Self-selecting No-Pay Service Delivery Strategies: A Rising Tide that Lifts All Boats?

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Services such as housing, food, and healthcare are expected to be universally accessible and affordable. However, rapidly increasing cost structures and income inequality are proving to be significant impediments. Some service organizations, having recognized this situation and wanting to ensure that everyone (including those that cannot pay) meets their needs, are implementing schemes under which customers can choose not to pay the required fees. Instead of resulting in a reduction in profits, these strategies, which literally give away services for free, can lead to profit enhancement for such organizations. Competing firms and consumers may also benefit, resulting in superior societal welfare. The reasons underlying this outcome are (i) philanthropic amplification of paying customers' willingness to pay, (ii) lower cost, no-frills service (and the associated utility reduction) designed for the non-paying customers, (iii) faster transition of service professionals up the learning curve, and (iv) service professionals' appreciation for the societal contribution and the associated compensation savings. We develop a mathematical framework capturing these characteristics, perform a rigorous analytical and computational analysis, characterize conditions under which service providers should introduce these strategies in a competitive environment, and determine the optimal parameter values they should use to get the highest benefits. We show that the strategy of offering free services to the needy can, in addition to benefiting the firm, the consumer, and the society, also benefit the competitor. Thus, it is a strategy that lifts all boats akin to a rising tide.

Key words: Philanthropy, Competition, Free service, Compensation, Cost Reduction

1. Introduction

"*Bringing business and philanthropic interests into harmony means that everybody wins.*"

- Michael E. Porter

Self-Selecting No-Pay (SSNP) service delivery strategy is well-known to be effective in ensuring that everyone receives the essential services (water, food, healthcare, housing, education, etc.) in these times of severe wealth inequity, global disruptions, and economic upheaval. Self-selecting

no-pay strategy enables the customers that cannot pay to avail of these essential services at no cost, whereas the other customers will pay the announced price. The SSNP delivery strategy we propose in this paper represents a new development of strategic philanthropy initiatives and is enhanced by a market pricing mechanism that bears some similarities with other popularly adopted Participatory Pricing mechanisms (e.g., Pay What You Want, Name Your Own Price, Consumer Elective Pricing). The general consensus is that all these mechanisms (including self-selecting no-pay) can significantly increase affordability of the essential services and result in significant increases in consumer surplus, corporate profit, and social welfare. However, their impact on the competitive context is less well understood and is the main focus of this research. We specifically show that the SSNP strategy can benefit the firm (or service provider), the consumer, and society. It also benefits the competitor (if any) and thus is truly a strategy that lifts all boats akin to a rising tide.

Aravind Eye Care System (13 eye hospitals, six outpatient centers, and 75 primary care centers) headquartered in Madurai, India, has, in its 43-year history, performed about eight million surgeries and 65 million outpatient visits, with about half of them performed at little or no cost to low-income patients, driven by their mission to "eliminate needless blindness". With its ability to achieve these philanthropic results while remaining financially successful in a competitive environment, Aravind Eye Care System epitomizes the self-selecting no-pay service provider we attempt to model and analyze in this research. While the benefits (to the firm, customers, and society) of this philanthropic service delivery strategy in a monopolistic environment have been well documented (see, e.g., Palsule-Desai et al. (2021)), the impact on competitors has not hitherto been characterized.

Self-selecting no-pay strategies, being a relatively recent research topic, have so far been evaluated only in a monopolistic setting, and we, for the first time, will model and analyze it in a duopoly environment. A few research studies have examined Pay What You Want (PWYW) pricing strategy in a competitive setting. Still, they were all set in discretionary consumer goods, in a Bertrand duopoly, with the main result being that the competitors are able to differentiate themselves and eke out some profits. We instead focus on essential services with a philanthropic context and show that both the competitors are able to realize higher profits while enabling consumers to enjoy a larger surplus, and the society is also better-off as a result.

1.1. Principal Drivers

Introducing the self-selecting no-pay strategy enables the firm to recognize a number of changes regarding consumer valuation, the workforce learning curve, and workforce compensation. The central theme in the principal drivers described below is borrowed from Palsule-Desai et al. (2021). An interested reader may refer to Palsule-Desai et al. (2021) for further details.

Philanthropic customer utility amplification : Many organizations nowadays have a well-defined corporate social responsibility strategy, and participating in charitable activities and improving society's welfare are an integral part of it. Firms achieve it by (i) donating money, (ii) donating goods and services, (iii) donating employees' time and skills, and (iv) via community-oriented initiatives. These activities are often time- and resource-intensive, and yet, are not designed to increase revenues directly. Nevertheless, they significantly increase costs. The prevalence and scale of these activities seem to indicate that there must be a positive impact that overcomes the aforementioned detrimental financial impacts, and that probably is the goodwill generated among the prospective customers. It amplifies their willingness to pay, which results in the firm's ability to charge a higher price for its products. We model this philanthropic customer utility amplification using a scale factor (η) greater than one.

Restrictions-induced no-pay utility reduction : When the SSNP (also referred to as free service) option is offered, a customer can choose not to pay for the service, and this often is not free of other encumbrances. The service provider may use an elaborate and comprehensive process for checking income level, not provide a specific scheduled time for the service and/or make the customer wait longer, restrict the options that the customers can choose from, and deny access to secondary facilities such as the preparation and recovery rooms. While these restrictions will reduce the utility the customers realize, they may still be attracted to it because they do not have to pay anything. We model this inconvenience-caused utility reduction using a scale factor (ω) less than one.

Faster learning curve transition for service professionals : Offering the SSNP option allows the service provider to significantly increase the number of customers it serves. This increased volume will enable the service professionals to go up the learning curve much faster and accumulate a skill set that is valued by the marketplace (see Govindrajan and Ramamurti (2013) for further details). Recognizing this, many service professionals choose to start their careers (often at a lower than market salary) at a charitable organization. Then, after a few years, having compiled a larger than normal work experience, they transition to the traditional market at a significantly higher salary level. The service professional can choose the transition point to maximize their own career earning potential, and the charitable organization saves in salary costs from the time of hire to transition time. Thus, this system is beneficial to both the service professional and the charitable service organization. We model this using a multiplicative factor ($\delta \in (0, 1]$) to capture the lower starting salary, a slope factor (μ_H) to reflect an income growth, and a slope factor (μ_P) to denote the rate at which the service professionals' market value increases. Knowing these factors, a service professional can determine the optimal time of transition (t_H) to maximize their own career earnings.

Mission-driven employees' compensation reduction : Not all service professionals that start their careers at a charitable organization leave to realize their market potential. Some identify themselves very well with the social mission of the service provider and realize life and career fulfillment that is non-monetary, but more than compensates for the lower salary they earn for their entire careers. We capture this phenomenon considering three types of service professionals (simply referred to as professionals in this paper): philanthropic, traditional, and hybrid professionals.

The cost savings that result from, among other factors, lower compensation to its professionals, higher throughput in service delivery, and relatively longer working hours contributed by its professionals at the service provider offering the SSNP option to its customers compared to a *traditional* service provider offer significant impetus to the former's profitability. On the other hand, philanthropic customer utility amplification can enhance revenues, while the restriction-induced no-pay utility reduction can mitigate revenue dilution due to the SSNP option. These serve as additional drivers of profitability.

Our main goal in this research is to understand the role these various phenomena play in shaping the strategic decision of whether a service provider should offer the SSNP option to its customers. If it offers that, we are further interested in understanding how it should decide the capacity levels, compensation for the service professionals, and the overall service delivery blueprint. To answer these questions and gain relevant managerial insights, we formulate, analyze, and solve a duopoly competition model for a hybrid competition setting in which one firm (*hybrid*) offers the SSNP option and the other (*traditional*) does not.

1.2. Research Questions

Motivated by real-world observations, in this paper, we develop a stylized model to address the following questions:

1. What are the conditions under which SSNP is introduced (by a hybrid service provider) into an industry?

2. When a (hybrid) service provider introduces SSNP, what is the impact on the profits at the competitor firm?

3. When a (hybrid) service provider introduces SSNP, what is the impact on consumer surplus?

4. When a (hybrid) service provider introduces SSNP, what is the impact on social welfare?

5. When the philanthropy-driven service delivery cost for the hybrid firm changes, how do the answers to Questions 1-4 change?

1.3. Critical Findings

Our model provides interesting insights into a hybrid competition setting in which one of the service providers offers the customers a self-selecting no-pay option for its service. The analysis of our proposed model and accompanying computational study enable us to conclude that the hybrid firm's strategy to combat inequality is beneficial for the competing service providers and customers and enhances social welfare under certain situations.

Our critical results are summarized as follows:

1. Implications for the competing firms: Contrary to a common belief, we found that the hybrid firm's strategy of offering the SSNP option to the customers may lead to Pareto efficient outcomes. Thereby, the profits for the competing firms increase even when the philanthropic customers act pessimistically, i.e., even when the valuations for the firms' paid services reduce in the hybrid competition setting.

2. Implications of free service valuation: The hybrid firm's strategy of offering the SSNP option to the customers benefits the competing service provider when the value generated by the customers adopting the free service is relatively small.

3. Implications for consumer surplus: The Pareto efficient equilibrium for the competing service providers need not be detrimental to the customers. We observe that the overall consumer surplus increases under hybrid competition when the number of philanthropic customers in the market is relatively large.

4. Implications of service professionals: Contrary to a common belief, the hybrid firm may prefer to be associated with hybrid professionals that act in self-interest. By appropriately setting the income levels of the hybrid professionals, the hybrid firm induces turnaround of professionals to its own advantage and enhances its own profitability, that of the competitor, consumer surplus, and the social welfare.

5. Implications for the service professionals' career choices: The hybrid professionals that act in self-interest benefit from splitting the time in their careers between the hybrid and traditional firms.

6. Implications of service professionals' learning curve: We show that the increased cost-efficiency of the hybrid firm benefits its competitors and customers as well. Specifically, the hybrid firm shares the cost reduction benefits with its customers by lowering the price of its paid service, thereby increasing the profitability of its own and that of the competitor. In addition, it also enhances social welfare, provided the professionals' compensation package is appropriately designed.

We organize the remainder of the paper as follows. The following section summarizes the existing literature and positions our work. Section 3 presents our models describing the problems faced by each of the players – customers, service providers, and service professionals – involved in the multi-stage game. In Section 4, we analyze the models to obtain the solutions for the players' problems and to provide insights into the implications of the supply- and demand-side dynamics in the hybrid competition setting. We conclude the paper in Section 5. The proofs of the technical results presented in the main paper and additional results are presented in an appendix.

2. Related Literature

This paper presents a Self-Selecting No-Pay (SSNP) business model that can successfully apply to a competitive environment and benefit every stakeholder, including even competitors. SSNP represents a new development of strategic philanthropy initiatives and is enhanced by an innovative market pricing mechanism. Similar to the well-known Pay-What-You-Want (PWYW) mechanism, SSNP allows consumers to choose the option of receiving a service or good at zero (or a highly subsidized) price. Differentiated from PWYW, however, for consumers who are willing to pay, SSNP amplifies these consumers' philanthropic utility. Therefore, they are willing to pay a price higher than a *regular* price in the market. The integration of pricing mechanisms and strategic philanthropy also brings significant changes to the behaviors of both internal employees and external consumers and market competitors. In this section, we review three research streams that characterize corporate philanthropy, PWYW mechanism under competition, and consumer response separately. Finally, we link these streams of literature to suitably position our work in this paper.

2.1. Corporate Philanthropy

The study of corporate philanthropy, in particular, strategic philanthropy, explores the underlying mechanism for answering the question of why a company might be willing to give its assets for public purposes in the long run (Burke 1992, Young and Burlingame 1996). Porter and Kramer (2003) emphasize that, while much of Corporate Social Responsibility (CSR) of today is about preventing abuses or mitigating harm, corporate philanthropy, in contrast, is about using corporate money and other resources to create and maximize social value. The improved social conditions brought by corporate philanthropy can directly influence a company's strategy and help its economic success. To this end, strategic philanthropy represents "an overt effort to link corporate giving with the firm's economic objectives" (Wood 1990). According to the theory, if a business can apply its unique corporate resources to help build strong economies in a region, it can improve the standard of living and quality of life of its citizens for the long term, therefore eventually bringing in direct and

measurable financial returns to the company operating in this region (Gautier and Pache 2015). However, empirical evidence has indicated many challenges in fulfilling these goals of strategic philanthropy. Marx (1999) notices that few companies in practice could directly measure their financial returns from their contributions to local communities. Similarly, the relationship between their philanthropic efforts and new market development is also difficult to measure directly. In addition, traditional philanthropic actions, mainly in the form of donations, require an outflow of costly resources (Fombrun et al. 2000). When the local environment is struck by disasters, such as the case of the COVID-19 pandemic, a devastating event that needs the most from corporate philanthropy, companies often become financially more conservative, and therefore, reduce their spending on philanthropy (Chen et al. 2021). For companies that did manage to provide aid during the COVID-19 pandemic, such as the donations of rooms and food in Spring 2020 from major hotel corporations to health care professionals (Florio 2020), a recent study (Shin et al. 2021) concludes that these decisions have had negative influences, at least in the short term, on hotel firms' performance and prospective hotel customers' booking behavior.

Studies also indicate positive influences of CSR and corporate philanthropy on external stakeholders such as consumers, investors, and partners (Long and Driscoll 2008, Luo and Bhattacharya 2006) and internal employees (Jones et al. 2014, Gao and Yang 2016, Gond et al. 2017). For internal stakeholders, particularly employees, research has long recognized that CSR engagement may reflect an individual's self-concern or self-interest. Most studies emphasize the fulfillment of employee goals on a moral base (Rupp et al. 2011). By supporting and actively engaging in CSR initiatives, employees seek solutions for their care-based concerns (Rupp and Mallory 2015), for a meaningful existence (Cropanzano et al. 2001), or a higher-order need (Glavas 2016). Furthermore, corporate philanthropy helps link employees' willingness to contribute to society (Tongo 2015, Zhao and Zhang 2020) and toward charity (Wang et al. 2015) to a satisfactory competitive performance for the firm. However, very few papers so far have addressed other motivations, such as developmental needs (Mirvis 2012), of employees in support of CSR. Caligiuri et al. (2013) examine a corporate volunteer program and find that employees are more willing to engage in volunteer assignments if such assignments can help develop their professional skills that can be applied in the regular work role. Also, there is very little existing research addressing the strategic alignment of employees' CSR drivers with the company's CSR initiatives and financial performance in a quantitative way, as several review papers have pointed out (Rupp and Mallory 2015, Glavas 2016, Gond et al. 2017).

