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# What is the optimal subsidy for exercise? Informing health insurance companies' fitness reimbursement programs

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# **What is the optimal subsidy for exercise? Informing health insurance companies' fitness reimbursement programs**

Molly E. Freat

Advisor: Pete Ferderer

**ABSTRACT:** Health care costs account for 17% of US GDP and many programs and policies seek to reduce these costs. This paper focuses on exercise as preventive care due to its immense physiological benefits. I model the profit-maximizing choice of health insurance companies to subsidize exercise and the utility-maximizing choice of individuals to engage in exercise using a traditional principal-agent framework. I then use principles from behavioral economics and psychology to critique these models and provide further insight into understanding our underconsumption of such preventive services. I end with an evaluation of current programs and suggestions for improvement using empirical findings.

**KEYWORDS:** subsidy, health insurance, moral hazard, fitness, hyperbolic discounting

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## **I. Introduction**

As the healthcare industry grows and health care costs rise, there is a strong focus on reducing health care costs, both for the societal benefits and for the increased profit for health insurance companies. The United States Centers for Medicare and Medicaid Services report that national health expenditures reached \$2.5 trillion in 2009, which translates to \$8,086 per person or 17.6 percent of the country's Gross Domestic Product (Centers for Medicare & Medicaid Services, 2011). This figure includes personal health care (hospital/dental care, physician and clinical services) as well as Medicare, Medicaid, private health insurance and out-of-pocket spending. Furthermore, estimates suggest that as much as one third of medical care does not actually improve our health (Gruber, 2011). These healthcare expenditures, effective or not, have been rising for many years (Figure 1) and many of these implicit costs are associated with outcomes that can be avoided, or at the very least, alleviated through preventive care. Therefore, it is in health insurance companies' best interests to invest resources in programs and policies that promote preventive behavior.

This paper focuses on one type of preventive care – exercise – and discusses how it can be motivated through health insurance reimbursement or subsidies. The paper begins with a discussion of the benefits of exercise, followed by a description of the traditional economic approach to insurance. Included in this approach are two economic models – the profit-maximization choice of insurance companies to incentivize preventive care and the utility-maximizing choice of individuals to exercise. Following the models is a description of current fitness reimbursement programs and their encouraging results. I then provide a more critical analysis of the problem and the current system using insights from psychology and behavioral economics that can better help us understand the behavior as well as evaluate and improve the

programs that are currently in place, a step not taken in the literature thus far. I end with a brief empirical analysis of the choice to exercise, with implications for how subsidies should be targeted and delivered.

## **II. Benefits of Exercise**

There are many benefits of exercise, both in terms of individual health and individual productivity. Perhaps most evident is the clear link between exercise and obesity, a growing problem in the United States. The age-adjusted prevalence of obesity in the United States between 2007 and 2008 was 33.8% (Flegal et al., 2010), and in 2010 no state had an obesity rate less than 20% (Centers for Disease Control and Prevention, 2011). Obesity carries many health risks, including increased risk of hypertension, type 2 diabetes, coronary heart disease, sleep apnea, respiratory problems and even some cancers (Wang et al., 2008). Research has shown that exercise not only reduces obesity but also is associated with improvements in the risk and progression of diabetes (Manson et al., 1992, Gibala et al., 2012), cardiovascular disease and depression (Penedo & Dahn, 2005), hypertension, osteoporosis, and cancer (Warburton et al., 2006). If current trends in obesity continue (shown in Figure 2), total health-care costs attributable to obesity are estimated to more than double every decade, with costs ranging from \$860 to \$956 billion by 2030 (Wang et al., 2008). To put this figure in perspective, this is 17% of total health care costs, or roughly 1 in every 6 dollars spent on health care. Any efforts to reduce these huge increases in cost could be extremely effective in the long run.

Shephard (1999) completed a meta-analysis of work-site exercise and health programs and showed that in addition to making employees healthier, exercise also improves worker productivity. Employees with on-site fitness programs were between 4% and 5% more productive than those without. Furthermore, those employers with such programs in place

experienced a cumulative benefit of \$500 to \$700 per worker per year for physical activity and aerobic fitness. Exercise, along with regular religious practice, also appears to have a positive impact on general well-being or happiness (Mochon, Norton & Ariely, 2007) – arguably reason enough for regular physical activity, let alone the immense physiological benefits.

There is also substantial research on and public attention given to other benefits of exercise – with many academic studies on these benefits being publicized in large newspapers like The New York Times. In the past year alone, the following studies have received great media attention. Head et al. (2012) found that daily physical activity such as a walk or a jog reduces both the risk of developing Alzheimer’s and also has the potential to change the course of the disease should it develop. Another study underscores the importance of staying active by showing that exercise is crucial in the human body’s method of removing garbage or waste from inside its cells, a process called autophagy (He et al., 2012). Matsui et al. (2011) used rats to study how the brain fuels itself during exercise and showed that prolonged exercise significantly lowers the brain’s stores of energy, particularly in the frontal cortex and the hippocampus – areas involved in thinking and memory. A follow-up study showed that after exercise, a period of rest and eating restores brain levels of glycogen (a substance used for energy) as much as 60 percent above original levels (pre-exercise) in the frontal cortex and hippocampus – a sort of overcompensation for the loss experienced during exercise (Matsui et al., 2012). Further, they found that for continued exercise, the overcompensation level became the new normal level, with baseline levels of glycogen showing significant increases compared to sedentary subjects. This prolonged rise in fuel reserves has tremendous implications for not only the brain’s ability to sustain and direct movement, but also for sharper cognitive function given the associated areas.

Despite these benefits being widely acknowledged and often even understood, many people still have trouble getting themselves to the gym or even outside for a short run or bout of physical activity. The following section outlines current fitness incentive programs offered by health insurance companies in the US (as well as other exercise initiatives) that try to capitalize on these immense gains to exercise.

### **III. Current Fitness Incentive Programs**

Many incentive schemes like the one modeled above exist today, with some health insurance companies already publishing encouraging results. Table 1 displays the top 10 health insurance companies in the US (according to US News & World Report) and the different fitness incentive programs they offer. Some programs include only educational resources and information, but many also offer monetary discounts or reimbursement for fitness memberships. Insurance companies throughout the US, the top-10 and others, offer a variety of programs aimed at motivating and incentivizing fitness. Tufts Health Plan's "Fitness Rewards" and Blue Cross Blue Shield of Massachusetts' "Fitness Benefit" programs offer members up to \$150 back on fitness center membership only once they have been members of a fitness center for at least four months. Harvard Pilgrim Health Care and Harvard Pilgrim Health Care of New England offer similar reimbursement schemes to members. Blue Cross Blue Shield of Minnesota offers members up to \$20 off of monthly health club membership fees if they meet attendance goals (typically 8-10 visits per month) and Connecticare of Connecticut also offers members discounted monthly membership fees. The structure of these reimbursement programs is typically retroactive; members submit a form to the health insurance provider with evidence of fitness membership payment/attendance. Should they meet the stipulations of the program, they are then reimbursed accordingly.

With such reimbursement programs in place, it is important that the cost to the health insurance companies is offset by the health benefits (from the increase in exercise behavior) of members and the reduced medical costs paid by the insurance company. There is little publicized research in this domain; however, Blue Cross Blue Shield of Minnesota (2007) conducted a yearlong study of 74,000 members participating in their “Fitness Discounts” program. They found that frequent users (defined as using a fitness center at least eight times per month) had claim costs 17.8% lower than non-participants after adjusting for health history, as well as emergency room visit rates and hospital admission rates 38.7% and 41.4% lower than non-participants, respectively. Their study also showed that the more workouts, the better. Frequent users had claim costs 9.8% lower than low users (defined as those who used a fitness center for fewer than eight times a month). Similarly, frequent user emergency room visit rates and hospital admission rates are 41.8% and 45.2% lower than low users. As of March 2007, roughly 90,000 BCBS of MN members were enrolled in the program, representing about 10% of those eligible.

