Modeling Employer Provided Health Incentive Programs

Uyen Tran

December 6, 2013

This paper explores the participation in employer provided health incentive programs and the choices made by individuals offered these benefits. The theory presented in this paper models the decisions to exercise, eat well, and get educated about improving one's health. There is a brief discussion on possible data to be used for empirical research in the future at the end.

1 Introduction

According to a report in the Wall Street Journal, in 2009 about 57% of companies based in the United States provided financial or wellness incentives in an effort to make their employees healthier. Today, that number is nearly 90%. The nominal value of these incentives has increased as well, doubling from $260 to $521 over the past four years. There are several reasons why these health incentive programs are becoming a new business trend. More than sixty percent of Americans receive their health insurance coverage through their employer and an even higher percentage among working age individuals, and healthier employees have been shown to benefit employers in the following ways:

- Health incentive programs have been shown to lead to reductions in medical care consumption as well as lower health insurance premiums. Based on a meta-analysis conducted by Baicker, Culter and Song (2010), medical costs fell by approximately $3.27 for every dollar spent on health and wellness programs.
- Healthier employees miss fewer days of work and are generally more productive. From the same analysis, the costs to a company from absenteeism fell by $2.73 for every dollar spent on health and wellness programs.

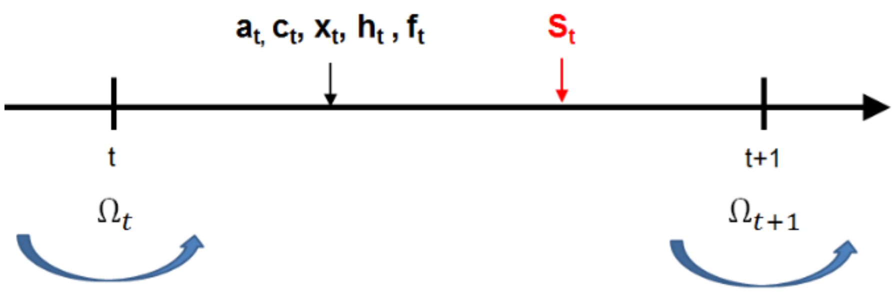
These programs are being readily adopted by larger firms while smaller firms have been slower to execute implementation. These health incentive programs come in several forms varying in size and scope. They can be categorized into the following groups:

- **Education and personal health assessment:** Rewards are granted to participating employees for completing activities that measure personal health related risk factors. Assessments vary in intensity from an online questionnaire to an in-person medical screening.
- **Plan Based Incentives:** Reduced premiums are offered to employees based on a company's health plan costs. An employee may reap the benefits of lower premiums based on eligibility (e.g. non-smoker, low cholesterol, etc.); upfront incentives or disincentives (lower premiums vs. surcharge penalties).
- **Action-Based Incentives:** : Participating employees are rewarded with cash or gift cards for investing in their own health through logged exercise, risk assessments, and/or joining health related support groups.
- **Negative Incentives:** An employee may be penalized with premium surcharges for not participating in health activities. Negative incentive programs are rarely used independently, but, rather, often coupled with incentive programs.
- **Comprehensive Incentives:** Any combination of the incentives listed above.

The model presented in this paper will focus on three specific forms of employer provided health incentive programs: (1) education and personal health assessment, (2) plan based incentives, and (3) action based incentives. Given the way these three types of incentives are modeled, negative incentives and comprehensive incentives are naturally built into the framework.

2 The Model

A dynamic stochastic model of participation in health incentive programs is described in this section. Given four variables including the health wellness incentives provided by the employer, previous education, health history, and experience, the model defines the employees decision to participate in the program and to what degree. Participation in the program is a multifaceted choice faced by the employee in each period and includes receiving health education, exercising, eating well, consumption, and deciding how much to work. If the employee chooses not to participate, he/she may save both time and the costs of participation, but does not benefit from possibly lower premiums and better health outcomes (e.g. lower Body Mass Index (BMI) and the avoidance of a "health shock" such as a heart attack.). Based on the employee's decisions, his/her wage and health (proxied here by BMI) evolve stochastically. Thus, this model captures the optimization problem of employees with employer provided health incentive programs available to them. The timing of the model is presented in the figure below.



At the beginning of time t, it is assumed that the employee has full knowledge of her state variables, denoted in the figure above as Ω_t . Next, the employee makes a joint decision between health education, consumption, exercise, hours worked and food intake. Finally, at the end of the period, the employee either observes a health shock or does not, and in general health (BMI) is updated (as are all of the state variables). This will affect the optimization problem in time $t+1$.

The state variable vector, Ω_t is formed by years of health education history (A_t), years of work experience (E_t), history of exercise (X_t), body mass index (BMI) history (B_t) and whether or not the individual experienced a health shock in the previous period (S_{t-1}).