2.2. Pay-What-You-Want Mechanism Under Competition

PWYW is a pricing mechanism that allows individual consumers to decide how much to pay for a product or service. PWYW has gained significant attention from academic researchers in recent years (e.g., Kim et al. (2009), Schmidt et al. (2015), Spann et al. (2018)) and motivated many companies to adopt this innovative idea in practice. However, not all of them have been proven successful (e.g., Evans (2014), Mettler (2019)). Greiff and Egbert (2018) review 52 empirical studies on PWYW pricing published between 2009 and 2015, and Gerpott (2017) conducts another review of 72 empirical studies on PWYW pricing published between 2006 and 2016, containing a total of 97 independent empirical data sets. Interested readers can refer to these two review papers on various aspects of PWYW. Here, we highlight one critical aspect of PWYW that is most relevant to our model setting: the impact of competition.

A seller adopting PWYW faces competition from sellers who use fixed pricing for the same product or service. With offers from competing sellers, buyers' behavior is understandably different from that in a monopoly setting where only one seller is in the market. Unfortunately, as both Gerpott (2017) and Greiff and Egbert (2018) have noticed, only two papers (Krämer et al. (2017) and Schmidt et al. (2015)) across both reviews have considered a competitive market environment. Krämer et al. (2017) design several experiments in which sellers with various pricing mechanisms compete. Schmidt et al. (2015) examine the effect of competition in experiments with two sellers and six buyers. Both studies reach similar conclusions that PWYW helps achieve higher market penetration in a monopolistic market. Still, competition, in which conventional fixed prices are available from at least one other seller, causes a negative effect on the level of prices that PWYW buyers pay, and therefore, lowers the profit for sellers who adopt PWYW. Thus, these studies conclude that PWYW is less successful as a competitive strategy; when given a choice, most sellers opt for using a fixed price rather than a PWYW pricing strategy (Schmidt et al. 2015). Since then, a few theoretical papers have been published to investigate the competitive advantage of PWYW to prevent the Bertrand trap where competitors compete in uniform prices and all end in zero profits. Chen et al. (2017) integrate product differentiation using a Hotelling city model and find that PWYW allows a firm to price discriminate among heterogenous consumers and helps to moderate price competition. Thus, they suggest that PWYW is suitable in more competitive industries and during economic downturns. Chao et al. (2019) model a pricing competition where two sellers of homogeneous products compete in a simultaneous setting. They find that by one firm choosing PWYW and the other fixed-pricing, both firms earn positive profits, thus breaking the Bertrand trap. However, the firm using fixed pricing always earns higher profits. Margaret (2020) models

a sequential game where a seller who enters the market can choose its pricing scheme between PWYW and fixed-pricing. The study finds that the first mover will always choose fixed-pricing under certain conditions, but later entrants can only choose PWYW to avoid Bertrand competition. Overall, all the existing studies on PWYW seem to agree that although the introduction of PWYW in a competitive market can help companies move away from pure price competition, the firm that implements the PWYW mechanism will often earn less profits than its competitor and also earn much less profit compared to that in a monopoly setting.

2.3. Consumers' Response

We will now summarize the literature that studies the consumers' response to CSR and corporate philanthropy and link them with studies in PWYW literature on consumer motives for positive payments. Instrumental stakeholder theory asserts that there exists a positive association between CSR and corporate financial performance (Berman et al. 1999), which has been confirmed by numerous empirical studies (Plewnia and Guenther 2017, Wang et al. 2016). In relation to market competitiveness, empirical evidence suggests that corporate philanthropy can help firms gain sociopolitical legitimacy (Wang and Qian 2011) and sales growth relative to rivals (Hu et al. 2021) by eliciting positive responses from stakeholders, who compare a firm's philanthropic contribution to that of its rivals in the same industry to determine their level of support of the firm. Bhattacharya and Sen (2003) argue that customers may increase their demand for a firm's products or services and pay premium prices if the firm's social responsibility efforts help go beyond satisfying consumers' basic utilitarian needs by fulfilling their higher-order self-definitional needs. In other words, CSR and corporate philanthropy provide an effective mechanism for consumers to express their self-identity through their purchases. An empirical study by Luo and Bhattacharya (2006) further confirms the positive relationship between CSR and market value through customer satisfaction as the mediator. The authors also notice that a company's innovation capability could positively impact the effectiveness of its CSR activities. Therefore, a proper combination of CSR initiatives and product-related abilities is essential.

Studies on the motives for consumers' voluntary payment in PWYW provide important insights from the other angle. Consumers are willing to pay more because of their social preferences (Fehr and Schmidt 2006), including altruism (Andreoni and Miller 2002) and inequity aversion (Bolton and Ockenfels 2000). Laboratory experiments from Schmidt et al. (2015) provide evidence of consumer social preferences that drive their paying decisions, but the same study also warns that competition significantly alters the picture. Many customers turn to the sellers offering posted prices when such options exist. Gautier and Klaauw (2012) report that PWYW is not a feasible

long-term strategy as the campaign mainly attracts consumers with relatively few pro-social reputational concerns. Narwal et al. (2021) examine how customers lower their motivation to pay more for products offered under PWYW by morally disengaging themselves from reciprocity concerns. In short, the current studies seem to suggest that the effect of customers' social preferences through PWYW or other participative pricing mechanisms (see Spann et al. (2018) for more details) is not strong enough to sustain profitable operations in the long-term or in the face of competition.

The Self-Selecting No-Pay (SSNP) strategy proposed in this paper effectively remedies the weakness of the participative pricing mechanisms mentioned above. In SSNP, potential customers with high social preferences see a clear and innovative way of fulfilling their higher-order self-definitional needs by purchasing the offered good or service at a premium price because the extra payment will go directly toward social equality. On the other hand, customers with fewer pro-social concerns will then choose the competitor that offers a lower fixed price and fewer restrictions, thus saving the insufficient capacity in the hybrid firm for those who cannot pay. SSNP is also an enhancement to the Pick Your Price (PYP) strategy (Wang et al. 2021) with only two options, pay zero or pay a premium, to ease the pricing decision-making burden for the consumers and increase purchase outcomes for the firm. In summary, the SSNP strategy enables a self-selection mechanism among consumers. It helps both the hybrid firm and the competitor extract higher profits — a mechanism that could benefit everyone, akin to a rising tide lifting all boats.

3. Models

This section presents our models that capture essential features of the decision-making processes of the players involved – namely, customers, service providers, and service professionals. (In this paper, we also refer to service providers as *firms* for exposition purposes.) The players' decisions provide insights for service providers into the viability of offering the SSNP option to customers in competitive settings.

In the environment where service providers contemplate offering the SSNP option to customers, the sequence of events in the strategic decision-making by the players is as follows: (i) Stage 1: the service providers (firms) announce whether they offer the SSNP options to customers in the market, (ii) Stage 2: service professionals determine their choice of the firm(s) to associate with in their careers, (iii) Stage 3: the firms announce retail prices for their services simultaneously and independently, (iv) Stage 4: each customer adopts a service from one of the firms, the market clears, and the firms realize demands. (See Figure 1 for brevity.)

For ease of exposition, we present our models in this section in the reverse sequence. The Customer Problem (Stage 4) in the following Section 3.1 describes the market shares of the service

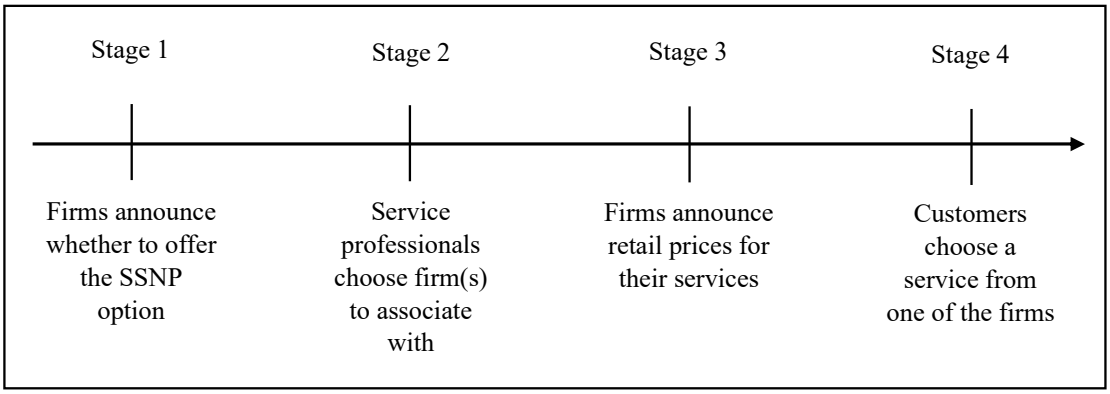


Figure 1 Sequence of Players' Strategic Decision-Making

providers, given their retail prices on the demand side (Stage 3) which are obtained by solving the problem presented in Section 3.2. On the supply side, Section 3.3 describes the Service Professional's Problem (Stage 2) governing one of the critical cost components for the service providers that subsequently influences their retail prices and market shares. Finally, the firms' choice for the SSNP option is governed by their profitability (Stage 1).

3.1. Stage 4: Customer Problem

Consider a duopoly competition setting in which two service providers – designated as *hybrid* (H) and *traditional* (T) – offer a type of service to customers in the market. The traditional firm adopts *only* the *regular* (R) mode of operation. The hybrid firm chooses between the regular and the *philanthropic* (P) mode of operation. Under the philanthropic mode, the hybrid firm extends the SSNP option in addition to the paid service alternative to the customers. In the regular mode, the firms *only* offer their paid service alternative to the customers.

The firms in our motivating examples compete for customers in the market by announcing the prices of their respective service offerings. In a duopoly Bertrand competition, if the firms are symmetric and the customers perceive the competing services to be identical, then the firms' prices will be driven down to marginal costs, and both firms will earn zero profit. To avoid this trivial situation and to align with the existing literature (see, e.g., Atasu et al. (2008)), we assume that the firms are asymmetric in two ways.

First, we assume that the firms' marginal costs are unequal. Let c_H be the constant marginal cost at the hybrid firm, and c_T be the traditional firm's constant marginal cost.

Second, the asymmetry between the firms is also represented in our model through the utilities derived by the customers at these facilities. The customers in the market are heterogeneous such that a θ-customer will receive a gross utility of θ by adopting the service offered by the hybrid firm.

Let θ be uniformly distributed between zero and one. The gross utility a θ-customer derives at the traditional firm is $\phi\theta$. Here, ϕ, the parameter of the customer's *affinity*, is greater than one. This affinity-based utility magnification for the traditional firm's service could be due to better branding, facilities, accessibility, and other features offered by the traditional service provider. For instance, in India wherein almost two-third of the population goes to private hospitals and doctors' clinics for treatment, merely 4.1% of the population adopts informal, charitable, non-governmental or trust-based service providers for diverse reasons based on geography, demography, gender, culture, affordability, etc. (Anand and Thampi 2020). While we consider $\phi > 1$ in our model to avoid trivial situations, our results are also applicable when $\phi = 1$ (see Section 4.1.1).

A customer's net utility that determines *her* choice of the service provider is equal to the difference between the gross utility and the price of the service. We denote the prices of the paid services offered by the hybrid and traditional firms by p_H and p_T, respectively. A θ-customer's net utility from the paid service of the hybrid firm is $\theta - p_H$, and that from the traditional firm is $\phi\theta - p_T$. Without loss of generality, we normalize the demand rate to one unit in a period of *unit* length. (In the following sections, we explicitly define the length of the planning horizon.)

3.1.1. Model RR: Neither Firm Offers the Self-Selecting No-Pay Option

In this section, we consider a setting in which neither service provider offers the SSNP option to the customers. The hybrid and traditional firms, H and T, participate in a pricing game to maximize their profits by adopting the regular mode of operation. This scenario presents a benchmark to analyze the impact of the hybrid service provider H offering the SSNP option to the customers (Model PR, presented in Section 3.1.2).

Demand Functions

A θ-customer adopts the paid service of the traditional firm if and only if $\phi\theta - p_T > \theta - p_H$ and $\phi\theta - p_T > 0$. Similarly, a θ-customer adopts the paid service of the hybrid firm if and only if $\theta - p_H > \phi\theta - p_T$ and $\theta - p_H > 0$. Consider $\check{\theta}_h$ and $\check{\theta}_l$ as follows: $\check{\theta}_h = (p_T - p_H)/(\phi - 1)$ and $\check{\theta}_l = p_H$. (In this benchmark scenario, we denote a variable x by $\check{x}$.)

Given $p_H, p_T \geq 0$, if $\check{\theta}_l < \check{\theta}_h$, then it can be easily shown that the conditions $\phi\theta - p_T > \theta - p_H$ and $\phi\theta - p_T > 0$ are satisfied for any $\theta > \check{\theta}_h$ — the set of customers that adopt the paid service of the traditional firm. The customer with utility $\theta = \check{\theta}_h$ is indifferent between adopting the paid service of the traditional firm and that of the hybrid firm. Similarly, the conditions $\theta - p_H > \phi\theta - p_T$ and $\theta - p_H > 0$ are satisfied for any $\theta \in (\check{\theta}_l, \check{\theta}_h)$ — the set of customers that adopt the paid service of the hybrid firm. The customer with utility $\theta = \check{\theta}_l$ is indifferent between adopting the paid service of the hybrid firm and not adopting the services of either of the service providers.

If $\check{\theta}_l \geq \check{\theta}_h$, no customer adopts the hybrid firm's paid service. Similarly, if $\check{\theta}_h \geq 1$, no customer adopts the traditional firm's paid service. To make our model relevant to real-world settings, we focus on the situations $\check{\theta}_l \leq \check{\theta}_h \leq 1$. The demand for the paid services of the competing service providers in the benchmark setting (Model RR) is given as follows:

$$\check{q}_H = \check{\theta}_h - \check{\theta}_l = \frac{p_T - p_H}{\phi - 1} - p_H, \qquad \check{q}_T = 1 - \check{\theta}_h = 1 - \left(\frac{p_T - p_H}{\phi - 1}\right) \tag{1}$$

3.1.2. Model PR: The Hybrid Firm Offers the SSNP Option

In this section, we describe a setting in which the hybrid firm offers the SSNP option to the customers, and thereby, it operates under a "Philanthropic" philosophy. The traditional firm has remained unchanged, and it operates under a "Regular" philosophy. This *hybrid* competition setting between the two service providers splits the customers into two sets: M^P, referred to as the philanthropic customer segment (a fraction, λ, of the unit market that considers the hybrid and traditional firms' service offerings), and M^T, referred to as the traditional customer segment (the remaining $(1-\lambda)$ fraction of the unit market that only considers the traditional firm). We assume that the customers in the philanthropic segment are uniformly distributed on a utility continuum that characterizes their valuation of the competing firms' services. Similarly, the traditional customers are considered to be uniformly distributed on a utility (or valuation) continuum. (Under Model PR, superscripts P and R suggest customer segments.)

A θ^P-customer from the philanthropic segment M^P has three alternatives to choose from. It derives utilities from the services offered by the hybrid and traditional firms as follows: (i) $\omega\theta^P$: if it adopts the hybrid firm and selects the SSNP option, (ii) $\eta\theta^P$: if it adopts the hybrid firm and selects the paid service, and (iii) $\beta\phi\theta^P$: if it adopts the traditional firm and selects the paid service.