Medica (2007) performed a similar analysis of members enrolled in their “Fit Choices” program who met the threshold for reimbursement of eight visits to a gym per month. Those who met the threshold had significantly lower costs for prescriptions, doctor appointments, and care at clinics and hospitals. The average monthly medical costs of these enrollees were 33.6% lower than those in a matched control group. These people also reported improvements not only regarding weight loss, but also in levels of energy and stress. People not enrolled in the “Fit Choices” program and who did not exercise eight times a month were 43%-105% more likely to have been to a clinic, hospital, or emergency room.

While the BCBSMN and Medica studies do not have the benefit of inferring cause that can be isolated using randomized controlled field studies, and are likely prone to selection bias,

both studies are nonetheless suggestive and encouraging. Though it is likely that many members enrolled in such programs would exercise anyway, the programs likely still have the power to incentivize motivation for some who would not be engaging in physical activity otherwise. At the very least, their results clearly show the link between exercise and lower health-care costs. There is certainly cause for further research on the influence of such programs on physical activity and on their ultimate effectiveness in reducing claims costs, affecting the health insurance company's bottom line.

Research on the impact of incentives on exercise in other contexts is also encouraging. Charness and Gneezy (2009) carried out a study looking at the motivating effect of different monetary incentives to exercise. As part of the study, they compare the behaviors of participants randomized into three groups. All groups were given a handout on the benefits of exercise. One group was not given anything else (no incentive group). Participants in another group were additionally paid \$25 to attend a gym once in a given week (low-incentive group) and participants in the other group were given the \$25 incentive as well as \$100 if they attended the gym eight more times in the following four weeks (high-incentive group). After observing attendance before, during and for a period of seven weeks after the end of the intervention, their main finding was that post-intervention attendance was more than twice as high for the high-incentive group than for the no-incentive group (0.56 visits per week compared to 1.24 visits per week). Furthermore, the difference did not decline at all during the time following payment, suggesting that their high-incentive scheme was successful in inducing positive habit formation. While the study shows that the dollar amount matters, the exact relationship between payment and amount exercised and whether or not it is continuous or incremental in nature, is not clear. These results have potential implications for the amount of reimbursement health insurance



companies provide – too little could not have the desired effect to truly reduce cost and too much could be unnecessary (and in other words, a waste for the health insurance company).

It is evident that there is substantial variation in past and current approaches to motivating exercise habits. In an effort to understand and explain this variation, the following sections take a theoretical approach to the firm's choice to subsidize exercise and the individual's choice to exercise. The theoretical portion begins with a discussion of the traditional economic explanation of why people often remain sedentary and underinvest in beneficial measures of preventive care like exercise.

#### **IV. Traditional Economics of Insurance**

##### *1. Overview*

The economic principle of moral hazard is crucial in understanding the dynamics between health insurance companies and their customers. Consideration of this phenomenon lends itself to understanding why many people seemingly do not act in their own self-interest and behave in a way that is contrary to what is best for their health.

Moral hazard is the term used to describe a lack of motivation to guard against risk when one is protected or insulated from the risk's consequences (Hölmstrom, 1979). Moral hazard is characterized by a situation where an individual makes a decision that is of higher risk, knowing another party will cover the cost, compared to the decision he would make if he were fully exposed to the risk. Moral hazard occurs in insurance markets because the behavior of the insured is affected by the insurance itself and the insured person's actions affect the insurer's costs. This is likely the reason why many individuals consume suboptimal levels of preventive care. For example, if someone has health insurance and chooses to not get immunized against a certain disease and then contracts it, the health insurance company bears the significant burden

of the financial cost of the disease. There is therefore little incentive for the individual to obtain the immunization. Another example may be engaging in poor dietary habits because the costs of ensuing problems like heart disease will be covered. The same intuition applies for exercise as a preventive action – many individuals see it as costly to exercise in the short run so they choose not to, and the cost of this lack of physical activity is shifted to the health insurer in the long run. This problem of moral hazard leads to a classical principal-agent problem where the principal (the insurer) attempts to alter the behavior of the agent (the insured) through an incentive scheme, described later on.

An agent is anyone that is employed or managed by a principal and whose actions affect the principal. A principal-agent problem arises when agents pursue their own goals rather than the goals of principals. This problem is often discussed in the context of a business – it is costly for managers to oversee and monitor their workers. This leads to employees pursuing their own interests by shirking or engaging in other activities that reduce the firm's profitability. Firms often respond to this principal-agent problem by offering bonuses, piece-rates or other performance incentives to better align the goals of their employees with those of the firm.

This problem applies to insured parties as agents and the insurance companies as principals. Moral hazard arises because insured parties have less incentive to guard against risks, since they are protected from their consequences by the insurance. For example, a health insurance company lowers the cost to the insured of engaging in an unhealthy lifestyle because future hospital bills will be paid for by the insurance company. With this lower cost, individuals are more likely pursue a less healthy lifestyle, which raises the future costs of the insurance company that is insuring them.

In addition to moral hazard, our tendency to discount the future is also likely affecting our choices not to exercise. Put simply, discounting is the tendency of people to decrease the present value of rewards as they occur further and further into the future. For example, one values \$100 obtained today more than the promise of \$100 obtained tomorrow, and one values \$100 tomorrow more than \$100 the next day.

The notion that discount rates are consistent over time is referred to as exponential discounting, and is represented by the following equation, where  $0 \leq \delta \leq 1$  is the discount rate and  $\delta = 1$  implies no discounting:

$$D(t) = \delta^t = 1, \delta, \delta^2, \delta^3, \dots \quad (1.1)$$

This gives rise to the following equation for overall utility at time  $t$ ,  $U_t$ , where  $u_t$  represents the per-period utility occurring in future periods:

$$U_t = u_t + \delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + \dots \quad (1.2)$$

As shown in Eqs. (1.1) and (1.2), exponential discounting asserts that the marginal rate of substitution between consumption at any two points in time depends exclusively on the distance between the two points. In other words, the value of a given reward decays by the same proportion for each time period (day, month, year) that the reward's occurrence is delayed. For example, if  $\delta = 0.5$  and exercise lowers  $U_t$  by 1 and raises  $U_{t+1}$  by 1.5, the individual will not choose to exercise even though  $|\Delta U_t| < |\Delta U_{t+1}|$  because  $|\Delta U_t| > \delta |\Delta U_{t+1}|$ . Because the rewards of exercise often occur in the future, they are discounted by the individual and therefore less weight is placed on potential benefits when an individual makes a decision to or not to exercise.

To combat both moral hazard and exponential discounting, health insurance companies pursue policies and programs like those outlined in the previous section. The incentive scheme of reimbursement can be modeled using the following traditional framework.

## 2. Theory: Health Insurer Decision

The following model is an adaption of that proposed by Pauly (1990). Consider the population of members insured by a health insurance company,  $N$ . Each individual in population  $N$  has two possible future states of health,  $H_1$  or  $H_2$ . In  $H_1$ , the insurance company's medical expenditures on the individual,  $E$ , are zero because he does not incur any illness. In  $H_2$ , however, the individual contracts an illness and medical expenditures on the individual are  $E > 0$ . A prevention service that reduces the risk of illness, in this case exercise or fitness,  $F$ , is available in the current period at a membership fee,  $P$ . If the prevention service is not consumed in the current period, the probability of state  $H_2$  occurring is  $p_N$ . However, if the service is consumed, the probability of state  $H_2$  occurring is  $p_Y$ , where  $p_Y < p_N$ . From the insurance company's point of view, entire coverage of fitness is cost effective if the following condition holds:

$$(p_N - p_Y) \cdot E > P_F \quad (2.1)$$

In other words, if fitness lowers the expected future medical costs by more than the membership fee, the service is cost-effective.

