car, assuring consistent quality of the maintenance service would add little value to the consumer, whereas for a low quality car, the opposite would be true. This implication, however, does not suggest that a lower level of service quality is acceptable in the premium bundle. On the contrary, consumers of the premium bundle may expect a high level of service quality, but within that level of service, service consistency is less important.

The results also provide valuable guidance to managers facing hybrid bundle choices. One such choice is between offering a hybrid bundle with high complementarity and one with service autonomy. If the costs of each option are the same, then firms should strive for the bundle with high complementarity over the bundle with service autonomy. In our data, based on marginal means, the WTP for a hybrid bundle with high complementarity but no service autonomy ($882) is 11% higher than a bundle with low complementarity and service autonomy ($817).

Unsurprisingly, premium quality bundles fetch higher prices but also cost more to create. One way to cut costs is to avoid spending on raising an already high service quality *consistency* as this action has little impact on the WTP for premium bundles. At the other end of the spectrum, *consistent* service quality provides a clear and measurable benefit for firms offering basic quality bundles. In our data, consumer WTP is 55% higher when service quality variability is low versus high ($108 versus $69).

Some firms offer different hybrid bundles at different quality levels. These firms may have the same set of employees servicing all their customers, some of whom buy high quality bundles and some who buy low quality bundles. In this case, rather than offering the same consistency of service quality for all bundle quality levels, the firm may want to assign a group of employees to provide consistent service quality for the basic bundle and another group of employees for premium bundles, which do not command higher WTP for enhanced service quality consistency.

Limitations and future research

The limitations of our research suggest future research directions. First, the conjoint designs used in the studies were of pure bundle form, regardless of whether or not the components were autonomous. Future research could examine mixed bundling and pure components forms and the optimal pricing of such bundles. Second, optimism bias where respondents believe they are less likely to get a service with poor quality (Tanner and Carlson 2009) might exist and could be tested by future research. Third, order effects that may exist in conjoint tasks for unfamiliar product categories (Kumar and Gaeth 1991) could be explored for hybrid bundles as well. Fourth, although our focus was on hybrid bundles, bundles of goods-only components and bundles of services-only components may also share similar differences in autonomy, complementarity, bundle quality, or quality variability. Future research could examine if our results generalize to these situations as well. Fifth, we focused on quality variability for the service because the quality of service is often more variable than that of the good. However, in some situations, the good may also vary significantly in quality due to differences across manufacturers. The additional role of such differences on WTP could also be studied. Sixth, our studies could be extended to more types of hybrid bundle situations, such as frequently purchased hybrid bundles (e.g., fast food, hairstyling). Future studies could also explore the differences between digital and human services within hybrid bundles. Seventh, studying hybrid bundling in competitive context can offer additional insights, extending Kopalle et al. (1999). Eighth, our studies did not test the possible behavioral mechanisms underlying the interaction between complementarity and service autonomy or between service quality variability and bundle quality. These behavioral mechanisms, such as shifting of reference prices, perception of greater value in non-complementary bundles, and positivity bias, could be tested by future studies. Finally, we estimated the WTP for the bundle but not for its individual components. Future research can explore conjoint designs for estimation of WTP for hybrid bundle components.

Conclusion

Many companies are increasingly selling hybrid bundles, whose pricing and success hinge on a better understanding of WTP for the bundle. The results of our analyses show that: autonomy of the service from the good in the bundle and their complementarity interact to increase WTP, and bundle quality and quality variability interact to heighten WTP and its variance. These results offer important guidelines for managers to develop appropriate hybrid bundles. Faced with the alternatives of offering either of two hybrid bundles, one with high complementarity and the other with service autonomy,

managers should offer the bundle with high complementarity. However, firms can receive a greater price premium when the components are highly complementary and the service is autonomous from the good, contrary to popular notion. Furthermore, contrary to conventional wisdom, managers may want to raise service quality consistency for basic quality bundles but simply maintain it for premium bundles.

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Appendix

Complementarity and service autonomy interaction

In analytical bundling models, complementarity[11] is defined as:

$$\Theta = \frac{R_{12} - (R_1 + R_2)}{R_1 + R_2}, \tag{1}$$

where $\Theta > 0$ represents complementarity between the bundle components, R_{12} represents the reservation price for the bundle, and R_1 and R_2 represent the reservation prices for the two bundle components (Venkatesh and Kamakura 2003). Using this convention, a consumer's reservation price for a hybrid bundle is given by:

$$R_{HB} = (1 + \Theta)(R_G + R_S), \tag{2}$$

where R_{HB}, R_G, and R_S are the reservation prices for the hybrid bundle, the good, and the service, respectively. Service autonomy from the good should have a direct effect on the reservation prices of the service, R_S. Consider a simple hybrid bundle where a service is either autonomous or not, and suppose the average valuation of these two states for the service is chosen to be unity. The reservation price for the service, R_S, is equal to $1 + a$ when the service is autonomous and $1 - a$ when it is not, where $a > 0$. For simplicity, further suppose the reservation price for the good, R_G, is not affected by service autonomy. The reservation price for the hybrid bundle is now

$$R_{HB} = (1 + \Theta)[R_G + (1 + a)], \tag{3}$$

when the service is autonomous and

$$R_{HB} = (1 + \Theta)[R_G + (1 - a)], \tag{4}$$

when the service is not autonomous. We can see that the difference in a consumer's reservation price for a hybrid bundle with service autonomy versus no service autonomy is $2a + 2a\,\Theta$. Therefore, we predict a positive interaction between complementarity and service autonomy.