The parameter $\omega < 1$ captures the utility reduction realized by a customer because by choosing the SSNP option, she may face certain inconveniences, such as longer waiting time, and a smaller basket of available choices not-so-cozy environment, etc. Also, $\omega > 0$ ensures that no philanthropic customer goes without being served by either of the service providers. The parameter $\eta > 1$ captures the philanthropic amplification of utility because the customer feels good about supporting the hybrid firm that is making a difference in society. We also assume that $\beta > 0$, the parameter referred to as the customers' *narcissistic* multiplier in the hybrid competition setting. When $\beta > 1$, it reflects the *narcissistic* amplification of utility for the customer. On the other hand, $\beta < 1$ reflects the possibility of the customer's *pessimistic* discounting of the traditional firm's paid service in the presence of the hybrid firm. When $\beta = 1$, the customer is said to be *neutral* with respect to the hybrid service provider's philanthropic activities. Our modeling approach to characterize

modifications in the customer valuation of the (competing) service providers' offerings is similar to that of Palsule-Desai et al. (2021).

On the other hand, a θ^T-customer in the traditional market segment M^T has only two alternatives to choose from: visit the traditional firm and receive utility $\phi\theta^T$, or do nothing and receive zero utility. The traditional customers' utility from the paid service of the traditional firm remains unchanged irrespective of whether the competing hybrid service provider H adopts the regular service delivery mode (Model RR) or the philanthropic service delivery mode (Model PR).

Henceforth, we make the following assumptions to ensure the relevance of Model RR and Model PR to practice:

ASSUMPTION 1. $\phi < \eta/\beta$

ASSUMPTION 2. $\phi > \max\{1, \omega/\beta\}$

If Assumption 1 were not satisfied (i.e., $\phi \geq \eta/\beta$), it would mean that the customer utility due to narcissistic behavior in the hybrid competition setting is larger than the philanthropic amplification. In an internal study at one of the service providers in our motivating examples (that we were privy of during our study presented here), it was estimated that the customers' willingness to pay for the paid service is higher by 38 percent in a region where the SSNP option is offered than that in the region where only the paid service is offered. Additionally, this assumption allows us to characterize the settings in our motivating examples, wherein the customers at the higher end of the valuation continuum adopt the hybrid firm's paid service. This is contrary to Model PR, wherein the customers at the higher end of the valuation continuum adopt the traditional firm's paid service. By demonstrating the hybrid firm's economic viability to offer the SSNP option to the poor, we highlight a strategic advantage for the firm to serve the rich in competitive environments.

Assumption 2 captures the fact that the utility of the paid service by the traditional firm is *always* more than the utility derived from the SSNP option offered by the hybrid firm. The assumption reflects the entailing inconveniences from the hybrid firm's free services mentioned earlier.

Demand Functions: Philanthropic Customer Segment

Consider the philanthropic customer segment M^P. A θ^P-customer adopts the paid service of the hybrid firm if and only if $\eta\theta^P - p_H > \omega\theta^P$ and $\eta\theta^P - p_H > \beta\phi\theta^P - p_T$. By the assumption $\omega > 0$, the first condition also ensures that $\eta\theta^P - p_H > 0$. Similarly, a θ^P-customer adopts the paid service of the traditional firm if and only if $\beta\phi\theta^P - p_T > \eta\theta^P - p_H$ and $\beta\phi\theta^P - p_T > \omega\theta^P$. The latter condition implies that $\beta\phi\theta^P - p_T > 0$. Consider θ_h^P and θ_l^P as follows: $\theta_h^P = (p_H - p_T)/(\eta - \beta\phi)$ and $\theta_l^P = p_T/(\beta\phi - \omega)$.

Given $p_H, p_T \geq 0$, if $\theta_l^P < \theta_h^P$, then it can be easily shown that the conditions $\eta\theta^P - p_H > \omega\theta^P$ and $\eta\theta^P - p_H > \beta\phi\theta^P - p_T$ are satisfied for any $\theta^P > \theta_h^P$ – the set of philanthropic customers that adopt the paid service of the hybrid firm. Similarly, the conditions $\beta\phi\theta^P - p_T > \eta\theta^P - p_H$ and $\beta\phi\theta^P - p_T > \omega\theta^P$ are satisfied for any $\theta^P \in (\theta_l^P, \theta_h^P)$ – the set of customers that adopt the paid service of the traditional firm.

A θ^P-customer adopts the SSNP option of the hybrid firm if and only if $\omega\theta^P > \beta\phi\theta^P - p_T$ and $\omega\theta^P > \eta\theta^P - p_H$. If $\theta_l^P < \theta_h^P$, the conditions are satisfied for any $0 \leq \theta^P < \theta_l^P$. Here, $\omega\theta^P > 0$ follows from $\omega > 0$ for $\theta^P > 0$.

The customer with utility $\theta^P = \theta_l^P$ is indifferent between adopting the SSNP option of the hybrid firm and the paid service of the traditional firm. Similarly, the customer with utility $\theta^P = \theta_h^P$ is indifferent between adopting the paid service of the traditional firm and that of the hybrid firm.

If $\theta_l^P \geq \theta_h^P$, no customer adopts the traditional firm's paid service. In this case, the two customer segments are segregated between the competing firms. Similarly, if $\theta_h^P \geq 1$, no customer adopts the hybrid firm's paid service. To make our model relevant to real-world settings, we focus on the situations $0 \leq \theta_l^P \leq \theta_h^P \leq 1$.

Let q_H^P and q_T^P denote the number of customers in the philanthropic segment M^P that adopt the paid service of the hybrid and traditional service providers, respectively. Similarly, let q_F^P be the number of customers in the philanthropic segment M^P that adopt the SSNP option of the hybrid firm. We obtain

$$\begin{aligned} &q_H^P = \lambda\left(1-\theta_h^P\right) = \lambda\left(1-\frac{p_H-p_T}{\eta-\beta\phi}\right), \qquad q_T^P = \lambda\left(\theta_h^P-\theta_l^P\right) = \lambda\left(\frac{p_H-p_T}{\eta-\beta\phi}-\frac{p_T}{\beta\phi-\omega}\right), \\ &q_F^P = \lambda\left(\theta_l^P\right) = \lambda\left(\frac{p_T}{\beta\phi-\omega}\right) \end{aligned} \tag{2}$$

Demand Functions: Traditional Customer Segment

Consider the traditional customer segment, M^T. A θ^T-customer adopts the paid service of the traditional firm if and only if $\phi\theta^T - p_T > 0$. This is satisfied *only* when $\theta^T > \theta_h^T$, where $\theta_h^T = p_T/\phi$. The $\theta^T = \theta_h^T$ customer is indifferent between adopting the paid service of the traditional firm and not adopting *any* service at all.

The demand for the traditional firm's paid service in the traditional customer segment M^T, denoted by q_T^T, is described as follows:

$$q_T^T = (1-\lambda)\left(1-\theta_h^T\right) = (1-\lambda)\left(1-\frac{p_T}{\phi}\right) \tag{3}$$

Considering the customer demands in the philanthropic and traditional segments described above, the aggregate demands for the competing service providers are given as follows:

$$q_H = q_H^P, \qquad q_T = q_T^P + q_T^T, \qquad q_F = q_F^P \tag{4}$$

Recall that the demand functions described above are valid if and only if $0 \leq \theta_l^P \leq \theta_h^P \leq 1$. From (2), the condition also implies that $q_T^P \geq 0$.

3.2. Stage 3: Service Providers' Problems

3.2.1. Model RR: Neither Firm Offers the Self-Selecting No-Pay Option

The expected profit function for service provider $j \in \{H, T\}$ in the benchmark setting is described as follows:

$$\check{\pi}_j\left(p_j; p_{-j}\right) = \left(p_j - c_j\right)\check{q}_j, \qquad j \in \{H, T\} \tag{5}$$

where, $\check{q}_j$ is as described in (1). The traditional firm's problem is described as $\max_{p_T \geq 0} \check{\pi}_T\left(p_T; p_H\right)$ subject to $\check{\theta}_l \leq \check{\theta}_h \leq 1$. Similarly, the hybrid firm's problem is described as $\max_{p_H \geq 0} \check{\pi}_H\left(p_H; p_T\right)$ subject to $0 \leq \check{\theta}_l \leq \check{\theta}_h$. It may be noted that the service providers' problems as described here reflect that each firm determines the price for its service ensuring that its market share is between zero and one.

3.2.2. Model PR: The Hybrid Firm Offers the SSNP Option

The hybrid and traditional firms' expected profit functions are described as follows:

$$\pi_H\left(p_H; p_T\right) = \left(p_H - c_H\right) q_H - c_H \cdot q_F \tag{6}$$

$$\pi_T\left(p_T; p_H\right) = \left(p_T - c_T\right) q_T \tag{7}$$

where, q_H, q_F, q_T are as described in (4). The hybrid firm's problem is described as $\max_{p_H \geq 0} \pi_H\left(p_H; p_T\right)$ subject to $\theta_l^P \leq \theta_h^P \leq 1$. The traditional firm's problem is described as $\max_{p_T \geq 0} \pi_T\left(p_T; p_H\right)$ subject to $0 \leq \theta_l^P \leq \theta_h^P$.

In the online supplement, we describe and analyze our Model PR in detail for the scenario in which the market share of the traditional firm in the philanthropic customer segment M^P is zero.

3.3. Stage 2: Service Professional's Problem

The market that observes a hybrid competition between the hybrid and traditional firms also accommodates service *professionals* that are of three types: (i) a traditional professional allocating *her* service capacity *only* to the traditional firm in her career, (ii) a philanthropic professional allocating her service capacity *only* to the hybrid firm in her career, and (iii) a *hybrid* professional splitting her career between the hybrid and traditional firms.

In this section, we develop and analyze a (service professional's) model for the three types of professionals considering their associations with the hybrid and traditional firms in their careers. Using the service professional's model, we determine the service providers' cost components related to service professionals' income that subsequently govern the retail prices considered in the previous section to determine the market shares.

3.3.1. Service Professional's Career Choice and the Income Level

In what follows, we model the hybrid professional's strategic decision in her career. For exposition purposes, refer to Figure 2 that describes the hybrid professional's income level in each time period in her career based on her choice of the firms to associate with. Similarly, using Figure 2, we determine the philanthropic and traditional professionals' income levels in their careers. As demonstrated in the following section, we use the service professionals' income levels based on their career choices related to the firms to associate with to capture the implications for the competing service providers' cost functions. Diverging from numerous studies in the existing literature that provides insights into optimal *efforts* for workers with career concerns (see, e.g., Gibbons and Murphy (1992)), in this paper, we examine the implications of a service professional's choice of service providers to be associated with throughout her career to maximize the career income.

For simplicity, we assume that the *career duration* for a service professional, irrespective of her type, involves $t_P > 0$ periods of unit length each. In keeping with our motivating examples, we assume that the hybrid professional that splits her service capacity in her career between the hybrid and traditional firms begins her career, at time $t = 0$, at the hybrid firm. Later in her career, she switches over to the traditional firm at time t_H (referred to as the *transition time*) and continues till the end of her career at t_P. Here, $t_H \in [0, t_P]$.

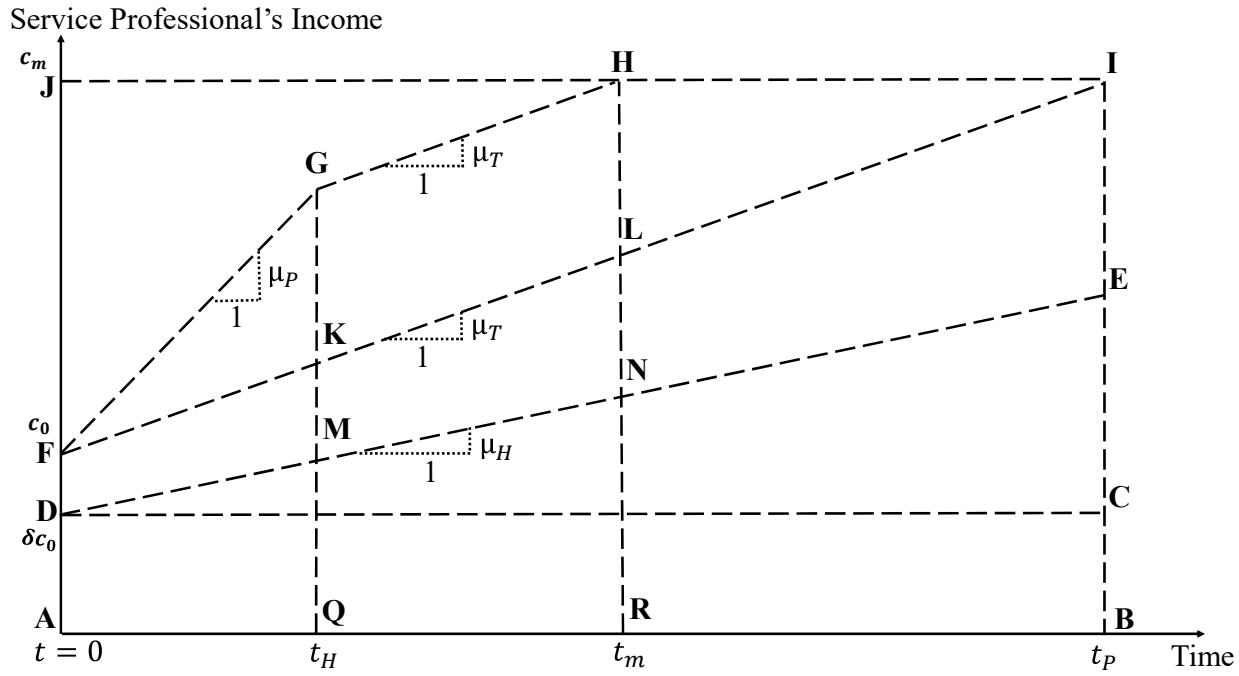


Figure 2 **Service Professional's Career Plan and Income Level**

A professional's income in a period involves the compensation she receives from the service provider after adjusting for the cost of allocating her capacity and exerting efforts at the service provider during the period. Let c_0 be a traditional professional's income at the traditional firm at time $t = 0$, and her income grows at a constant rate of μ_T (e.g., US dollars per unit time) throughout her career. In keeping with the practice in real-world settings, let δc_0, $\delta \in (0, 1]$, be the income of a professional irrespective of her type – philanthropic and hybrid – at the hybrid firm at time $t = 0$. This professional's income at the hybrid firm grows at a constant rate of μ_H. Here, the parameter δ reflects the professional's *cost discounting* at time $t = 0$ at the hybrid firm compared to the traditional firm.