Insurance companies can also choose to cover or reimburse only a *fraction* of fitness membership fees. Let  $K$  be the fraction of fitness membership fee ( $P$ ) that is covered by insurance. In other words,  $K$  is the percentage of  $P$  that is paid by the health insurance company. If  $K = 1$ , the insurance company covers the entire price of the membership fee. If  $K = 0.25$ , the insurance company covers 25% of the membership fee, and so on. Because demand is a function of price and  $K$  effectively lowers the price of fitness memberships, demand for fitness memberships can thus be characterized by the following, where  $N$  is size of the total population:

$$D_1 = f(K) \quad (2.2)$$

$$D_2 = N - D_1 \quad (2.3)$$

Above,  $D_1$  refers to the subset of the population that consumes a fitness membership ( $F$ ), given a certain level of  $K$ , while  $D_2$  refers to the remainder of the population that does not consume  $F$ .

The partial derivatives of the demand equations with respect to  $K$  are shown below, with their expected signs:

$$\frac{dD_1}{dK} > 0 \quad (2.4)$$

$$\frac{dD_2}{dK} < 0 \quad (2.5)$$

That is, for an increase in  $K$  (more coverage),  $D_1$  is expected to rise, while  $D_2$  is expected to fall.

The health insurance company's total cost is dependent on both the reimbursement cost and the cost of illness and can be modeled by the following:

$$\theta_T = (D_1 \cdot K \cdot P) + E(D_1 \cdot p_Y + D_2 \cdot p_N) \quad (2.6)$$

In the above equation, the left term on the right hand side,  $(D_1 \cdot K \cdot P)$ , refers to current period costs – it is the product of the price the health insurance company pays for each membership ( $K \cdot P$ ), and the quantity of memberships consumed,  $D_1$ . The right term on the right hand side shows future costs. Specifically, each group ( $D_1$  and  $D_2$ ) poses a different expected cost to the health insurance company in the future, characterized by the two groups' differing probabilities of contracting an illness. The quantity in parentheses is thus the quantity of members expected to contract the illness and it is multiplied by the medical expenditure per individual with that illness,  $E$ . If the health insurance company chooses to set  $K > 0$ , and cover a certain portion of the fitness membership price,  $P$ , current expenses increase but future expenses fall.

I use this conceptualization by Pauly (1990) to model the change in costs induced by changes in  $K$ . This is done by taking the partial derivative of Eq. (2.6) with respect to  $K$ , which yields the following equation:

$$\frac{d\theta}{dK} = P(D_1 + K \cdot \frac{dD_1}{dK}) + E(p_Y \cdot \frac{dD_1}{dK} + p_N \cdot \frac{dD_2}{dD_1} \cdot \frac{dD_1}{dK}) \quad (2.7)$$

Eq. (2.7) simplifies to the following, because we know the partial derivative of  $D_2$  with respect to  $D_1$ :

$$\frac{d\theta}{dK} = P(D_1 + K \cdot \frac{dD_1}{dK}) + E \frac{dD_1}{dK} (p_Y - p_N) \quad (2.8)$$

Thus, the change in total costs is made up of an increase in current costs for the reimbursement and a decrease in the expected future costs due to more members consuming  $F$  (and a higher  $D_1$ ) with the higher reimbursement amount. Specifically, the left term on the right hand side of Eq. (2.8) is positive, because the partial derivative of  $D_1$  with respect to  $K$  is positive. The right term on the right hand side of Eq. (2.8) is negative because the positive partial derivative ( $dD_1/dK$ ) is positive and the quantity  $(p_Y - p_N)$  is negative.

To minimize costs, the health insurance company maximizes profit by setting the optimal level of  $K$ . This occurs when Eq. (2.8) is equal to zero and can be characterized by:

$$K^* = \frac{E}{P} (p_N - p_Y) - \frac{D_1}{\varphi} \quad \text{where } \varphi = \frac{dD_1}{dK} \quad (2.9)$$

According to Eq. (2.9), the larger the differential between  $p_N$  and  $p_Y$ , the greater the subsidy ( $K$ ) should be. This intuitively makes sense – the subsidy should be greater the more beneficial the preventive service (fitness) is for one's health. The direct relationship between  $E$  and  $K$  also makes sense – the greater the medical expense to the insurer, the higher the subsidy should be. The term  $\varphi$  refers to how responsive members are to changes in  $K$ . Such knowledge has implications for how health insurance companies set  $K$  in their efforts to minimize costs and maximize profit in the long run. If consumers are very responsive to changes in  $K$ , rises in  $K$  will be associated with significantly greater reductions in future expected costs. However, if

consumers are less sensitive to changes in  $K$ , it may not be in the health insurance company's best interest to adjust  $K$  because reductions in future costs may not offset the expenditure used in reimbursement.

If firms like health insurance companies are susceptible to the same discounting tendencies as individuals, the exponential discount rate,  $\delta$ , would affect the medical expenditure variable,  $E$ , because it is a future cost. This changes the equation for the optimal  $K$  to the following:

$$K^* = \frac{\delta \cdot E}{P} (p_N - p_Y) - \frac{D_1}{\varphi} \quad (2.10)$$

With discounting behavior, the optimal  $K$  is directly related to the discount rate. As firms discount the future more and  $\delta$  falls, the optimal level of  $K$  also falls because firms weigh and care about the future medical cost relatively less. Conversely, as firms care more about the future and  $\delta$  increases, the optimal level of  $K$  rises and the forward-looking nature of the firm is in a sense transferred to the individual being subsidized. The following section models the individual choice to exercise or be a part of  $D_1$ , given the level of  $K$  set by his/her health insurance company.

### 3. Theory: Consumer Decision

The previous model presented the equation characterizing the optimal level of the subsidy for exercise,  $K^*$ . Included in the equation is the relationship between changes in  $K$  and individual member behavior in consuming  $F$  (to be a part of  $D_1$ ). To better understand how this decision is made, it is important to understand how consumption of services like  $F$  and others affect a given individual's lifetime utility function. For the following model, I use the conceptualization of utility given by Newhouse (2006): utility at time  $t$  is characterized by the following condition:

$$U_t = U(X_t, H_t(m, X)) \quad (3.1)$$

In the above equation,  $X$  refers to non-medical goods and services consumed and  $H$  refers to a stock of health, which is dependent on both consumption of  $X$  and a stock of medical care,  $m$  (from consumption of medical goods and services). Both  $m$  and  $X$  are not subscripted to indicate that health depends on prior period consumption.

In the case of this paper, I posit that exercise, or fitness ( $F$ ) affects  $m$  in that it is a preventive medical service. In a two-period model, lifetime utility is characterized by:

$$U = U[X_1, H_1(m_1(1, F_1), X_1), X_2, H_2(m_1(1, F_1), m_2(m_1(1, F_1), F_2), X_1, X_2)] \quad (3.2)$$

I also assume that the individual faces a budget constraint where lifetime income,  $I$ , is spent entirely on  $X$  and  $F$  in each period, priced as  $P_{X_1, X_2}$  and  $P_{F_1, F_2}$ , respectively:

$$I = ((1 - K_1) \cdot P_{F_1} \cdot F_1) + ((1 - K_2) \cdot P_{F_2} \cdot F_2) + (P_{X_1} \cdot X_1) + (P_{X_2} \cdot X_2) \quad (3.3)$$

The individual chooses or plans levels of  $X_1$ ,  $X_2$ ,  $F_1$  and  $F_2$  in the first period and maximizes utility in Eq. (3.2) subject to (Eq. 3.3). This maximization is characterized by the following Lagrangian:

$$\Phi = U(X_1, X_2, H_1, H_2) - \lambda [((1 - K_1) \cdot P_{F_1} \cdot F_1) + ((1 - K_2) \cdot P_{F_2} \cdot F_2) + (P_{X_1} \cdot X_1) + (P_{X_2} \cdot X_2)] \quad (3.4)$$

This maximization yields first-order conditions in Eqs. (3.5), displayed in Table 2. It is important to note the multitude of elements that affect each marginal utility. For example, note the lasting effect of goods consumed in the first period on future period health, and thus utility. Simplified versions of the first-order conditions, after setting them equal to zero – Eqs. (3.6) – are displayed in Table 3.