Balanced overlap choice-based conjoint method

The balanced overlap method utilized in this study is based on a randomized experimental design. In this method, different combinations of full profile choice sets are randomly shown to respondents. The combinations are selected based on the amount of overlap, the balancing of levels within attribute, and orthogonality among attributes. While this differs from the more traditional fractional factorial design, research has shown that randomized designs are more efficient when attributes are asymmetric (i.e., different number of levels) (Mulhern 1999).

WTP model development and estimation

Model Consider a choice set consisting of J hybrid bundles. Each choice bundle j (j = 1, …,J) represents a hybrid bundle that is described in terms of attribute levels and price. We assume that consumer i (i = 1, …,I) cannot choose more than one bundle. Let p_j be the total price associated with hybrid bundle j. We specify the following surplus equation for consumer i and bundle j (S_{ij}):

$$S_{ij} = WTP_{ij} - p_j + \varepsilon_{ij} = s_{ij} + \varepsilon_{ij}, \tag{5}$$

where WTP_{ij} is consumer i's willingness to pay for bundle j and ε_{ij} is a random error term. For bundle j, s_{ij} (WTP_{ij} - p_j) is the systematic component of surplus.

Let j = 0 denote the no-choice option. We set the willingness to pay for the no-choice option to zero (i.e., $WTP_{i0} = 0$). Then using Eq. (1), the surplus corresponding to the no-choice option for consumer i is $S_{i0} = \varepsilon_{i0}$..

To capture the impact of bundle attributes, we specify WTP_{ij} as follows:

$$WTP_{ij} = \exp\left(\sum_{l=1}^{L} \alpha_{il} x_{jl}\right), \text{for } i = 1, \ldots, I; j = 1, \cdots, J; \text{and } l = 1, \cdots, L, \tag{6}$$

where x_{jl} is the value of bundle j on attribute l, and α_{il} measures the impact of x_{jl} on w_{ij1} (part-worth). Note that the use of the exponential function ensures the positivity of WTP.

Estimation Consider a sample of I consumers, each choosing at most one bundle from a set of J bundles. Let t indicate a choice task. If consumer i contributes T_i such observations,

[11] Technically, Θ represents a consumer's degree of contingency, where $\Theta > 0$ is complementarity and $\Theta < 0$ is substitutability. However, by definition, hybrid bundles only have complementarity. Therefore, we use Θ to represent only complementarity.

then the total number of observations in the data is given by $T = \sum_{i=1}^{I} T_i$. Let $z_{ijt} = 1$ if the choice of bundle j is recorded for choice task t, otherwise, $z_{ijt} = 0$. As $j = 0$ denotes the index for the no-choice alternative, $z_{i0t} = 1$ if the consumer chooses none of the bundles.

We assume that consumers are surplus maximizers. On choice task t, let $S_{ijt} = s_{ijt} + \varepsilon_{ijt}$ and $S_{i0t} = \varepsilon_{i0t}$ denote the surplus from bundle j and the no-choice option, respectively. Thus, a consumer would choose bundle j in choice task t if it has the maximum surplus $\{S_{ijt} > S_{ikt}, k = 0, \cdots, J, k \neq j\}$ and would choose none of the bundles if the no-choice option ($j = 0$) has the maximum surplus $\{S_{i0t} > S_{ijt}, j = 1, \cdots, J\}$..

We assume that ε_{ijt} follows an iid extreme value distribution with scale parameter $\mu_i > 0$ (see Ben-Akiva and Lerman 1985, pp. 104–105). The scale parameter μ_i is necessary because the price coefficient is normalized to one in the surplus Eq. (5). Therefore, consumer i's choice probability for bundle j on choice occasion t, Pr_{ijt}, and no-choice probability, Pr_{i0t}, are:

$$Pr_{ijt} = \frac{\exp(\mu_i s_{ijt})}{1 + \sum_{k=1}^{J} \exp(\mu_i s_{ikt})} \text{ and } \quad Pr_{i0t} = \frac{1}{1 + \sum_{k=1}^{J} \exp(\mu_i s_{ikt})}. \tag{7}$$

Because we model consumer surplus, the parameter estimates directly provide the reservation price that makes a consumer indifferent between buying and not buying an alternative (Jedidi and Zhang 2002, p. 1352).

For an individual i, let $\alpha_i = (\alpha_{i1}, \cdots, \alpha_{iL})'$ and $\theta_i = (\alpha_i, \mu_i)$ be the joint vector of parameters. We use the choice data to estimate the vector of parameters, θ_i, for each individual. Because it is not possible to obtain sufficient choice data to estimate separate models for each individual, we use a Bayesian multi-level structure (e.g., Allenby et al. 1995; Venkatesan et al. 2007) that specifies how the individual-level parameters vary in the population. We assume that:

$$\theta_i \sim N(\bar{\theta}, \Sigma), \tag{8}$$

where $\bar{\theta}$ and Σ are population level parameters to be estimated.

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