When the hybrid professional begins her career at the hybrid firm at time $t = 0$ before switching over to the traditional firm, her *potential* income in the market (or market value) increases at a constant rate of μ_P. As mentioned earlier, a professional while at the hybrid firm may garner higher potential income in the market than the income received by a traditional professional at the traditional firm. This is due to her relatively higher accumulated experience and skill level at the hybrid firm than at a traditional service provider. Accordingly, we assume that $\mu_H \leq \mu_T < \mu_P$. We refer to μ_H (μ_T) as the philanthropic (traditional) professional income growth rate. The parameter μ_P is referred to as the hybrid professional's *potential income growth rate* in the market.

One may interpret the parameters μ_T and μ_P as the professionals' growth rates that are adjusted for their accumulated experience at the respective service providers. Thereby, they signify the professionals' throughput rates – the number of customers served in unit time. Since $\mu_H \leq \mu_T < \mu_P$ by assumption, μ_H can be interpreted as the lower-income growth rate offered by the hybrid firm. It signifies the *income penalty* levied on the professional by the hybrid firm to be in sync with its philosophy.

When the hybrid professional switches over to the traditional firm from the hybrid firm at the transition time t_H, she begins her tenure at a higher income level than a traditional professional who began her career with the traditional firm at $t = 0$. The incomes for both types of professionals at the traditional firm increase at the same rate μ_T for the remainder of their respective careers. Additionally, the professionals' throughput rates are also identical. In a process-driven service delivery environment, as in our motivating examples, a professional's throughput rate is primarily governed by the process standardization and technology adoption by the service provider, rather than by an individual professional's expertise. Consequently, the traditional firm benefits from the hybrid professionals that switch over from the hybrid firm to enhance cost reduction (to be discussed in Section 4.3.2).

The hybrid professional's relatively superior experience at the hybrid firm that improves her skill level in a *short* span of time and that reduces the service provider's marginal cost is attributed to several factors arising from the SSNP option of the hybrid firm. In particular, (i) a relatively larger pool of customers is available to be served, (ii) the throughput of the service delivery system is higher because of which a professional can serve a large number of customers (in unit time) based on process standardization and superior service delivery systems developed over time for the high-volume setting, and (iii) a professional typically spends longer working hours while at the hybrid firm. Over the years, the Aravind Eye Care System, for example, has developed a healthcare service delivery environment, resembling a typical lean system in an assembly line from manufacturing, to serve multiple patients simultaneously while meeting the quality standards at low cost (see Shah and Murthy (2004) for further details). Such settings result in lower professional-income costs for the hybrid firm due to the professionals' *learning* through accumulated experience and superior service processes.

We assume that $c_0 \in [0, c_m)$, where c_m is the maximum potential income in unit time a traditional professional can earn during her entire career t_P while at the traditional firm. Let t_m be the time at which the hybrid professional when she switches over to the traditional firm from the hybrid firm, earns the maximum income of c_m. Without loss of generality, we assume that a traditional professional, when she allocates her service capacity at the traditional firm for her entire career, earns the maximum income c_m at the end of the career, i.e., at time t_P. We normalize the professional's compensation to zero from any sources other than the respective (parent) service providers. (For instance, it is a common practice among professionals in the healthcare service delivery industry to serve patients at multiple outlets, such as private clinics, *other* hospitals, simultaneously. To relate with our motivating examples, we ignore such a possibility.) Thereby, the compensation a service provider offers to professionals captures one of the components of costs incurred by the service provider – referred to as the *professional-income cost*. Similarly, we normalize the professional's cost of allocating her service capacity at a service provider to zero. It implies that the compensation a professional receives from a service provider in a period is her *net* income for the period.

3.3.2. Hybrid Professional's Transition Time and Career Income

It may be noted that $t_H \in [0, t_P]$ and $t_m \in [t_H, t_P]$. From Figure 2, we also observe that $c_m = c_0 + \mu_P t_H + \mu_T (t_m - t_H) = c_0 + \mu_T t_P$ and $t_P = (c_m - c_0)/\mu_T$. The time t_m since $t = 0$ at which the hybrid professional earns the maximum income of c_m, given that she switches over to the traditional firm from the hybrid firm at the transition time t_H, is described as follows:

$$t_m(t_H) = \frac{c_m - c_0}{\mu_T} - \left(\frac{\mu_P}{\mu_T} - 1\right) t_H = t_P - \left(\frac{\mu_P}{\mu_T} - 1\right) t_H \tag{8}$$

The hybrid professional determines time t_H for which she allocates her service capacity to the hybrid firm before switching over to the traditional firm to maximize her income during the entire career. The hybrid professional's income, π_w, during her entire career is described as follows (see Figure 2):

$$\begin{aligned}
\pi_w(t_H) &= \text{Area}(ADMQ) + \text{Area}(QGHR) + \text{Area}(RHIB) \\
&= \frac{t_H(2\delta c_0 + \mu_H t_H)}{2} + \frac{(t_m - t_H)(c_m + c_0 + \mu_P t_H)}{2} + (t_P - t_m) c_m \\
&= \frac{t_H(2\delta c_0 + \mu_H t_H)}{2} + \frac{c_m^2 - (c_0 + \mu_P t_H)^2}{2\mu_T} + \left[t_P - \frac{c_m - c_0}{\mu_T} + \left(\frac{\mu_P}{\mu_T} - 1\right) t_H\right] c_m
\end{aligned} \tag{9}$$

3.4. Service Providers' Cost Composition

3.4.1. Professional-Income Cost Component

As discussed earlier, the hybrid firm enhances its competitiveness by deriving a cost advantage over the traditional firm. The cost savings that result from, among other factors, lower compensation to its professionals, higher throughput in service delivery, and relatively longer working hours contributed by professionals at the hybrid firm compared to the traditional firm offer significant impetus to the hybrid firm's profitability. In what follows, we estimate the cost advantage the hybrid firm enjoys over the traditional firm from the hybrid professional's switching strategy between the two service providers.

Let T be the number of periods, each of unit length, in the entire planning horizon for the service providers. A professional's career span that involves t_P periods is considered to be sufficiently smaller than the planning horizon under the steady-state assumption, i.e., $t_P << T$. Let N be the number of *fresh* graduate professionals that enter the job market in each period. Without loss of generality, we normalize N to one. Let ρ_P, ρ_T, and ρ_H be the fractions of the professionals that are of the philanthropic, traditional, and hybrid type, respectively, such that $\rho_P, \rho_T, \rho_H \in [0,1]$ and $\rho_P + \rho_T + \rho_H = 1$.

Distinguishing the professionals based on their types is impossible for the hybrid firm due to their lack of tacit knowledge about the professionals' types. For simplicity, we assume that all philanthropic, traditional, and hybrid professionals are homogeneous within their respective categories.

Each of the ρ_H number of hybrid professionals that start their career with the hybrid firm in any period allocates its service capacity to the hybrid firm for t_H periods, specifying the transition time. Here, t_H is as described in (24). These professionals are associated with the hybrid firm for aggregate $\rho_H t_H$ professional periods. Accordingly, across T periods in the planning horizon of the service

providers, the aggregate of professional periods the hybrid professionals allocate to the hybrid firm is $\rho_H t_H T$. The total number of professional periods the philanthropic professionals allocate to the hybrid firm is $\rho_P t_P T$. Similarly, the total number of professional periods the hybrid and traditional professionals allocate to the traditional firm is $\rho_H (t_P - t_H) T$ and $\rho_T t_P T$, respectively.

Let $\alpha_H (t_H)$ and $\alpha_T (t_H)$ be the number of hybrid professionals as a fraction of the hybrid and traditional firms' workforce, respectively, at any instance of time. It can be shown that

$$\alpha_H (t_H) = \frac{\rho_H t_H T}{\rho_H t_H T + \rho_P t_P T} = \frac{\rho_H t_H}{\rho_H t_H + \rho_P t_P} \tag{10}$$

$$\alpha_T (t_H) = \frac{\rho_H (t_P - t_H) T}{\rho_H (t_P - t_H) T + \rho_T t_P T} = \frac{\rho_H (t_P - t_H)}{\rho_H (t_P - t_H) + \rho_T t_P} \tag{11}$$

The remaining fraction $(1 - \alpha_H)$ of the professionals at the hybrid firm is of the philanthropic type. Similarly, $(1 - \alpha_T)$ is the fraction of the traditional professionals at the traditional firm. (For simplicity, wherever it is evident from the context, we denote $\alpha_H (t_H)$ and $\alpha_T (t_H)$ simply as α_H and α_T, respectively.)

The hybrid and traditional firms' (average) professional-income cost functions under the steady-state assumption (e.g., USD per unit time) are described as follows (see Figure 2):

$$\begin{aligned} c_H^w (t_H) &= \alpha_H \left[\frac{\text{Area}\,(ADMQ)}{t_H} \right] + (1 - \alpha_H) \left[\frac{\text{Area}\,(ADEB)}{t_P} \right] \\ &= \alpha_H \left[\frac{2\delta c_0 + \mu_H t_H}{2} \right] + (1 - \alpha_H) \left[\frac{2\delta c_0 + \mu_H t_P}{2} \right] = \delta c_0 + \frac{\mu_H \left[\alpha_H t_H + (1 - \alpha_H) t_P \right]}{2} \end{aligned} \tag{12}$$

$$\begin{aligned} c_T^w (t_H) &= \alpha_T \left[\frac{\text{Area}\,(QGHR)}{t_m - t_H} + \frac{\text{Area}\,(RHIB)}{t_P - t_m} \right] + (1 - \alpha_T) \left[\frac{\text{Area}\,(AFIB)}{t_P} \right] \\ &= \alpha_T \left[\frac{c_m + c_0 + \mu_P t_H}{2} + c_m \right] + (1 - \alpha_T) \left[\frac{2c_0 + \mu_T t_P}{2} \right] = c_0 + \alpha_T c_m + \frac{\mu_T t_P + \alpha_T \mu_P t_H}{2} \end{aligned} \tag{13}$$

3.4.2. Marginal Cost Functions

We assume that the hybrid and traditional firms' marginal costs c_H and c_T, as modeled in Section 3.1, consist of three components: professional-income cost (modeled in Section 3.3), professional-*training* cost, and supplies cost comprising expenditure toward equipment, consumables, and miscellaneous items used to serve customers. Segregating the professional-income cost from *other* costs is significant in such settings as the former component contributes approximately 40 percent of the firm's marginal cost, as observed in our field study. An interested reader may refer to Govindrajan and Ramamurti (2013) for a specific example of the open-heart surgery at Narayana Health (https://www.narayanahealth.org/), a world-renowned service provider offering cardiac treatments at affordable rates.

Let w_H and w_T be the professional-training costs at the hybrid and traditional firms, respectively. The professional-training costs correspond to the expenses incurred by the service providers toward

activities such as professional screening, recruitment, orientation, and training at the beginning of their careers. These costs are professional-specific, highlighting the importance of aligning the service orientations of the firms and the respective professionals. When the professional-training costs are significantly higher, the traditional firm benefits from employing the hybrid professionals that switch over from the hybrid firm, *even* though the hybrid professional begins her tenure at the traditional firm at a higher income level compared to a traditional professional. For simplicity, we assume that the professional-training costs are constant.

$$w_H = \rho_H k_H + \rho_P k_P \qquad \text{and} \qquad w_T = \rho_T k_T \tag{14}$$

Here, $k_H, k_P, k_T > 0$ are the scale parameters that signify a service provider's training cost per professional. Recall that the parameters μ_P and μ_T signify a professional's throughput rate at the hybrid and traditional firms, respectively, and thereby, the (average) constant marginal costs per customer c_H and c_T are defined as follows:

$$c_H = \frac{c_H^w(t_H) + w_H}{\mu_P} + c_s \qquad \text{and} \qquad c_T = \frac{c_T^w(t_H) + w_T}{\mu_T} + c_s \tag{15}$$

$c_H^w(t_H)$ and $c_T^w(t_H)$ are described in (12) and (13), respectively. Let c_s be the supplies cost per customer, which is assumed to be constant and identical for the two providers.

We assume that μ_P and μ_T are the designed throughput rates, and they are *always* realizable in practice, irrespective of the number of customers served in a period. This is possible when the number of customers in the market to be served is sufficiently large, which is the case in our motivating examples.

When the hybrid service provider does not offer the free service (and thereby, it acts as the traditional firm), we can derive the results in the professional's model by substituting $\mu_H = \mu_T$ and $\delta = 1$. Additionally, μ_P approaches to μ_T in the limit. From (8) and (24), we obtain $t_H^* = 0$ and $t_m = t_P$. Also, (10) and (11) provide $\alpha_H = 0$ and $\alpha_T = \rho_H/(\rho_H + \rho_T)$. From (12) and (13), we obtain $c_H^w = \delta c_0 + (c_m - c_0)/2$ and $c_T^w = [c_m + c_0 + 2\rho_H c_m/(\rho_H + \rho_T)]/2$.

In our field study, we observe that a hybrid service provider could derive additional cost savings benefits by reducing its associated fixed costs. Such benefits can be derived from managing service delivery systems, as mentioned earlier, using assembly line techniques that are feasible in a high-volume setting. The SSNP option enables creating a conducive environment for the hybrid firm (see Shah and Murthy (2004) for further details). In our work presented here, we ignore the implications of the fixed costs of service delivery since they do not impact any of the strategic decisions and interactions among the variables modeled.

3.5. Service Providers' Workforce

It may be noted that the hybrid firm's cost function, described in (15), is independent of the parameter N, the number of professionals that enter the job market in each period. Given the professional's throughput rate at the hybrid firm, μ_P, and the prices of the services of the competing firms, the expected number of professionals that the hybrid service provider requires in the hybrid competition setting can be described as $N_H = (q_H + q_F)/\mu_P$, where q_H and q_F are described in (4). Similarly, for the benchmark setting $\check{N}_H = \check{q}_H/\mu_T$. Recall that $\mu_P = \mu_T$ (in the limit) in the benchmark setting. Similarly, the expected number of professionals that the traditional firm requires can be described as $N_T = q_T/\mu_T$ and $\check{N}_T = \check{q}_T/\mu_T$.

4. Analyses of the Models

Given the sequence of events (see Figure 1), we obtain the equilibrium solutions to the games between the players – customers, service providers, and service professionals – using a backward induction-based approach. In particular, using the Stage 4 outcomes that determine the competing firms' market shares as described in the previous section, we determine the Stage 3 price equilibrium solutions for Model RR and Model PR (Section 4.1). It is followed by the analysis of the service professional's problem in Stage 2 (Section 4.2). Finally, in Section 4.3 solve the hybrid firm's Stage 1 problem to identify the conditions for the firm to adopt the philanthropic service strategy and provide insights into the implications for the competitor, customers, and the entire society.

4.1. Stage 3: Service Providers' Price Equilibrium

For brevity, we denote the hybrid and traditional firms' marginal costs by c_H and c_T, respectively.