Combining several of the first order conditions yields the following two equations, representing the tradeoff between  $X$  and  $F$  within each period:

$$\frac{MU_{X_1}}{MU_{F_1}} = \frac{P_{X_1}}{(1 - K_1) \cdot P_{F_1}} \quad (3.7)$$



$$\frac{MU_{X_2}}{MU_{F_2}} = \frac{P_{X_2}}{(1 - K_2) \cdot P_{F_2}} \quad (3.8)$$

The above equations show that within each period, the marginal utility the individual derives from both  $X$  and  $F$  is related to the value of  $K$ . For an increase in  $K$  in either period, the price ratio increases and to maintain equilibrium, either  $MU_X$  must increase or  $MU_F$  must fall – this occurs when consumption of  $F$  increases and/or  $X$  decreases. Intuitively, this makes sense because an increase in  $K$  is effectively lowering the price of  $F$ , leading to increased consumption.

The first order conditions can also be combined to show the between period trade-offs of consuming  $X$  and  $F$ .

$$\frac{MU_{X_1}}{MU_{X_2}} = \frac{P_{X_1}}{P_{X_2}} \quad (3.9)$$

$$\frac{MU_{F_1}}{MU_{F_2}} = \frac{(1 - K_1) \cdot P_{F_1}}{(1 - K_2) \cdot P_{F_2}} \quad (3.10)$$

The relationship in Eq. (3.10) shows that the marginal utility the individual derives from fitness in each period is related to the health insurance company's choice of  $K$  in each period. This is because the individual derives marginal utility from the quantities of  $F_1$  and  $F_2$  consumed, which in turn depend on the values of  $K$ . For example, an increase in  $K_1$  decreases the value of the price ratio in Eq. (3.10), and to maintain equilibrium, it follows that  $MU_{F_1}$  must fall and/or  $MU_{F_2}$  must rise. Because marginal utility of  $F_1$  falls as consumption of  $F_1$  increases (and the converse for  $F_2$ ), the ultimate result of an increase in  $K_1$  must be an increase in  $F_1$  and/or a decrease in  $F_2$ . In this case, an increase in  $K_1$  is analogous to the introduction of a subsidy for exercise. Similarly, an increase in  $K_2$  increases the value of the price ratio, and now  $MU_{F_1}$  must rise and/or  $MU_{F_2}$  must fall, or, consumption of  $F_1$  must fall and/or consumption of  $F_2$  must rise. It is also possible to create comparative statics from the first order conditions that show

substitution between  $F$  in one period and  $X$  in the other due to the planning nature of the model. For example, the consumer may choose to substitute towards  $F_1$  at not only at the expense of  $X_1$  but also/instead at the expense of  $X_2$ .

Thus far I have assumed no discounting on the part of the member when weighing second-period utility. However, since we know that individuals do discount the future and its benefits, it is important to observe how the previous analysis changes when discount rates are introduced.

Using a model of traditional exponential discounting, where individuals discount or weigh future outcomes with a constant discount rate  $\delta$ , lifetime utility can be characterized by:

$$U_t = \sum_{i=0}^n \delta^i u_{t+i} \quad (3.11)$$

Translated into the two-period model of this paper, lifetime utility is then characterized by the following expression:

$$U = u[X_1, H_1, (m_1, X_1)] + \delta \cdot u[X_2, H_2, (m_2, X_1, X_2)] \quad (3.12)$$

Conceptually, this yields first order conditions such that the marginal utility of anything in the future ( $H_2$  or  $X_2$ ) is discounted by  $\delta$ , and worth less to the individual at time 1, when decisions are made. This gives rise to a new set of ratios representing utility maximization between periods, shown below:

$$\frac{MU_{X_1}}{\delta \cdot MU_{X_2}} = \frac{P_{X_1}}{P_{X_2}} \quad (3.13)$$

$$\frac{MU_{F_1}}{\delta \cdot MU_{F_2}} = \frac{(1 - K_1) \cdot P_{F_1}}{(1 - K_2) \cdot P_{F_2}} \quad (3.14)$$

The same interpretation of Eq. (3.10) holds for Eq. (3.14), however, the marginal utility of  $F_2$  is now modified by the traditional exponential discount rate,  $\delta$ , which affects all future

periods. Relative to the previous case where  $\delta = 1$ , the same increase in  $K_1$  means that  $MU_{F_1}$  must be relatively lower and/or  $MU_{F_2}$  must be relatively higher. That is, the individual must increase consumption of  $F_1$  or decrease consumption of  $F_2$ . This makes sense intuitively because discounting of future benefits of exercise ( $MU_{F_2}$ ) would lead the consumer to plan to consume less of  $F_2$ . The next section provides a more critical look at this choice to exercise and the associated incentive programs, using a behavioral economic and psychological perspective.

## **V. Insights from Psychology & Behavioral Economics**

While the previous two models are useful in understanding the individual choice to exercise, and the health insurance company's attempt to influence that choice, both models do not capture the entire reality of the problem. Insights from both behavioral economics and psychology can help to further explain and understand the apparent underconsumption of clearly beneficial activities. Furthermore, this additional perspective improves our ability to evaluate the relative potential effectiveness of current programs or policies aimed at solving the problem and suggest improvements.

### *Understanding the Problem*

Contrary to traditional beliefs about exponential discounting, research has shown that exponential discounting is not actually as common as one might believe, and in fact, people often hyperbolically discount, and place *additional* weight on the present (Laibson, 1997). In hyperbolic discounting, the intertemporal marginal rate of substitution is not exclusively dependent on the distance between two consumption points in time. A situation of exponential discounting posits that if I prefer \$100 today to \$110 tomorrow, then I would also prefer \$100 a year from now to \$110 a year and one day from now, but when given this choice, many would be

willing to wait the additional day to receive \$110 a year from now, suggesting that discount rates are not constant over time.

A comparison between traditional exponential discounting rates and hyperbolic discounting rates over time is shown in Figure 3. There are two key differences in the features of the curves. In the hyperbolic function, there is a steep initial drop off point showing present-bias and the immediate higher discounting of future rewards. The hyperbolic function also becomes flatter than the exponential function, showing that delayed rewards are less discounted in hyperbolic models than in exponential models.

Hyperbolic discounting would be observed with exercise in that the trade-off rates between today and the metaphorical tomorrow are different than the trade-off rates between tomorrow and the next day. This difference often leads to preference reversals or a situation of dynamic inconsistency, the term given to the situation that arises when a decision-maker's preferences change over time (Bénabou, 2002). This can be easily understood by thinking of decision-makers as consisting of many selves over time – a today self, a tomorrow self, etc – that do not hold aligned preferences. For example, in the evening before bed, one may decide to set an alarm for 6:00 am but come the morning, the person actually prefers an extra hour of sleep and wakes up at 7:00 am. The same logic can be used to explain the procrastination of exercise – a person may decide on Friday to exercise on Monday, but come Monday, the person's preferences have changed and exercising is no longer a top priority.

In contrast to the standard model of exponential discounting, hyperbolic discounting makes overall utility at time  $t$ ,  $U_t$ , equivalent to:

$$U_t = u_t + \beta\delta u_{t+1} + \beta\delta^2 u_{t+2} + \beta\delta^3 u_{t+3} + \dots \quad (5.1)$$

$$\text{or} \quad U_t = u_t + \beta(\delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + \dots) \quad (5.2)$$

Above,  $\delta$  is the standard exponential discounting rate, and  $\beta$  is the hyperbolic discount rate, which represents our tendency to overvalue the present and uniformly discount all future periods,

DellaVigna (2009) uses the following  $(\beta, \delta)$  model to illustrate the case of preference reversal and self-control problems that occur with exercise. Consider three time periods, denoted  $t_0$ ,  $t_1$  and  $t_2$ . In the first and second periods, the decision maker or agent is a “planner” and “doer”, respectively. Exercise is a good with both an immediate cost ( $b_1$ , which is negative), incurred in the second period ( $t_1$ ), and a future benefit ( $b_2$ ), experienced in the third period ( $t_2$ ). From an ex ante perspective, the planner will plan to exercise at  $t_1$  if  $\beta\delta b_1 + \beta\delta^2 b_2 \geq 0$ , or:

$$b_1 + \delta b_2 \geq 0 \quad (5.3)$$

Above,  $\beta$  cancels out because all payoffs are in the future. However, when the time comes to exercise, the agent *actually* does so only if this new condition holds:

$$b_1 + \beta\delta b_2 \geq 0 \quad (5.4)$$

Note here that  $\beta$  applies to the second term on the left-hand side because it is occurring in the future, but not the first because the present is now  $t_1$ . For certain values of  $b_1$ ,  $b_2$ ,  $\beta$  and  $\delta$ , the agent will plan to exercise but choose not to when the time comes. For example, if  $b_1 = -6$ ,  $b_2 = 8$ ,  $\beta = \frac{1}{2}$  and  $\delta = 1$ , the agent plans to exercise because Eq. (5.3) is positive, but ultimately does not exercise because Eq. (5.4) is negative. This preference reversal occurs because when the time comes to exercise, the future benefit is discounted by the hyperbolic discount rate  $\beta$  and the relatively more salient current costs overpower the future benefit.

Consistent with the example above, Leibman and Zeckhauser (2008) explain that this behavior is common, where many people tend to underinvest in preventive measures like exercise due to overweighting of current-period costs and underweighting of future-period benefits. Such is the nature of exercise – though there are several short-term or immediate

benefits of exercise (for example, heightened energy), many of the benefits are experienced later and are not salient at the time the action occurs. Therefore, in addition to mitigating the moral hazard and exponential discounting problems, subsidizing the costs associated with preventive care helps to overcome the underconsumption of such care by people who act under the inefficient conditions of dynamic inconsistency. In essence, subsidies like those in fitness reimbursement schemes operate to decrease our assessment of the immediate cost of exercise,  $b_1$ , leading us to choose to exercise as a “doer”, not only as a planner.

It is worthwhile, also, to consider the discounting behavior on the part of the health insurer in more detail. If consumers act under conditions like hyperbolic discounting, leading to preference reversals, it follows that firms may do the same and in addition to exponential discounting, also fall victim to present-biased decisions. However, an argument can be made that firms are less prone to these biases due to their scale, organization, experience and exposure to competition. In his book *The Visible Hand*, Alfred Chandler (1977) explains the emergence of the managerial structure of firms and highlights the fact that managers prefer policies that are geared towards long-term stability and growth to policies that solely maximize current profits. Chandler (1990) goes into greater depth describing the organization of modern businesses, explaining that the modern industrial firm is defined as “a collection of operating units, each with its own specific facilities and personnel, whose combined resources and activities are coordinated, monitored, and allocated by a hierarchy of middle and top managers.” In many firms, one of these units specializes in long-term thinking and carries out activities such as research and development, hiring consultants and analysis of large data sets (e.g. data on past experience). Such specialization leads to efficient resource utilization and reductions in costs.

The fact that firms are subject to competition also serves to reduce the incidence of present-bias, as those firms that are less rational are less likely to survive – firms that are predominantly forward-looking ultimately outcompete those who only focus on the present. Even if firms were to have nonstandard features, they still have the incentive to respond to the nonstandard features of consumers – the principal-agent framework is not escapable and it will always be in a firm’s best interest to pursue policies or programs that mitigate the problem.

### *Evaluating Health Behavior Change Programs/Policies*

In efforts to predict and evaluate the relative effectiveness of various behavior-change policies, there should be consideration of how certain programs influence the decision-making process and what they assume to be the underlying factor driving the problem. The designs of the various interventions that exist today suggest what the insurer hypothesizes as to the cause of the problem. Educational modules, pamphlets and online tutorials aim suggest that our failure to exercise at optimal levels is at least in part due to a lack of information. For some individuals, it may be sufficient to provide them with a brochure on the long-term benefits to incite behavior change. For others, however, the problem comes down to more than simple lack of knowledge or misunderstanding of the advantages of regular physical activity. Programs that offer monetary incentives, however, acknowledge that there is more to the problem than just a deficiency of information. Health insurers and employers incentivize people financially because they understand that humans often require the additional nudge to change behavior.

In the three-period  $(\beta, \delta)$  model, it is possible that educational approaches operate to exclusively increase  $b_2$ , while financial incentives like monthly reimbursement serve to reduce current period valuations of the costs of exercise, making  $b_1$  less negative. This idea will be further explored in Section V. Because discount rates are so powerful, it may be that investing in

and developing programs or policies with rewards that cannot be discounted are more likely to change behavior. These will be programs that affect our perception and valuation of immediate rewards versus delayed rewards. In fact, research has shown that in the human brain, separate neural systems evaluate the two types of rewards (McClure et al., 2004). This shows that we think about them differently and arguably therefore modify our behavior based on them differently. While there is some worry that offering extrinsic incentives can undermine intrinsic interest (Lepper, Greene and Nisbett, 1973), it is also possible that extrinsic incentives can be used effectively to change behavior, particularly when the level of initial intrinsic interest in the activity is low and when the activity is one whose attractiveness becomes apparent after engaging in it for a prolonged period of time. Marteau, Ashcroft, and Oliver (2009) share this view, explaining “offering a reward can help people to align their actions more closely with their true preferences. From such a perspective, incentives operate to enhance rather than to restrict autonomy.”

Ariely and Norton (2008) explain that actions can also often create, not just reveal, preferences. They argue that a person’s actions are determined not only by the hedonic utility of those options but also of their memories for past actions that have been influenced by random situational factors. These memories then shape future utilities and thus future actions. In the case of physical activity, exercising in the context of an incentive or in another type of random positive environment may lead to the creation of a preference for the activity that the individual views as reflective of his or her stable preferences. A similar phenomenon is the “learning-by-doing” concept in economic theory where workers are able to improve their productivity through repetition of a given action (Hall and Rosenberg, 2010).



Furthermore, psychological literature on positive addiction suggests that once certain behaviors are undertaken, people can become addicted to their positive psychological effects, a phenomenon pioneered and first described by Glasser (1976). He explains that a positive addiction is an activity that increases one's mental strength and when missed results in some kind of misery, pain, or upset (psychological or physical). The activity causes a pleasurable, sometimes even euphoric mental state, which he describes as trancelike and transcendental. He writes that running, and other types of exercise, as well as meditation, are particularly amenable to this phenomenon. Specifically, he outlines six criteria for a positive addiction: (1) it is something noncompetitive that you choose to do and you can devote an hour (approximately) a day to it; (2) it is possible for you to do it easily and it does not take a great deal of mental effort to do it well; (3) you can do it alone or rarely with others but it does not depend upon others to do it; (4) you believe that it has some value (physical, mental, or spiritual) for you; (5) you believe that if you persist at it you will improve, but this is completely subjective – you need to be the only one who measures that improvement; (6) the activity must have the quality that you can do it without criticizing yourself. Glasser also points out that addiction to exercise or running does not come quickly, with many runners needing to build enough endurance so that they can run effortlessly before they truly reap the mental effects. Such is likely another reason why humans have difficulty starting and maintaining regular exercise routines – the short-term benefits are ironically not necessarily immediately available and the long-term benefits are discounted and therefore not as salient as current costs.