4.1.1. Model RR: Neither Firm Offers the Self-Selecting No-Pay Option

Proposition 1 describes the equilibrium prices for the hybrid and traditional firms in the Bertrand competition when none of the firms offers the SSNP option to customers.

PROPOSITION 1. *(i) Consider* $c_H \leq (\phi - 1 + c_T)/(2\phi - 1)$ *and* $c_T \leq [2\phi(\phi - 1) + \phi c_H]/(2\phi - 1)$. *The unique Nash equilibrium* ($\check{p}_H^*$ *and* $\check{p}_T^*$) *of the pricing game between the hybrid and traditional firms in Model RR is given as follows:*

$$\check{p}_H^* = \frac{(\phi - 1 + 2\phi c_H + c_T)}{4\phi - 1}, \qquad \check{p}_T^* = \frac{\phi[2(\phi - 1) + c_H + 2c_T]}{4\phi - 1} \tag{16}$$

The corresponding demands for the (paid) services offered by the service providers are described as follows:

$$\check{q}_H^* = \frac{\phi[\phi - 1 - (2\phi - 1)c_H + c_T]}{(4\phi - 1)(\phi - 1)}, \qquad \check{q}_T^* = \frac{2\phi(\phi - 1) + \phi c_H - (2\phi - 1)c_T}{(4\phi - 1)(\phi - 1)} \tag{17}$$

(ii) When $c_H > (\phi - 1 + c_T)/(2\phi - 1)$*, the hybrid firm does not offer its paid service. In this case, the optimal price for the traditional firm is* $\check{p}_T^* = (\phi + c_T)/2$*, and the corresponding demand is* $\check{q}_T^* = (\phi - c_T)/(2\phi)$*.*

(iii) When $c_T > [2\phi(\phi - 1) + \phi c_H]/(2\phi - 1)$*, the traditional firm does not offer its paid service. In this case, the optimal price for the hybrid firm is* $\check{p}_H^* = (1 + c_H)/2$*, and the corresponding demand is* $\check{q}_H^* = (1 - c_H)/2$*.*

From (16), it is immediate that $\check{p}_H^* > 0$ and $\check{p}_T^* > 0$ for any $\phi > 1$ and any $c_H, c_T \geq 0$. Moreover, $\check{q}_H^* \geq 0$ and $\check{q}_T^* \geq 0$ (see (17)) for $c_H \leq (\phi - 1 + c_T)/(2\phi - 1)$ and $c_T \leq [2\phi(\phi - 1) + \phi c_H]/(2\phi - 1)$.

To focus on the non-trivial cases, henceforth we assume the following:

ASSUMPTION 3. $c_H \leq (\phi - 1 + c_T)/(2\phi - 1)$

ASSUMPTION 4. $c_T \leq (2\phi(\phi - 1) + \phi c_H)/(2\phi - 1)$

When $\phi = 1$ and $c_H = c_T = c$, the equilibrium prices (16) are simplified to $\check{p}_H^* = \check{p}_T^* = c$, which will lead to the classic result of $\check{q}_H^* = \check{q}_T^* = (1 - c)/2$. (In this special case, the equilibrium demand as described in (17) does not apply.)

4.1.2. Model PR: The Hybrid Firm Offers the SSNP Option

To facilitate analysis of the model, we define a useful bound for c_T – the constant marginal cost of the traditional firm – denoted by $\underline{c_T}$. (See the online supplement for technical details.) In our analysis, we observe that when the marginal cost at the traditional firm is *strictly* below threshold $\underline{c_T}$, i.e., $c_T < \underline{c_T}$, the equilibrium prices of the paid services of the hybrid and traditional firms are such that a set of customers from the philanthropic segment M^P buy the paid service of the traditional firm, i.e., $q_T^P > 0$. In this case, the philanthropic customers' consideration set consists of both service providers. On the contrary, when the marginal cost at the traditional firm is beyond the threshold, i.e., $c_T \geq \underline{c_T}$, the competition between the two service providers is virtually non-existent, and the markets for the service providers are segregated. The hybrid firm serves the entire philanthropic market segment M^P, and the traditional firm only caters to the traditional market segment M^T. Formally:

PROPOSITION 2. *If* $c_T < \underline{c_T}$*, the unique Nash equilibrium (*p_H^* *and* p_T^**) of the pricing game between the hybrid and traditional firms in Model PR is given as follows:*

$$p_H^* = \frac{(2c_H + c_T)\tilde{T} + (\eta - \beta\phi)\left[2\tilde{T} + (1 - \lambda)\phi(\beta\phi - \omega)\right]}{4\tilde{T} - \lambda\phi(\beta\phi - \omega)} \tag{18}$$

$$p_T^* = \frac{c_H\lambda\phi(\beta\phi - \omega) + 2c_T\tilde{T} + (2 - \lambda)\phi(\eta - \beta\phi)(\beta\phi - \omega)}{4\tilde{T} - \lambda\phi(\beta\phi - \omega)} \tag{19}$$

The equilibrium demands for the hybrid and traditional firms are given as follows:

$$q_H^{P*} = \frac{\lambda\left\{-c_H\left[2\tilde{T}-\lambda\phi\left(\beta\phi-\omega\right)\right]+c_T\tilde{T}+\left(\eta-\beta\phi\right)\left[2\tilde{T}+\left(1-\lambda\right)\phi\left(\beta\phi-\omega\right)\right]\right\}}{\left(\eta-\beta\phi\right)\left[4\tilde{T}-\lambda\phi\left(\beta\phi-\omega\right)\right]} \tag{20}$$

$$q_T^{P*} = \left\{\lambda\left\{c_H\left(\beta\phi-\omega\right)\left[2\tilde{T}-\lambda\phi\left(\eta-\omega\right)\right]-c_T\left(2\eta-\beta\phi-\omega\right)\tilde{T}+\left(\eta-\beta\phi\right)\left(\beta\phi-\omega\right)\times \left\{2\tilde{T}-\phi\left[\left(2-\lambda\right)\eta-\left(1-\lambda\right)\beta\phi-\omega\right]\right\}\right\}\right\}\times\left\{\left(\eta-\beta\phi\right)\left(\beta\phi-\omega\right)\left[4\tilde{T}-\lambda\phi\left(\beta\phi-\omega\right)\right]\right\}^{-1} \tag{21}$$

$$q_F^{P*} = \frac{\lambda\left\{c_H\lambda\phi\left(\beta\phi-\omega\right)+2c_T\tilde{T}+\left(2-\lambda\right)\phi\left(\eta-\beta\phi\right)\left(\beta\phi-\omega\right)\right\}}{\left(\beta\phi-\omega\right)\left[4\tilde{T}-\lambda\phi\left(\beta\phi-\omega\right)\right]} \tag{22}$$

$$q_T^{R*} = \frac{\left(1-\lambda\right)\left\{-c_H\lambda\phi\left(\beta\phi-\omega\right)-2c_T\tilde{T}+\phi\left\{3\tilde{T}+\left(\eta-\beta\phi\right)\left(\lambda\phi-\beta\phi+\omega\right)\right\}\right\}}{\phi\left[4\tilde{T}-\lambda\phi\left(\beta\phi-\omega\right)\right]} \tag{23}$$

Conditions for Philanthropic Customers Availing Traditional Firm

Our analysis thus far has shown that in Model PR, some philanthropic customers will avail of the paid services of the competing firms, and the traditional firm will be interested in identifying the conditions that facilitate it. This occurs when the traditional firm's marginal cost is relatively lower. We conjecture (and our numerical results are in alignment with) the following behavior of $\underline{c_T}$ with respect to various system parameters on the demand-side:

1. $\underline{c_T}$ increases in η, philanthropic customer utility amplification.
2. $\underline{c_T}$ increases in λ, the number of philanthropic customers.
3. $\underline{c_T}$ decreases in ω, the utility reduction parameter.
4. $\underline{c_T}$ increases in ϕ, the customers' affinity parameter, up to a certain threshold level, and then it decreases.
5. $\underline{c_T}$ increases in β, the customers' narcissistic multiplier, up to a certain threshold level, and then it decreases.

As η increases, the price charged by the hybrid firm increases, enabling the traditional firm to identify a price at which it can attract philanthropic customers while maximizing its own profit. As λ increases, there are more philanthropic customers to compete for, which encourages the traditional firm to figure out how to do so. As ω increases, the no-pay option at the hybrid firm becomes more attractive, making it harder for the traditional firm to attract the philanthropic customers. At very low and very high values of ϕ and β, the combination of the service offered and its price selected by the traditional firm is unappealing to the philanthropic customers – at very low values of ϕ and β, the service itself is not sufficiently attractive, while at very high values of ϕ and β, the selected price is too high – and thus the traditional firm is only able to attract the philanthropic customers at medium values of these parameters.

4.2. Stage 2: Service Professional's Switching Strategy Optimization

We first determine a hybrid service professional's optimal transition time for associating with the hybrid and traditional firms in her career.

PROPOSITION 3. *The optimal transition time t_H^* from the beginning of her career at which the hybrid professional switches over to the traditional firm from the hybrid firm is described as follows:*

$$t_H^* = \max\left\{0, \frac{(c_m - c_0)\,\mu_P - (c_m - \delta c_0)\,\mu_T}{\mu_P^2 - \mu_T \mu_H}\right\} \tag{24}$$

Proposition 3 shows that there *may* exist situations in which it is economical for the hybrid professional to allocate her service capacity to the hybrid firm at the beginning of her career, i.e., $t_H^* > 0$. It can be easily shown that $t_H^* < t_P$, implying that it is *never* optimal for the hybrid professional to allocate her service capacity over the entire career to the hybrid firm.

From (24), we note that the hybrid professional's optimal transition time t_H^* is non-decreasing in $(c_m - c_0)$, and it is non-increasing in $(c_m - \delta c_0)$. The gap between the maximum income the hybrid professional earns in her entire career and the income it earns at the traditional firm at the beginning of her career is wider when $(c_m - c_0)$ is larger. The hybrid professional has a stronger incentive to start her career at the hybrid firm (as reflected by a larger range of the parameter values for which $t_H^* > 0$). She also has an incentive to spend more time at the beginning of her career with the hybrid firm. On the other hand, when $(c_m - \delta c_0)$ increases, the gap between the maximum income the hybrid professional earns in her career and the income she earns at the hybrid firm at the beginning of her career increases. The incentive for the hybrid professional to begin her career with the hybrid firm decreases (as reflected by a narrower parameter range for which $t_H^* > 0$).

4.2.1. Implications of Potential Income Growth and Cost Discounting for Hybrid Professional's Switching Strategy

COROLLARY 1. *If the hybrid professional's potential income growth rate is below the threshold $\overline{\mu_P}$, i.e., $\mu_P \le \overline{\mu_P}$, she does not allocate her service capacity to the hybrid firm. She spends her entire career at the traditional firm. On the contrary, if the potential income growth rate is beyond the threshold, i.e., $\mu_P > \overline{\mu_P}$, the hybrid professional spends her career by splitting her service capacity between the hybrid and traditional firms. Here, $\overline{\mu_P} = (c_m - \delta c_0)\,\mu_T/(c_m - c_0)$ and $\overline{\mu_P} \ge \mu_T$.*

Corollary 1 shows that the potential income growth in the market which provides incentives to the hybrid professional to allocate her service capacity to the hybrid firm at lower income levels before associating with the traditional firm in her career should necessarily be sufficiently large.

The inverse relationship between $\overline{\mu_P}$ and δ shows that the hybrid professional has more incentives (as reflected in a wider parameter range for $\overline{\mu_P}$) to allocate her service capacity to the hybrid firm at the beginning of her career when she begins her career at the hybrid firm at a higher income level. The result equivalently suggests that the hybrid professional begins her career with the hybrid firm provided the firm's choice of the parameter δ is such that the professional's starting income is sufficiently large, i.e., $\delta > \overline{\delta} = c_m/c_0 - (c_m - c_0)\,\mu_P/(c_0\mu_T)$. The existent of the range for the parameter δ is assured from $\overline{\delta} < 1$ for $\mu_P > \mu_T$.

Our results highlight the importance of the hybrid professional splitting her service capacity between the hybrid and traditional firms to maximize her income during her entire career. By adopting the strategy of earning a lower income at the hybrid firm in the early part of her career, the hybrid professional increases her valuation in the market substantially before switching to the traditional firm. It fetches her higher income, and thereby, increasing her overall income during the entire career.

To avoid trivial situations in the analyses of our model in the remainder of the paper, using Corollary 1, we make the following assumption:

ASSUMPTION 5. $\mu_P > \overline{\mu_P}$.

By Assumption 5, we identify the hybrid professionals' optimal transition time as follows: $t_H^* = [(c_m - c_0)\,\mu_P - (c_m - \delta c_0)\,\mu_T]\,/\,(\mu_P^2 - \mu_T\mu_H) > 0$.

COROLLARY 2. *The hybrid professional's optimal transition time t_H^* increases in δ. On the other hand, t_H^* increases (respectively, decreases) in the professional's potential income growth rate μ_P when $\delta < \grave{\delta}$ (respectively, $\delta > \grave{\delta}$), where $\grave{\delta} = [c_m - (\mu_P^2 + \mu_T\mu_H)\,(c_m - c_0)\,/(2\mu_P\mu_T)]\,/c_0$.*

When the hybrid professional begins her career with the hybrid firm at a relatively lower income level due to a smaller δ, associating with this firm for a longer duration in her career, i.e., higher t_H^*, is optimal for the professional when her potential income growth rate in the market (μ_P) increases. By doing so, she begins her tenure with the traditional firm after switching at a much higher income level, equal to $(\delta c_0 + \mu_P t_H^*)$. On the other hand, when the hybrid professional's starting income at the hybrid firm is higher due to a relatively higher δ, she need not be associated with this firm for a longer duration when μ_P also increases. In this case, the gap between her maximum career income (c_m) and her income at the traditional firm after switching is much smaller. Thereby, associating with the hybrid firm for a smaller duration could be the optimal strategy for the hybrid professional.

While splitting her career time between the hybrid and traditional firms may be optimal for a hybrid service professional, its impact on the hybrid firm is not clear yet. In the following, we examine the implications for the competing firms.

4.2.2. Implications for Service Providers' Workforce

COROLLARY 3. *$\alpha_H(t_H^*)$ and $\alpha_T(t_H^*)$ increase in ρ_H. $\alpha_H(t_H^*)$ increases, and $\alpha_T(t_H^*)$ decreases, in δ.*

The fraction of hybrid professionals (at any given time) in the hybrid firm's workforce increases with the fraction of the recent graduates of the hybrid type. Consequently, due to the switching strategy adopted by the hybrid professionals, their relative contribution to the traditional firm's service delivery during the entire planning horizon also increases.