More recent evidence on running/exercise addiction has confirmed Glasser's position. Perkins (1988) studied 100 runners, 99% of which reported feeling a positive addicted state, described as a transcendental, trance-like state that was characterized by free mental relaxation

and euphoria. Furthermore, 98% of the runners explained that they experience discomfort when a planned run is missed. Griffiths (1997) attempted to explain the positive addiction to running with an endorphin hypothesis, suggesting that the addiction is a result of “endogenous morphines” or endorphins that are produced with exercise, that lead to an enhanced mood. Leedy (2009) conducted a qualitative study of long-distance running in women and found that all women used running as a way to cope with emotional stress, supporting the idea that exercise and running lead to better mood states. Cox and Orford (2004) found similar results after interviewing avid exercisers – participants in the study reported both short-term (a ‘buzz’, feelings of enjoyment and satisfaction, and improved mood) and long-term (improved health, fitness, confidence and general well-being) payoffs to exercise that jointly affected their habits or addiction to the behavior. Many studies have also looked into negative exercise addiction or exercise dependence, suggesting that there is a fine line between the aforementioned positive addictive aspect of exercise and the negative dependent nature that some individuals experience that ends up being detrimental to their health (Smijewski & Howard, 2003; Allegre et al., 2006; MacLaren & Best, 2007; Adams, 2009).

#### *Improving Health Behavior Change Programs/Policies*

Given the aforementioned phenomena and research, it is evident that current policies and programs could be improved. It could be that people need only be incentivized to or reimbursed for exercise for a limited period of time, just enough to allow for the habit to develop and for individuals to feel to develop a true preference or feel positively addicted. In an ideal world, each individual would only be reimbursed for the length of time it takes for the habit to develop and the individual to engage in the behavior with or without incentives in place. While ideal, it is not

realistically feasible due to the great variation that exists among people in developing habits and the difficulty that would come with implementing such a complicated system of rewards.

It is also worthwhile to consider alternate means for the health insurance company to monitor or track people's behavior. Using the quantity of visits to the gym does not guarantee that the time is spent effectively or in some cases spent at all. It may be beneficial for insurers to move towards more biometric measures of fitness and reward individuals based on weight-loss or cardiac fitness. This would allow them to have a more accurate assessment of how the fitness or exercise is affecting their members' health and would arguably increase the salience of the benefits of exercise for members. For example, one may begin to see more value in exercising if he/she can and must observe how his/her heart rate or BMI is changing over time. Again, however, this could be costly and not very practical. A potential compromise could be to use a system where people are rewarded in a point accumulation system where points are assigned based on time spent exercising or machines/facilities used. The following section revisits the individual choice to exercise, taking an empirical approach to the assessment of the costs and benefits of exercise as described in the  $(\beta, \delta)$  hyperbolic discounting model.

## **VI. Empirics**

### *1. Design*

In order to further investigate my hypothesis as to the differential influence of incentive programs versus more educational/informative interventions on individual assessments of the cost and benefit, I conducted the following empirical study. I used a between-subjects design where 194 participants aged 13-85 completed a survey that asked them to assess the cost of a given exercise routine ( $b_1$ ) as well as their valuation of the benefits of the routine ( $b_2$ ). The exercise routine was given as exercising for at least one hour, two times per week for three

months. Before answering the cost and benefit questions, participants were primed to one of three conditions (two experimental and one control). The first experimental condition consisted of a monetary incentive prime in which participants were instructed to imagine they were enrolled in an incentive program that rewarded them with a cash subsidy for exercising each month. Specifically, the prime read:

While completing this survey, please imagine that you're in the following situation: You have just enrolled in a fitness benefits program via your Health Insurance Company that will indefinitely reward you for exercising regularly. According to the plan, your Health Insurance Company will pay \$20 of your monthly gym membership if you attend the health club 8 or more times in that month (roughly two visits per week). If you meet or exceed attendance goals, you will receive this reimbursement via a check at the end of each month.

The second experimental prime was educational in nature – participants were instructed to read an abridged version (see Appendix) of a report published by the Mayo Clinic (2011) on the benefits of physical activity. For the control condition, subjects were primed with a neutral prime, which discussed the tenants of the Affordable Care Act proposed by the current President, Barack Obama (see Appendix). After priming, each subject was asked to recall and summarize what he or she had received in the prime part of the survey. Participants that failed to complete this portion of the survey were excluded from analysis.

The next part of the survey consisted of three questions. The first question asked participants how they would value the cost (financial and non-financial) of the exercise routine ( $b_1$ ), the second asked participants how large of a benefit they would expect from the routine, and the third question asked participants how much they would value this benefit ( $b_2$ ). All answers were restricted to multiple-choice on a Likert scale from 1-10 where higher numbers signify greater cost or greater benefit. The final portion of the survey asked participants to answer a set of demographic questions including sex, age, educational status and employment status.

Participants were also asked to provide information on their current exercise habits and on their

perceptions of their current weight and level of fitness. Data was collected with SurveyMonkey and analyzed using SPSS Statistical Software.

## 2. Results

To test the hypotheses that an incentive scheme reduces an individual's evaluation of the current-period cost of exercise and an educational intervention increases an individual's evaluation of future benefits, mean cost and benefit values were compared across the three conditions (displayed in Table 4). Neither the monetary incentive nor health benefits conditions differed significantly from the control in evaluations of cost, but a marginally significant difference was observed between the monetary incentive and health benefits conditions ( $M=4.69$  vs.  $M=5.38$ ,  $p=0.075$ ), suggesting that there is a cost-reducing nature to monetary incentive programs. There were no significant differences observed amongst the three conditions for valuations of the benefits of exercise, suggesting that educational interventions may not affect individual perceptions of the benefits of exercise.

In addition to the general effect of the different conditions on valuations of costs and benefits, the prime effect was also tested within smaller groups defined by age, sex, weight and current exercise habits. Of note in these analyses are the following results. Infrequent exercisers, defined as exercising less than or equal to two times per week, in the monetary incentive condition perceive the cost to be significantly lower compared to participants in the control condition ( $M=5.11$  vs.  $M=6.42$ ,  $p<0.05$ ). Frequent exercisers, defined as those who exercise more than two times per week, in the monetary incentive condition perceive the cost to be marginally significantly lower compared to participants in the health benefits condition ( $M=4.42$  vs.  $M=5.38$ ,  $p=0.056$ ). Older adults, greater than 25 years of age, in the monetary incentive condition also perceive cost to be marginally significantly less than those primed with health

benefits ( $M=4.85$  vs.  $M=5.88$ ,  $p=0.091$ ). Finally, participants that consider themselves to be overweight or obese evaluate the value of exercise to be marginally significantly less in the incentive condition compared to those in the control condition ( $M=7.50$  vs.  $M=8.38$ ,  $p=0.073$ ). No effects were observed within young adults (less than or equal to 25 years of age) or those who consider themselves to be underweight or of normal weight.

A final set of exploratory analyses was conducted to see if valuations of the costs and benefits of exercise vary by groups, independent of condition. These analyses revealed that females value the benefit of exercise to be significantly higher than males ( $M=7.77$  vs.  $M=6.98$ ,  $p=0.013$ ). As one might expect, frequent exercisers also perceive the cost of exercise to be significantly lower compared to less-frequent exercisers ( $M=4.63$  vs.  $M=5.52$ ,  $p<0.01$ ). No difference was observed in these participants' perception of the benefits of exercise. Participants who consider themselves to be normal or underweight perceive the cost to be significantly higher than participants who consider themselves overweight or obese ( $M=5.11$  vs.  $M=4.41$ ,  $p=0.05$ ). No differences emerged between ages or by student or employment status. While these results are suggestive, it is important to note that because no corrections were performed for the experiment-wise alpha, the results from the reported t-tests may be affected. Future research should correct for the large number of comparisons to ascertain the true relationships.

### *3. Implications*

The results from this study have substantial implications for current fitness incentive or subsidy programs. The difference in cost perceptions observed across all participants between those in the incentive condition versus those in the health benefits conditions suggests that incentives do operate, to some extent, to reduce perceived cost and are likely to lead to changes in behavior. Furthermore, the differential effect of the different primes by groups suggest that to

achieve optimal results, incentive programs should potentially vary by groups. Current exercise habits predict different responses to the subsidies as well as age and weight status. The exploratory analyses by the smaller groups also suggest that current subsidy programs should be more tailored to individual characteristics. Perhaps females and those who already exercise frequently should be subsidized less and individuals with different weight statuses should receive different subsidies. As previously mentioned, however, there are concerns of fairness, therefore it may be moral to avoid essentially price-discriminating by arbitrary characteristics (sex and age) and focus exclusively on those that the individual can control or influence more easily (current habits and weight). While the hypothetical nature of the study is limiting, these results show that there is variation both across different groupings of individuals and in responsiveness to the three conditions. Future research is necessary and would be beneficial to provide greater insight as to how incentive schemes can be designed to achieve the best outcomes. An analogous system is auto-insurance companies using monitors in members' cars that track driving behavior, which in turn, affects the rates charged to the member.

## **VII. Conclusion**

This paper sought to model the individual choice to exercise and the health insurance company's subsidy for the behavior, as well as provide insight as to the optimal subsidy for such behavior. A traditional principal-agent framework is necessary and useful in understanding the problem: including both models for each decision maker's choice – the health insurance company choosing to set their amount of reimbursement and the individual choosing to exercise given that effective subsidy. A traditional economic approach, however, is not sufficient for this goal and is not able to fully explain or capture the essence of the problem. The phenomenon of hyperbolic discounting from the field of behavioral economics as well as insights from

psychology facilitate a deeper, more realistic understanding of the problem and therefore allow us to better design solutions. The empirical evidence provided further shows the need for careful design of programs that target individual characteristics rather than the insured population as a whole. It is only once we understand the root of a problem that we can effectively respond and find a solution. In the case of exercise and physical activity, the immense physiological and mental benefits can and hopefully will lead to not only lower costs but a generally happier, healthier population.



## Tables & Figures

Figure 1: US National Health Expenditures 2000-2009

Source: <https://www.cms.gov/NationalHealthExpendData/>

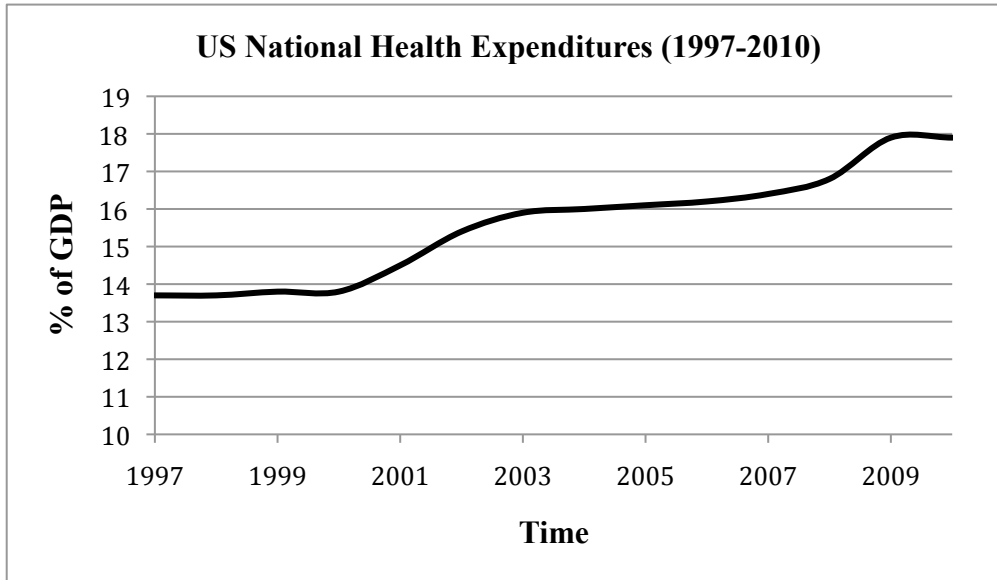


Figure 2: Age-adjusted Prevalence of Overweight, Obesity, and Extreme Obesity among US Adults aged 20 and over

Source: [http://www.cdc.gov/NCHS/data/hestat/obesity\\_adult\\_07\\_08/obesity\\_adult\\_07\\_08.pdf](http://www.cdc.gov/NCHS/data/hestat/obesity_adult_07_08/obesity_adult_07_08.pdf)