The hybrid firm offering higher income to a professional at the beginning of her career — by announcing higher δ — increases the proportion of hybrid professionals associated with the firm. A higher δ also results in the hybrid professional associating with the hybrid firm for a longer duration (t_H^*) in her career. Consequently, the relative contribution of the hybrid professionals at the traditional firm decreases when δ increases.

PROPOSITION 4. *$\alpha_H(t_H^*) \geq \alpha_T(t_H^*)$ if and only if $t_H^*/t_P > \rho_P/(\rho_P+\rho_T) = \rho_P/(1-\rho_H)$.*

Proposition 4 shows that the relative contribution of the hybrid professionals at the hybrid firm is higher than that at the traditional firm during the entire planning horizon of T periods, provided the fraction of the philanthropic professionals vis-à-vis the traditional professionals among the fresh graduating professionals is not too large. Otherwise, the hybrid professional's transition time (t_H^*) is not long enough to suggest relatively more contribution of the hybrid professional at the hybrid firm than at the traditional firm.

4.2.3. Implications for Service Providers' Marginal Costs

COROLLARY 4. *$c_H^w(t_H^*)$ decreases in ρ_H, and $c_T^w(t_H^*)$ increases in ρ_H.*

The hybrid firm's professional-income cost function $c_H^w(t_H^*)$ decreasing in ρ_H shows that its cost advantage is higher in a market dominated by the hybrid professionals as its average costs are lower. The hybrid professional's switching strategy, and consequently, the higher turnaround of professionals, offers the hybrid firm increased cost benefits. This is because every *new* professional's income is lower than that of an *experienced* professional. On the other hand, the traditional firm's professional-income cost function $c_T^w(t_H^*)$ increases in ρ_H as a larger fraction of its workforce is in the form of hybrid professionals that demand higher income compared to the traditional professionals.

PROPOSITION 5. *The hybrid firm's professional-income cost function is lower than the traditional firm's professional-income cost function, i.e., $c_H^w(t_H^*) < c_T^w(t_H^*)$.*

While the relative contribution of the hybrid professionals in the hybrid firm's service delivery is higher than that for the traditional firm *only* under certain situations (Proposition 4), the former firm *always* benefits from lower professional-income cost function than that for the latter firm (Proposition 5).

One may attribute the cost advantage to the hybrid firm to the relatively lower income drawn by *all* professionals associated with the firm. However, as demonstrated in the following section, the hybrid firm's relative cost advantage partially results from the hybrid professional's switching strategy as well.

4.2.4. Service Professionals' Switching Strategy and Hybrid Firm's Cost Advantage

In this section, we consider the case that a service professional's income at the beginning of her career and her income growth throughout her career at both types of service providers are equal. In this case, the hybrid firm's choice of the parameters μ_H and δ that govern a service professional's income is identical to the traditional firm's choice.

COROLLARY 5. *Consider a hybrid competition setting between the hybrid and traditional firms such that* $\mu_H = \mu_T$ *and* $\delta = 1$. *We obtain* $t_H^* = (c_m - c_0)/(\mu_P + \mu_T)$ *and* $t_m(t_H^*) = 2(c_m - c_0)/(\mu_P + \mu_T)$. *Thereby,* $\alpha_H(t_H^*) = \rho_H(c_m - c_0)/[\rho_H(c_m - c_0) + \rho_P(\mu_P + \mu_T)t_P]$ *and* $\alpha_T(t_H^*) = \rho_H\mu_P t_P/[\rho_H\mu_P t_P + \rho_T(\mu_P + \mu_T)t_P]$.

Corollary 5 shows that the hybrid professional *always* allocates a positive fraction of time in her career to the hybrid firm, i.e., $t_H^* > 0$, as $\mu_P > \mu_T = \mu_H$ and $\delta = 1$. Recall that when the hybrid firm offers $\mu_H < \mu_T$ (income penalty) and $\delta < 1$ (professional-income cost discounting), the hybrid professional's income in any period is lower at the hybrid firm than at the traditional firm. However, when the hybrid firm offers $\mu_H = \mu_T$ and $\delta = 1$, the hybrid professional benefits by receiving the same income as that at the traditional firm in each period. Additionally, in this case, the hybrid professional increases her overall income throughout her career as she allocates a *positive* fraction of her career time to the hybrid firm, increases her potential income in the market, switches over to the traditional firm, and thereon draws a higher income at the beginning of her tenure at the latter firm.

When the hybrid firm offers $\mu_H = \mu_T$ and $\delta = 1$ to its service professionals, the relative contribution of the hybrid professionals in terms of the total professional-periods in the hybrid (respectively, traditional) service provider's service delivery during the entire planning horizon of T periods decreases (respectively, increases) with the professional's potential income growth rate μ_P. This impact of μ_P on $\alpha_H(t_H^*)$ and $\alpha_T(t_H^*)$ is attributed to the lower fraction of her career time that the

hybrid professional allocates to the hybrid firm when the potential income grows faster, suggesting increased turnaround of professionals.

Recall that Proposition 5 shows that the hybrid firm's professional-income cost function is *always* lower than that for the traditional firm. The results presented in Corollary 5 demonstrate that the hybrid firm's cost advantage over the traditional firm is not derived *only* from the professionals' willingness to accept lower income from the hybrid firm. Instead, the hybrid firm may also enhance its profitability from the lower cost function that is determined by higher throughput and turnaround of professionals in its service delivery ecosystem.

4.3. Stage 1: Hybrid Firm's Service Delivery Strategy

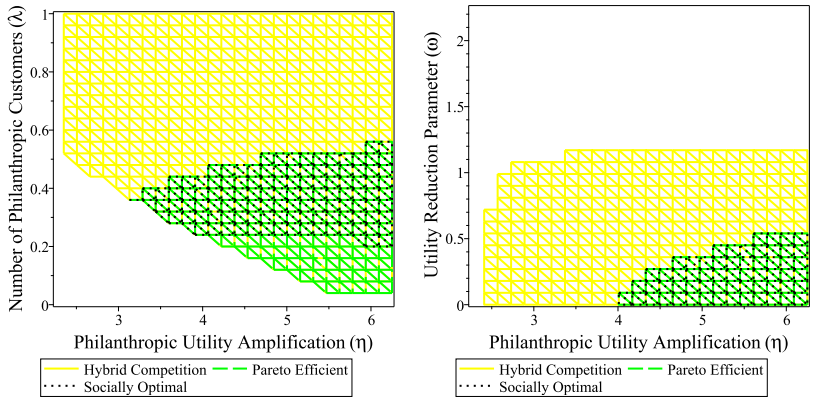
In this section, we compare the hybrid firm's profits in Model RR and Model PR according to the Stage-2, 3, and 4 outcomes described in the Sections 4.1 and 4.2 and identify the conditions for the firm to offer the SSNP option to customers, resulting in a hybrid competition environment. For brevity, we describe our results in Figures 3 –5. We also demonstrate the conditions based on various combinations of system parameters that improve the consumer surplus and social welfare under the hybrid competition setting.

To begin with, Section 4.3.1 focuses on providing insights into the equilibrium outcomes when the firms compete in the market by considering that the hybrid and traditional firms' marginal costs are equal, i.e., $c_H = c_T$. Here, the objective is to highlight the importance of the SSNP option in enhancing the industry performance in a competitive setting, devoid of the hybrid firm's supply-side cost advantage based on a lower income for its professional workforce. Subsequently, in Section 4.3.2, we examine the hybrid firm's optimal strategy and its market implications in the presence of strategic professionals. Here, the objective is to reinforce the findings from Section 4.3.1 to provide insights into the hybrid firm's trade-offs on the two ends of service delivery: supply and demand.

4.3.1. Pareto-Improvement of Service Providers' Profits, Consumer Surplus, and Social Welfare: Demand-Side Characteristics

Each illustration in Figure 3 is divided into four colored (empty, yellow, green, and black) regions, illustrating the implications of the service providers' optimal strategies. The empty region implies that both service providers will adopt the regular mode of operation, resulting in the outcomes described by Model RR. The yellow region suggests that the hybrid firm will choose the philanthropic service strategy (Model PR) and recognize a larger profit, but the traditional firm's profit is reduced (referred to as Hybrid Competition in Figure 3). The green region implies that the hybrid firm will operate under the philanthropic service strategy, and both service providers will realize

higher (vis-à-vis Model RR) profits as a result. The existence of the region of Pareto-improving service provider profits (referred to as Pareto Efficient in Figure 3) is fascinating. It is worth detailing how various system parameters affect the size and location of this Pareto-improving region. The black region implies that the consumer surplus is also enhanced when the firms obtain Pareto-improvement in their profits. The black region identifies the conditions for social welfare in Model PR to be more than that in Model RR (referred to as the Socially Optimal outcome in Figure 3).



(a) λ versus η (b) ω versus η

(c) ϕ versus η (d) β versus η

Parameter values: $c_H = 0.1, c_T = 0.1$. Additionally, in Figure 3*a*, $\beta = 1.5, \phi = 1.5, \omega = 0.25$. In Figure 3*b*, $\beta = 1.5, \phi = 1.5, \lambda = 0.5$. In Figure 3*c*, $\beta = 1.5, \omega = 0.25, \lambda = 0.5$. In Figure 3*d*, $\phi = 1.5, \omega = 0.25, \lambda = 0.5$.

Figure 3 Implications for Service Providers' Profitability, Consumer Surplus, and Social Welfare

η, Philanthropic Customer Utility Amplification : Larger values of η are more conducive to Pareto-improvement of service providers' profits because the hybrid firm can charge higher prices and the traditional firm can attract (as argued in Section 4.1.2) some of the philanthropic customers.

λ, *Number of Philanthropic Customers* : When the number of philanthropic customers is too low, the hybrid firm does not have enough incentives to adopt the philanthropic service strategy, and when the number of philanthropic customers is too large, the traditional firm loses profit when the system transitions from Model RR to Model PR. Thus, the region of Pareto-improving service providers' profits exists at medium values of the number of philanthropic customers.

ω, *Utility Reduction Parameter* : The region of Pareto-improving service providers' profits exists at low values of restriction-induced no-pay utility reduction parameter as it means that fewer customers opt for the no-pay option at the hybrid firm and the traditional firm can attract more philanthropic customers.

ϕ *and* β, *Customers' Affinity Parameter and Narcissistic Multiplier* : As argued in Section 4.1.2, at medium values of these parameters, the traditional firm can attract more of the philanthropic customers, and thus, it is at those levels that the region of Pareto-improving service providers' profits exists.

Role of System Symmetry in Enabling Pareto-Improvement

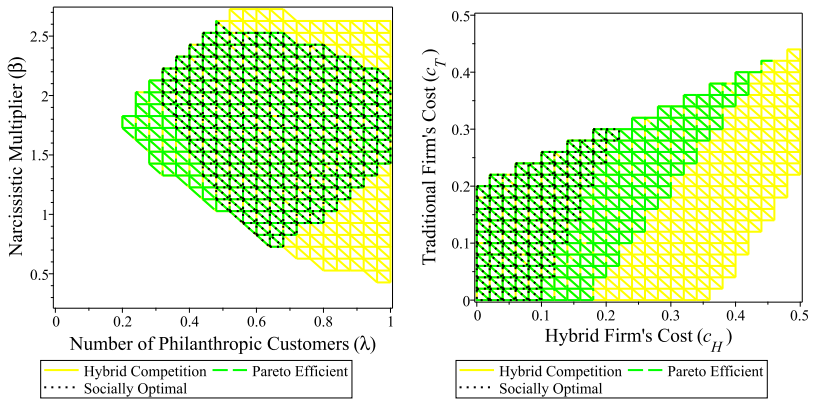
Figure 4*a* illustrates the regions of Pareto-improving service providers' profits, superior consumer surplus, and social welfare under Model PR vis-à-vis Model RR. The region is most prominent when the number of philanthropic customers is similar to the number of traditional customers. This is because the hybrid firm needs a large number of philanthropic customers to consider offering the SSNP option, and yet this number should not be too large, which could hurt the traditional firm's profit.

Similarly, Figure 4*b* illustrates the regions of Pareto-improving service providers' profits, superior consumer surplus, and socially optimal outcomes for various values of the service providers' marginal costs. The region is most prominent when their marginal costs are close to each other. When the marginal costs are dissimilar, it is very difficult for the traditional firm to attract the philanthropic customers in Model PR, and thus, impeding Pareto-improvement in the service providers' profits.

To achieve Pareto-improvement in the service providers' profits, the system should exhibit symmetry. The two service providers must be somewhat similar in terms of their marginal costs, and the two market segments must be fairly similar in terms of the number of customers.

Figure 4*b* also demonstrates that the Pareto-improvement in the service providers' profits is attained under low-cost settings. What is particularly interesting to note is that the hybrid firm may ensure the Pareto-improvement in the competing firms' profits by lowering its cost function, given the traditional firm's cost function. In Section 4.3.2, we provide insights into the hybrid firm's

alternative of influencing service professionals' income to reduce its own cost function and improve its profitability while adopting the philanthropic service strategy.



(a) β versus λ (b) c_T versus c_H

Parameter values: $\eta = 3, \phi = 1.1, \omega = 0.25$. Additionally, in Figure 4*a*, $c_H = 0.1, c_T = 0.1$. In Figure 4*b*, $\beta = 1.5, \lambda = 0.5$.

Figure 4 Implications for Service Providers' Profitability, Consumer Surplus, and Social Welfare

Changes in Consumer Surplus and Social Welfare

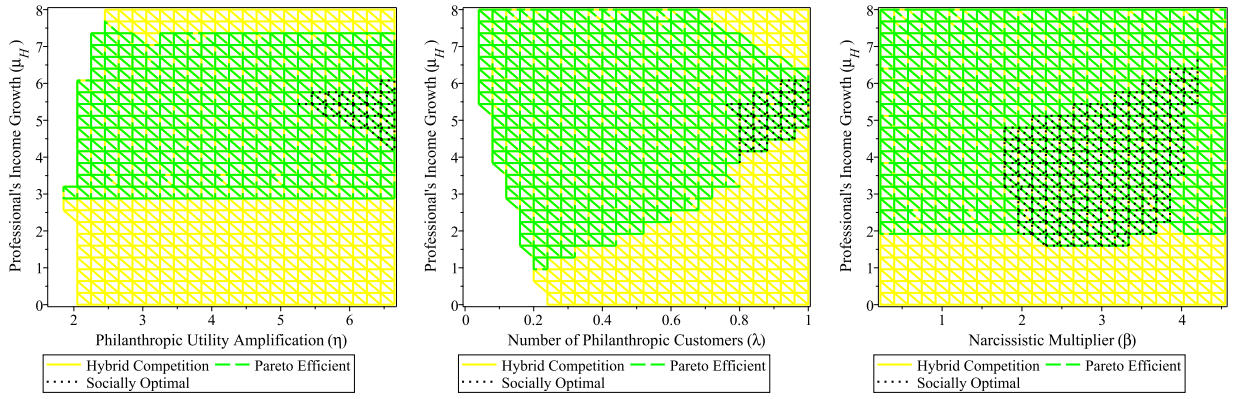
From Figure 4, it may be noted that When the number of philanthropic customers is large, the total utility surplus enjoyed by the consumers, and hence, social welfare, increases as the system transitions from Model RR to Model PR. However, when the number of philanthropic customers is small, the transition from Model RR to Model PR results in prices so high that some traditional customers will opt not to receive service, which leads to a reduction in the total consumer surplus. Due to space constraints, we do not present the details here. Interested readers may obtain them by contacting the authors.

4.3.2. Characterizing Supply and Demand Dynamics

In what follows, we examine the dynamics between the service professionals' income and critical customer characteristics that govern the viability of the philanthropic service strategy for the hybrid firm and the implications for the competitor, customers, and society. In particular, we provide insights into the hybrid firm's strategy to alter the associated professionals' income levels (using μ_H) on the supply side in response to the demand side characteristics, namely, (i) philanthropic customer utility amplification (captured using η), (ii) the market composition of the philanthropic and the traditional customers on the demand side (captured using λ), and (ii) the customers' narcissistic behaviour in the hybrid competition setting (captured using β). For brevity,

we demonstrate our results in Figure 5. Similarly, in Figure 6, we provide insights with respect to the hybrid professional's potential income growth (μ_P).

Without loss of generality, we assume that the customer demand model presented in Section 3.1 corresponds to a single period of unit length in the service providers' planning horizon of T periods of unit length each as described in the service professional's model described in Section 3.3.



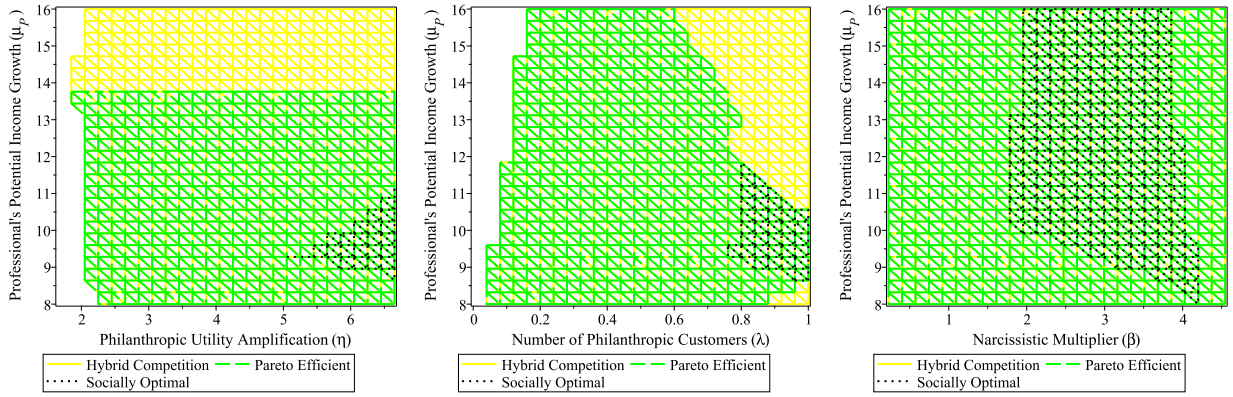
(a) μ_H versus η (b) μ_H versus λ (c) μ_H versus β

Note: Parameter values: $\phi = 1.1, \omega = 0.25, \delta = 0.75, \mu_T = 8, \mu_P = 10, c_m = 0.1, c_0 = 0.01, c_s = 0, k_H = 3, k_P = 1.5, k_T = 0.75, t_P = 1, \rho_h = 0.2, \rho_P = 0.4, \rho_T = 0.4$. Additionally, in Figure 5*a*, $\beta = 1.5, \lambda = 0.75$. In Figure 5*b*, $\eta = 5, \beta = 1.5$. $\mu_H = 1$. In Figure 5*c*, $\eta = 5, \lambda = 0.75$.

Figure 5 Implications for Service Providers' Profitability, Consumer Surplus, and Social Welfare: Dynamics Between Supply and Demand

Figure 5*a* illustrates the regions of Pareto-improving service providers' profits, superior consumer surplus, and socially optimal outcomes for various values of the professionals' income growth (μ_H) at the hybrid firm and the philanthropic customer utility amplification (η) when the hybrid firm adopts the philanthropic mode of operation, i.e., Model PR vis-à-vis Model RR. Similarly, Figures 5*b* and 5*c* identify the conditions for μ_H versus λ and μ_H versus β, respectively. It may be noted that the region is most prominent when the professionals' income growth (μ_H) is moderate. If the income growth rate is higher, the professionals' turnaround at the hybrid firm is lower, suggesting higher professional-income costs for the firm. On the other hand, if the income growth rate is lower, the professionals' turnaround is higher, resulting in a higher cost due to professional training.

Figure 6 demonstrates that the hybrid firm's philanthropic service strategy results in Pareto-improvement in the competing service providers' profits, superior consumer surplus, and enhanced social welfare when the hybrid professional's potential income in the market (μ_P) grows at a moderate rate. If the potential income growth rate is lower, the hybrid firm loses profit when the

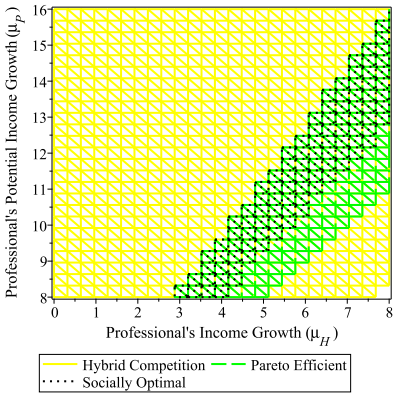


(a) μ_P versus η (b) μ_P versus λ (c) μ_P versus β

Note: Parameter values: $\phi = 1.1, \omega = 0.25, \delta = 0.75, \mu_T = 8, \mu_H = 5, c_m = 0.1, c_0 = 0.01, c_s = 0, k_H = 3, k_P = 1.5, k_T = 0.75, t_P = 1, \rho_h = 0.2, \rho_P = 0.4, \rho_T = 0.4$. Additionally, in Figure 6*a*, $\beta = 1.5, \lambda = 0.75$. In Figure 6*b*, $\eta = 5, \beta = 1.5$. $\mu_H = 1$. In Figure 6*c*, $\eta = 5, \lambda = 0.75$.

Figure 6 Implications for Service Providers' Profitability, Consumer Surplus, and Social Welfare: Dynamics Between Supply and Demand

hybrid firm adopts the philanthropic service strategy. On the contrary, the traditional firm loses profit when the rate is higher.



Note: Parameter values: $\eta = 5, \beta = 1.5, \phi = 1.1, \omega = 0.25, \lambda = 0.85, \delta = 0.75, \mu_T = 8, \mu_H = 5, c_m = 0.1, c_0 = 0.01, c_s = 0, k_H = 3, k_P = 1.5, k_T = 0.75, t_P = 1, \rho_h = 0.2, \rho_P = 0.4, \rho_T = 0.4$.

Figure 7 Implications for Service Providers' Profitability, Consumer Surplus, and Social Welfare: Dynamics Between Supply and Demand

Figure 7 provides insights into the trade-off between the hybrid professional's income at the hybrid firm and her potential income in the market to determine whether the competing firms, customers, and society, in general, would improve when the hybrid firm adopts the philanthropic

service strategy. It shows that the hybrid competition environment ensures the firms, the customers, and the entire society realize superior surplus *only* when the hybrid professional's income at the hybrid firm matches her potential income in the market, i.e., maintaining the essential system symmetry described in Figure 4b. These findings provide guidelines for the hybrid firm that contemplates adopting the philanthropic service strategy in a competitive setting to efficiently match supply and demand by designing a suitable compensation package for its professionals.

5. Conclusion and Future Directions

It is becoming common for profit-minded service providers to offer free services to customers who cannot afford to pay. The practice is quite popular in the healthcare sector in emerging countries. Additionally, it is also seen efficient outcome for establishments in *big* cities in the US and undoubtedly valid at universities and academic institutions across the world. In this paper, we develop a game-theoretic model to examine the incentives for a service provider to offer the self-selecting no-pay (SSNP) option to its customers that self-select the service of their choice from the available portfolio in a duopoly setting. We also develop an analytical model for skilled professionals that essentially drive the service provider's business model and govern its service delivery costs. We capture the essential features in a duopoly setting for a hybrid competition between the service providers in which one of the service providers offers the SSNP option to customers along with the paid service and examine the implications for the competitors.

We examine the implications of factors in the hybrid competition setting related to philanthropic customer utility amplification, inconvenience-caused no-pay utility reduction, faster learning curve transition for service professionals, process-driven service delivery marginal cost reduction, and mission-driven employees' compensation reduction for the competing service providers and their customers in the market. We mainly show that the strategy of the hybrid firm providing the SSNP option to customers to combat inequality is not only beneficial for the competing service providers and customers, but it also enhances consumer surplus, and consequently, social welfare, albeit rather under certain situations. Based on our field study, we present a model that identifies relevant factors and provides an economic rationale for philanthropic service providers to extend a self-selecting no-pay option for their services to serve customers even at a lower economic strata.

In our field study, we observe the effects of the hybrid competition between competing service providers at three levels: financial, operational, and societal. Financially speaking, at such hybrid service providers, the customers who can afford to pay are willing to pay more than they would at a traditional service provider. The main reason is the philanthropic utility they receive in addition to the utility from the service itself. Operationally speaking, since the hybrid firm is now serving a

large volume of customers per year, the service professionals can go down the learning curve much faster. The trajectory is not only advantageous to the service professionals and the hybrid firm, but it also improves the industry performance. Thus, these systems can be seen as training grounds for the industry. Societally speaking, having a healthier, well-fed, and educated (as the case may be) population increases the social welfare of the community. However, we also observe that not all industries have the characteristics necessary to achieve these results. For example, the learning curve may not be steep enough in some settings. In others, the philanthropic surplus may not be significant. In yet others, the societal benefit may not be feasible. It will be helpful to characterize the combination of settings in which these strategies will and will not work. Our work presented here provides a framework for obtaining critical insights in this regard.

Our stylized model provides enough insights into the observed phenomena in the hybrid competition setting. One can extend the modeling framework to address more complex issues in this environment. For instance, it would be critical to highlight the importance of enhancing the competitiveness of a philanthropic service provider based on cost reduction techniques using economies of scale in a high-volume environment that is developed by reaching out to poor customers. Similarly, insights into achieving an efficient balance between the paying and non-paying customers using suitable pricing strategies in a competitive setting would help philanthropic service providers meet their mission objectives and financial goals. One may explore ways for philanthropic service providers to devise trajectories to achieve their financial and mission objectives in the long run by considering the interrelationships between demand and supply sides in a charitable setting. It will mainly be helpful under capacity-constrained environments, such as limited human resources, financial limitations, etc., wherein self-feeding mechanisms take center stage to meet the requirements of a high-volume environment. Our modeling framework can be extended to devise growth trajectories for skilled professionals in their careers in high-volume settings developed by philanthropic service providers. At the same time, designing suitable service delivery packages for paying and non-paying classes of clientele in the competitive environment is essential. We leave many of these issues for future research.

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Appendix

A. Model PR: A scenario of the segregated market between the service providers

In this section, we consider a scenario of the traditional firm not catering to the philanthropic customers. The philanthropic (traditional) customers M^P (M^T) are served only by the hybrid (traditional) service provider H (T). We first derive the demand functions for the hybrid and traditional firms that is followed by the equilibrium solution of the pricing game.

A.1. Demand Functions

Philanthropic Customer Segment

Consider the philanthropic customer segment M^P. A θ^P-customer adopts the paid service of the hybrid firm if and only if $\eta\theta^P - p_H > \omega\theta^P$, i.e., when $\theta^P > \hat{\theta}_h^P = p_H/(\eta-\omega)$. It is trivial to show that $\eta\theta^P - p_H > 0$ and $\omega\theta^P > 0$ as $\omega > 0$. (In this scenario, we denote our model variables, x, as $\hat{x}$ to distinguish them from those described in Section 3.1.2.)

A θ^P-customer adopts the no-pay service of the hybrid firm if and only if $\omega\theta^P > \eta\theta^P - p_H$ and $\omega\theta^P > 0$, i.e., when $\theta^P < \hat{\theta}_h^P$. The customer with utility $\theta^P = \hat{\theta}_h^P$ is indifferent between adopting the paid service and the SSNP option of the hybrid firm.

The demand for the service providers in the philanthropic customer segment M^P is described as follows:

$$\hat{q}_H^P = \lambda\left(1-\hat{\theta}_h^P\right) = \lambda\left(1-\frac{p_H}{\eta-\omega}\right), \qquad \hat{q}_T^P = 0, \qquad \hat{q}_F^P = \lambda\left(\frac{p_H}{\eta-\omega}\right) \tag{25}$$

Traditional Customer Segment

Consider the traditional customer segment M^T. A θ^T-customer adopts the paid service of the traditional firm if and only if $\phi\theta^T - p_T > 0$, i.e., when $\theta^T > \hat{\theta}_H^T = p_T/\phi$. The customer with utility $\theta^T = \hat{\theta}_H^T$ is indifferent between adopting the paid service of the traditional firm and not adopting *any* service.

The demand for the traditional firm's paid service in the traditional customer segment M^T is as follows:

$$\hat{q}_T^T = (1-\lambda)\left(1-\hat{\theta}_R^T\right) = (1-\lambda)\left(1-\frac{p_T}{\phi}\right) \tag{26}$$

The aggregate demand for the two service providers are given as follows:

$$\hat{q}_H = \hat{q}_H^P, \qquad \hat{q}_T = \hat{q}_T^T, \qquad \hat{q}_F = \hat{q}_F^P \tag{27}$$

A.2. Service Providers' Problems

When the traditional firm does not serve the philanthropic (M^P) customers and serves only the traditional customers (M^T), the profit functions for the philanthropic (P) and the traditional (T) service providers are described as follows:

$$\hat{\pi}_H(p_H;p_T) = (p_H - c_H)\lambda\left(1 - \frac{p_H}{\eta-\omega}\right) - c_H\lambda\left(\frac{p_H}{\eta-\omega}\right) \tag{28}$$

$$\hat{\pi}_T(p_T;p_H) = (p_T - c_T)(1-\lambda)\left(1 - \frac{p_T}{\phi}\right) \tag{29}$$

A.3. Model Analysis

PROPOSITION 6. *If $c_T \geq \underline{c_T}$, the unique Nash equilibrium ($\hat{p}_H^*$ and $\hat{p}_T^*$) of the pricing game between the hybrid and traditional firms in Model PR is given by:*

$$\hat{p}_H^* = \frac{\eta-\omega}{2}, \qquad \hat{p}_T^* = \frac{\phi + c_T}{2} \tag{30}$$

The equilibrium demands for the hybrid and traditional firms are given as follows:

$$\hat{q}_H^{P*} = \frac{\lambda}{2}, \qquad \hat{q}_T^{P*} = 0, \qquad \hat{q}_F^{P*} = \frac{\lambda}{2}, \qquad \hat{q}_T^{R*} = \frac{(1-\lambda)(\phi - c_T)}{2\phi} \tag{31}$$

It may be noted that the profit functions for the hybrid and traditional firms are strictly concave in the respective decision variables. Their best response functions (BRF) are described as follows:

$$\hat{p}_H(p_T) = \frac{\eta-\omega}{2}, \qquad \hat{p}_T(p_H) = \frac{\phi + c_T}{2} \tag{32}$$

The BRFs are independent of the competitors' decision variables. The equilibrium obtained by simultaneously solving the BRFs is unique, and it also satisfies with the BRFs. By substituting (30) into (25) and (26), we obtain (31).