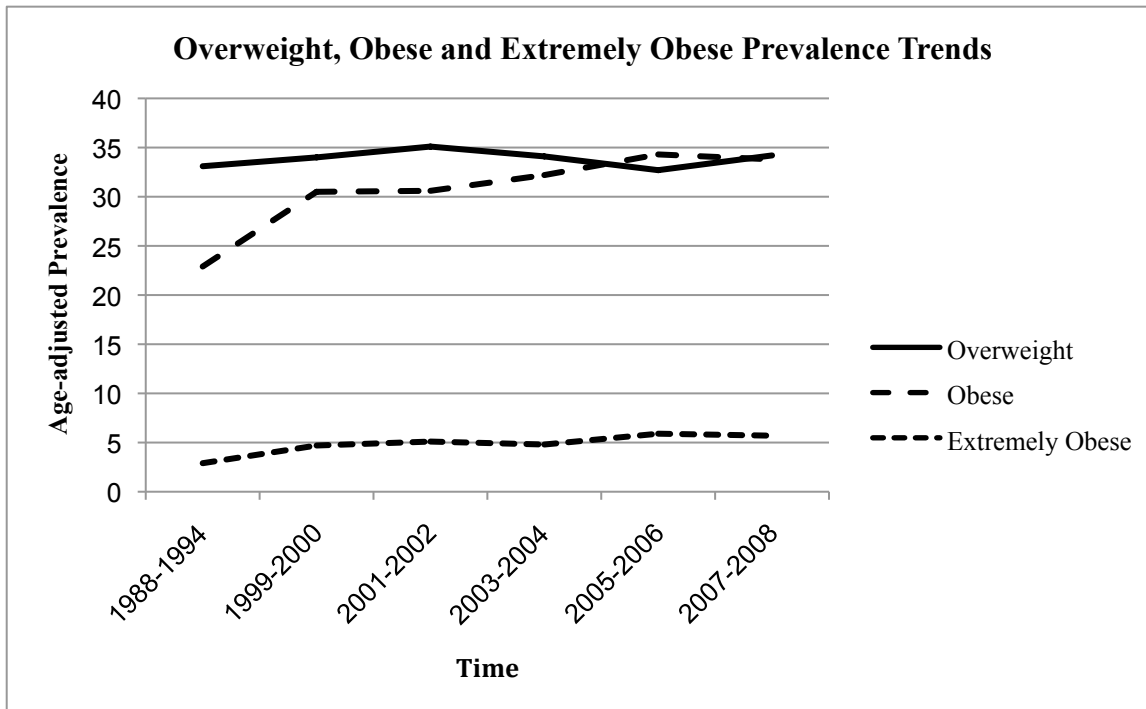


Figure 3: Exponential vs. Hyperbolic Discounting

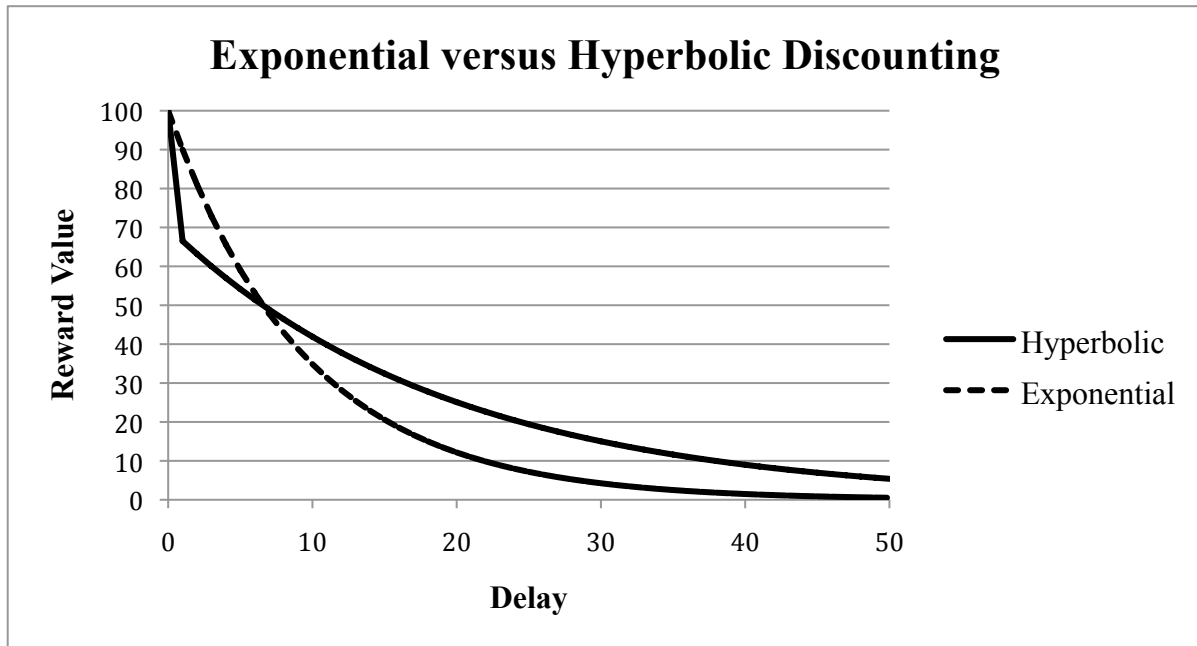


Table 1: Top 10 Health Insurance Companies (as ranked by US News and World Report)

Source: <http://health.usnews.com/health-plans/national-insurance-companies>

Name	Size	Type of Fitness Incentive
Unitedhealth Group	75 million	D, W
Wellpoint Inc. Group	66 million	D, W
Kaiser Foundation Group	8 million	D
Aetna Group	41 million	D, P
Humana Group	12 million	P
HCSC Group	13 million	D
Coventry Corp. Group	5 million	D, P
Highmark Group	5 million	D
Independence Blue Cross Group	3 million	D

D=Discounted gym memberships

W=worksite options

P=wellness/education programs

Table 2: First Order Conditions without Discounting Behavior

Equations (3.5) from the Consumer's Decision	
$\frac{d\Phi}{dX_1} = \frac{dU}{dX_1} + \frac{dU}{dH_1} \cdot \frac{dH_1}{dX_1} + \frac{dU}{dH_2} \cdot \frac{dH_2}{dX_1} - \lambda \cdot P_{X_1} = 0$	(3.5a)
$\frac{d\Phi}{dX_2} = \frac{dU}{dX_2} + \frac{dU}{dH_2} \cdot \frac{dH_2}{dX_2} - \lambda \cdot P_{X_2} = 0$	(3.5b)
$\frac{d\Phi}{dF_1} = \frac{dU}{dH_1} \left( \frac{dH_1}{dm_1} \cdot \frac{dm_1}{dF_1} \right) + \frac{dU}{dH_2} \left( \frac{dH_2}{dm_1} \cdot \frac{dm_1}{dF_1} + \frac{dH_2}{dm_2} \cdot \frac{dm_2}{dm_1} \cdot \frac{dm_1}{dF_1} \right) - \lambda \cdot (1 - K_1) \cdot P_{F_1} = 0$	(3.5c)
$\frac{d\Phi}{dF_2} = \frac{dU}{dH_2} \left( \frac{dH_2}{dm_2} \cdot \frac{dm_2}{dF_2} \right) - \lambda \cdot (1 - K_2) \cdot P_{F_2} = 0$	(3.5d)
$\frac{d\Phi}{d\lambda} = I - ((1 - K_1) \cdot P_{F_1} \cdot F_1) + ((1 - K_2) \cdot P_{F_2} \cdot F_2) + (P_{X_1} \cdot X_1) + (P_{X_2} \cdot X_2) = 0$	(3.5e)

Table 3: Simplified First-Order Conditions without Discounting Behavior

Equations (3.6) from the Consumer's Decision	
$MU_{X_1} = \lambda \cdot P_{X_1}$	(3.6a)
$MU_{X_2} = \lambda \cdot P_{X_2}$	(3.6b)
$MU_{F_1} = \lambda \cdot (1 - K_1) \cdot P_{F_1}$	(3.6c)
$MU_{F_2} = \lambda \cdot (1 - K_2) \cdot P_{F_2}$	(3.6d)
$I = ((1 - K_1) \cdot P_{F_1} \cdot F_1) + ((1 - K_2) \cdot P_{F_2} \cdot F_2) + (P_{X_1} \cdot X_1) + (P_{X_2} \cdot X_2)$	(3.6e)

Table 4: Mean Cost & Benefit Values by Prime

	Cost (b <sub>1</sub> )	Benefit (b <sub>2</sub> )
Fitness Incentive	4.69*	7.29
Health Benefits	5.38*	7.79
Control	4.87	7.74
Total	4.94	7.56

Note: \* indicates marginally significant difference

## Appendix

### *Health Benefits Prime*

Please read the following excerpt on the benefits of regular physical activity.  
(Source: Mayo Clinic)

Want to feel better, have more energy and perhaps even live longer? The benefits of exercise are yours for the taking, regardless of your age, sex or physical ability.

#### No. 1: Exercise controls weight

Exercise can help prevent excess weight gain or help maintain weight loss. When you engage in physical activity, you burn calories. The more intense the activity, the more calories you burn.

#### No. 2: Exercise combats health conditions and diseases

Being active boosts high-density lipoprotein (HDL), or 'good,' cholesterol and decreases unhealthy triglycerides. This one-two punch keeps your blood flowing smoothly, which decreases your risk of cardiovascular diseases. Regular physical activity can also help prevent or manage stroke, metabolic syndrome, type 2 diabetes, depression, certain types of cancer, arthritis and falls.

#### No. 3: Exercise improves mood

Physical activity stimulates various brain chemicals that may leave you feeling happier and more relaxed. Exercising regularly can also boost your confidence and improve your self-esteem.

#### No. 4: Exercise boosts energy

Regular physical activity can improve your muscle strength and boost your endurance.

#### No. 5: Exercise promotes better sleep

Regular physical activity can help you fall asleep faster and deepen your sleep.

#### No. 6: Exercise puts the spark back into your sex life

Regular physical activity can lead to enhanced arousal for women. And men who exercise regularly are less likely to have problems with erectile dysfunction than are men who don't exercise.

#### No. 7: Exercise can be fun

It gives you a chance to unwind, enjoy the outdoors or simply engage in activities that make you happy alone or with others.

### *Neutral Prime*

The Affordable Care Act, a bill recently passed by the Obama Administration, puts individuals, families and small business owners in control of their health care. It reduces premium costs for millions of working families and small businesses by providing hundreds of billions of dollars in tax relief – the largest middle class tax cut for health care in history.

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