B. Proofs of the results presented in the main paper

Proof of Proposition 1. In the traditional competition setting, the profit functions for the service providers P and R are as follows:

$$\pi_H(p_H;p_T) = (p_H - c_H)\left(\frac{p_T - p_H}{\phi - 1} - p_H\right) \tag{33}$$

$$\pi_T(p_T;p_H) = (p_T - c_T)\left(1 - \frac{p_T - p_H}{\phi - 1}\right) \tag{34}$$

It may be noted that the profit functions for the hybrid and traditional firms are strictly concave in the respective decision variables as $\phi > 1$. Their best response functions (BRF) are described as follows:

$$p_H^*(p_T) = \frac{\phi c_H + p_T}{2\phi}, \qquad p_T^*(p_H) = \frac{\phi - 1 + c_T + p_H}{2} \tag{35}$$

The $p_H^*(p_T)$ linearly increases in p_T, and $p_T^*(p_H)$ linearly increases in p_H. By simultaneously solving $p_H^*(p_T)$ and $p_T^*(p_H)$, we uniquely obtain $\check{p}_H^*$ and $\check{p}_T^*$ as described in (16). By substituting $\check{p}_H^*$ and $\check{p}_T^*$ into (1), we obtain $\check{q}_H^*$ and $\check{q}_T^*$ as described in (17). The solution is feasible, i.e., $\check{q}_H^* \geq 0$ and $\check{q}_T^* \geq 0$ if $c_H \leq (\phi - 1 + c_T)/(2\phi - 1)$ and $c_T \leq [2\phi(\phi-1) + \phi c_H]/(2\phi - 1)$. Clearly, the Nash equilibrium is unique.

Consider that $c_H > (\phi - 1 + c_T)/(2\phi - 1)$. From the above, it follows that the hybrid firm does not offer the paid service. The traditional firm's problem is described as $\max_{p_T \geq 0} (1 - p_T/\phi)(p_T - c_T)$ subject to $0 \leq (1 - p_T/\phi) \leq 1$. The optimal solution is $\check{p}_T^* = (\phi + c_T)/2$, and the corresponding demand is $\check{q}_T^* = (\phi - c_T)/(2\phi)$. The solution is feasible, i.e., $\check{q}_T^* \geq 0$ by Assumption 4.

Similarly, consider that $c_T > [2\phi(\phi - 1) + \phi c_H]/(2\phi - 1)$. From the first part of the proposition, we know that the traditional firm does not offer the paid service. The hybrid firm's problem is described as $\max_{p_H \geq 0} (1 - p_H)(p_H - c_H)$ subject to $0 \leq (1 - p_H) \leq 1$. The optimal solution is $\check{p}_H^* = (1 + c_H)/2$, and the corresponding demand is $\check{q}_H^* = (1 - c_T)/2$. The solution is feasible, i.e., $\check{q}_H^* \geq 0$ by Assumption 3. □

Proof of Proposition 2. When the traditional firm serves the philanthropic (M^P) and the traditional customers (M^T), the profit functions for the hybrid (H) and traditional (T) service providers using (2) and (3) are described as follows:

$$\pi_H(p_H; p_T) = (p_H - c_H)\lambda\left(1 - \frac{p_H - p_T}{\eta - \beta\phi}\right) - c_H\lambda\left(\frac{p_T}{\beta\phi - \omega}\right) \tag{36}$$

$$\pi_T(p_T; p_H) = (p_T - c_T)\left[\lambda\left(\frac{p_H - p_T}{\eta - \beta\phi} - \frac{p_T}{\beta\phi - \omega}\right) + (1 - \lambda)\left(1 - \frac{p_T}{\phi}\right)\right] \tag{37}$$

We obtain

$$\frac{\partial \pi_H}{\partial p_H} = \frac{\lambda(-2p_H + p_T + \eta - \beta\phi + c_H)}{(\eta - \beta\phi)} \tag{38}$$

$$\frac{\partial^2 \pi_H}{\partial p_H^2} = -\frac{2\lambda}{(\eta - \beta\phi)} \tag{39}$$

$$\frac{\partial \pi_T}{\partial p_T} = -\frac{(2p_T - c_T)\tilde{T} - \phi(\beta\phi - \omega)[(1 - \lambda)(\eta - \beta\phi) + \lambda p_H]}{(\eta - \beta\phi)(\beta\phi - \omega)} \tag{40}$$

$$\frac{\partial^2 \pi_T}{\partial p_T^2} = -\frac{2\tilde{T}}{(\eta - \beta\phi)(\beta\phi - \omega)} \tag{41}$$

Define $\underline{\eta}$ such that $4\tilde{T} - \lambda\phi(\beta\phi - \omega)(\leq) > 0$ for $\eta(\leq) > \underline{\eta}$. It suggests that the denominator of p_H^* and p_T^* in (18) and (19) is positive if $\eta > \underline{\eta}$. Here,

$$\underline{\eta} = \frac{4\phi[\lambda\omega + (1 - \lambda)\beta(\beta\phi - \omega)] + \lambda\phi(\beta\phi - \omega)}{4[\lambda\phi + (1 - \lambda)(\beta\phi - \omega)]} \tag{42}$$

It can be shown that $\beta\phi - \underline{\eta} = 3\lambda\phi(\beta\phi - \omega)/\{4[\lambda\phi + (1 - \lambda)(\beta\phi - \omega)]\}$. By Assumption 2, it is immediate that $\beta\phi > \underline{\eta}$, and hence, by Assumption 1, $\eta > \underline{\eta}$, suggesting the feasibility of p_H^* and p_T^* described in (18) and (19).

From (39), it is direct that $\partial^2 \pi_H / \partial p_H^2 < 0$ as $\eta > \beta\phi$ and $\lambda > 0$. From (45), we also observe that $\tilde{T} > 0$. It implies that $\partial^2 \pi_T / \partial p_T^2 < 0$. The problems of the philanthropic and he traditional service providers are convex programs in the respective decision variables. Their best response functions (BRF) can be obtained by solving the first order conditions using (38) and (40) to obtain

$$p_H^*(p_T) = \frac{p_T + \eta - \beta\phi + c_H}{2}, \qquad p_T^*(p_H) = \frac{c_T\tilde{T} - \phi(\beta\phi - \omega)[(1 - \lambda)(\eta - \beta\phi) + \lambda p_H]}{2\tilde{T}} \tag{43}$$

The BRF for a service provider is linear (and increasing) in the competitor's decision variable, and hence, the (Nash) equilibrium obtained by simultaneously solving the BRFs is unique. The Nash equilibrium prices are as described in (18) and (19). By substituting (18) and (19) into (2) and (3), we obtain (20) – (23).

From (21), it may be noted that q_T^{P*} is monotonically decreasing in c_T as $\eta > \phi, \omega$. Thereby, for $c_T \geq \underline{c_T}$, we have $q_T^{P*} \leq 0$, and for $c_T < \underline{c_T}$, we have $q_T^{P*} > 0$. Here,

$$\underline{c_T} = \frac{c_H(\beta\phi - \omega)\left[2\tilde{T} - \lambda\phi(\eta - \omega)\right] + (\eta - \beta\phi)(\beta\phi - \omega)\left\{2\tilde{T} - \phi[(2-\lambda)\eta - (1-\lambda)\beta\phi - \omega]\right\}}{(2\eta - \beta\phi - \omega)\tilde{T}} \tag{44}$$

$$\text{where} \qquad \tilde{T} = \eta[\lambda\phi + (1-\lambda)(\beta\phi - \omega)] - \phi[\lambda\omega + (1-\lambda)\beta(\beta\phi - \omega)] \tag{45}$$

The rest is straightforward, and hence, omitted. □

Proof of Proposition 6. When the traditional firm does not serve the philanthropic (M^P) customers and caters only to the traditional customers (M^T), the price equilibrium of the game between the philanthropic (P) and traditional (T) service providers is as described in (32) that satisfies (30).

From Proposition 2, it is immediate that the equilibrium solution (30) is valid when $c_T > \underline{c_T}$. The rest is straightforward, and hence, omitted. □

Proof of Proposition 3. The professional's profit function $\pi_w(t_H)$ is as described in (9). We obtain

$$\frac{\partial \pi_w}{\partial t_H} = \delta c_0 + \mu_H t_H - \frac{(c_0 + \mu_P t_H)\mu_P}{\mu_T} + \left(\frac{\mu_P}{\mu_T} - 1\right) c_m \tag{46}$$

$$\frac{\partial^2 \pi_w}{\partial t_H^2} = \mu_H - \frac{\mu_P^2}{\mu_T} \tag{47}$$

Clearly, $\partial^2\pi_w/\partial t_H^2 < 0$ since $\mu_H < \mu_T < \mu_P$. The professional's problem of maximizing income during the entire career by determining t_H is a convex program. The Kurush-Kuhn-Tucker (KKT) first order condition is (necessary and) sufficient to show the optimality of a solution. Using (46), it is easy to show that the solution $t_H' = [(c_m - c_0)\mu_P - (c_m - \delta c_0)\mu_T]/(\mu_P^2 - \mu_T\mu_H)$ satisfies $\partial\pi_w/\partial t_H = 0$.

It may be noted from Figure 2 that $t_P = (c_m - c_0)/\mu_T$.

$$t_P - t_H' = \frac{c_m - c_0}{\mu_T} - \frac{(c_m - c_0)\mu_P - (c_m - \delta c_0)\mu_T}{\mu_P^2 - \mu_T\mu_H} = \frac{(\mu_P^2 - \mu_T\mu_H - \mu_P\mu_T)(c_m - c_0) + \mu_T^2(c_m - \delta c_0)}{\mu_T(\mu_P^2 - \mu_T\mu_H)}$$
$$> \frac{(c_m - c_0)[\mu_P(\mu_P - \mu_T) + \mu_T(\mu_T - \mu_H)]}{\mu_T(\mu_P^2 - \mu_T\mu_H)} > 0$$

The first inequality follows from $c_m > c_0$ and $\delta \in (0, 1]$, and the second inequality follows from $\mu_H < \mu_T < \mu_P$. It implies that $t_H' < t_P$.

By the non-negativity of t_H, the solution t_H^* as described in (24) is indeed optimal. □

Corollary 6. *The hybrid professional's optimal time t_H^* from the beginning of her career when she switches over to the traditional firm from the hybrid firm is such that $t_H^* < t_P$.*

Proof of Corollary 6. The proof is straightforward from Proposition 3, and hence, omitted. □

Proof of Corollary 1. The proof is straightforward from (24) and the definition of $\overline{\mu_P} = (c_m - \delta c_0)\mu_T/(c_m - c_0)$. The denominator of $t_H' = [(c_m - c_0)\mu_P - (c_m - \delta c_0)\mu_T]/(\mu_P^2 - \mu_T\mu_H)$ is positive since $\mu_H < \mu_T < \mu_P$. The numerator is increasing in μ_P, and it is positive if and only if $\mu_P > \overline{\mu_P}$.

Additionally, for $\delta \in (0, 1]$, $\overline{\mu_P} \geq \mu_T$. □

Proof of Corollary 2. By Assumption 5, we have $t_H^* = [(c_m - c_0)\mu_P - (c_m - \delta c_0)\mu_T] / (\mu_P^2 - \mu_T\mu_H)$. It is immediate that t_H^* increases in δ. Also, $\partial t_H^*/\partial \mu_P = [-(\mu_P^2 + \mu_T\mu_H)(c_m - c_0) + 2\mu_P\mu_T(c_m - \delta c_0)] / (\mu_P^2 - \mu_T\mu_H)^2$, which is positive for $\delta < \grave{\delta}$ and negative otherwise. □

Proof of Corollary 3. (Recall that, $t_H^* = [(c_m - c_0)\mu_P - (c_m - \delta c_0)\mu_T] / (\mu_P^2 - \mu_T\mu_H)$ for $\mu > \overline{\mu_P}$.) Now, it is immediate that t_H^* is independent of ρ_H, and it increases in δ. Consider $1/\alpha_H = 1 + \rho_P t_P / (\rho_H t_H^*)$. Similarly, we write $1/\alpha_T = 1 + \rho_T t_P / [\rho_H (t_P - t_H^*)]$. The rest of the proof is straightforward, and hence, omitted. □

Proof of Proposition 4. The proof is straightforward from (10) and (11), and hence, omitted. □

Proof of Corollary 4. From (12), we obtain

$$\frac{\partial c_H^w(t_H^*)}{\partial \rho_H} = -\frac{\rho_P \mu_H t_H^* t_P (t_P - t_H^*)}{2(\rho_H t_H^* + \rho_P t_P)^2}$$
$$\frac{\partial c_T^w(t_H^*)}{\partial \rho_H} = \frac{\rho_T t_P (t_P - t_H^*)(3c_m - c_0 + \mu_P t_H^* - \mu_T t_P)}{2[\rho_H (t_P - t_H^*) + \rho_T t_P]^2}$$

From Corollary 6, we obtain $\partial c_H^w(t_H^*)/\partial \rho_H < 0$. From $c_m = c_0 + \mu_T t_P$, $t_H^* > 0$ (by Assumption 5), and Corollary 6, we have $\partial c_T^w(t_H^*)/\partial \rho_H > 0$. □

Proof of Proposition 5. From (12) and (13), we obtain

$$c_T^w(t_H^*) - c_H^w(t_H^*) = \alpha_T c_m + (1 - \delta) c_0 + \frac{\alpha_H \mu_H (t_P - t_H^*)}{2} + \frac{\alpha_T (c_m - c_0 - \mu_T t_P + \mu_P t_H^*)}{2}$$

Since $c_m = c_0 + \mu_T t_P$, the last term reduces to $\alpha_T \mu_P t_H^*/2$. From Corollary 6 and $\mu_T > \mu_H$, it follows that $c_T^w(t_H^*) - c_H^w(t_H^*) > 0$. □

Proof of Corollary 5. By substituting $\mu_H = \mu_T$ and $\delta = 1$ in (10), (11), and (24), we obtain the results presented in the statement of Corollary 5. □