With the knowledge of these state variables, the employee evaluates all alternatives which involve the joint actions of acquiring health education (a_t), levels of consumption (c_t), how much to exercise (x_t), how many hours to work (h_t), and what kind of food to eat (f_t).[1]

The form and evolution of these variables are presented below: education and personal health assessment, a_t, captures employee participation in a health questionnaire, meeting with a health professional, or receiving any new education in period t the indicator, a_t, takes on the values:

$$a_t = \begin{cases} 0 \text{ - to not receive health education} \\ 1 \text{ - to receive health education} \end{cases}$$

The state vector includes a count of the number of times an employee has received education A_t up to period t, and the evolution of this state variable is defined as $A_{t+1} = A_t + a_t$. The model assumes that education persists across periods. That is, it does not depreciate. For example, if an employee is informed by a doctor that she is at a high risk for heart attack, then she is not likely to forget it. The justification and use of this variable will be further described as the optimization problem is presented.

The types of food consumption, (f_t), is a discrete decision based on two basic assumptions: an employee chooses three meals a day and food may be classified as good or bad. In this context, "good" food may be defined as integral components of a healthy diet. "Bad" food may be defined as any other foods, including an excess of food over the employee's recommended caloric intake. The values for this variable are as follows: [2]

$$f_t = \begin{cases} 1 \text{ - to eat bad food all three meals} \\ 2 \text{ - to eat bad food two of three meals} \\ 3 \text{ - to eat good food two of three meals} \\ 4 \text{ - to eat good food all the time} \end{cases}$$

Similar to the f_t indicator, exercise (x_t) is a discrete variable that depends on the level of

[1] This joint decision can be broken up into two parts with a different structure and justification. If the individual first decides to get educated and assessed they may have to commit to that decision before hand (e.g. make an appointment, etc.). Then following that decision the individual would make a joint decision of consumption, hours worked, exercise and food. An argument can be made for both timings, but this model makes it a joint decision because the benefits of health education may not be realized immediately.

[2] Note that is a fantasy variable, in that it would be near impossible to have this variable, let along this level of detail in the data. I am still trying to think of ways to proxy for this variable going forward.

exercise in each period.[3] The evolution of this variable is a count of the number of times an individual has exercised $X_{t+1} = X_t + x_t$; this law of motion equation is completely deterministic.

$$x_t = \begin{cases} \text{0 - to never exercise} \\ \text{1 - to exercise some} \\ \text{2 - to exercise a lot} \end{cases}$$

Hours worked (h_t)is considered a continuous variable:h_t = number of hours worked per period. Work experience is a simple count variable that adds up the number of periods the individual has worked. E_t enters the state vector at time t and therefore is equivalent to the individual's experience up to time t. The evolution of this state variable is $E_{t+1} = E_t + e_t$.

This section describes the stochastic state variables that are not completely deterministic. Equation 2.1 describes wage as a stochastic variable based on work experience, hours worked and BMI.[4] To this end, the model also allows BMI to be stochastically determined. Even though there is a strong correlation with caloric intake and caloric expenditures, there is also an element of genetics. Equation 2.2 defines the probability of BMI based on BMI in the previous period, exercise and exercise history, food choices as well as education history. Education history is included with the assumption that a more health aware individual may be better at health producing activities which would eventually be reflected in BMI results.

$$w_t = w(E_t, h_t, B_t) \tag{2.1}$$

$$B_{t+1} = b(B_t, \underbrace{X_{t+1}}_{X_t + x_t}, f_t, \underbrace{A_{t+1}}_{A_t + a_t}) \tag{2.2}$$

Finally, equations 2.3 and 2.4 define the probability an individual experiences a health shock at the end of time t. This probability is a function of whether that person had experienced a shock in the previous period, her exercise history and current behavior, BMI, current food intake and consumption.

$$P(S_t = 1) = S(S_{t-1}, X_{t+1}, B_t, f_t, c_t) = \pi_t^S \tag{2.3}$$
$$P(S_t = 0) = 1 - \pi_t^S \tag{2.4}$$

The employee's utility function is defined in equation 2.5. Each period the individual gets utility from normal consumption and food consumption, exercise, health (proxied here by BMI), and leisure. The model also allows for heterogeneity in preferences. The utility from consumption and leisure are somewhat standard.

$$u_i = \alpha_0 \frac{(c_t + f_t^1 + f_t^2 + f_t^3 + f_t^4)^{1-\alpha_1}}{1-\alpha_1} + \alpha_2 \boldsymbol{X}(x_t, X_t, B_t, S_{t-1}, A_t) + \alpha_3 B_t + \alpha_4 \ell_t + \epsilon_t \tag{2.5}$$

[3]Unlike the food variable, this variable may not be quite as elusive. Due to the nature of health incentive programs and log preferences for accountability, some firms keep track of hours exercised.

[4]Several papers including Baum (2004) and Gilleskie, Han, Norton (2014) have suggested that BMI effects wages.

The individual gets utility from type of food consumed; fried foods taste better, etc. The utility gained from exercise is determined by a function of whether the person exercised in this period, his/her exercise history, BMI, whether or not they experienced a shock in the previous period and how much information he/she has on personal health and training. This is a function because individuals who have a shorter history of exercise may not gain utility from exercise, though they may benefit from other channels like BMI. Conversely, individuals who have never gone a day without exercise may get utility directly from exercising and may get disutility from not exercising. Finally, an individual may receive utility from BMI, if we use it as a proxy for health (e.g. he/she can climb the stairs without being winded, etc.)

To maximize this per period utility function, the employee is subject to two types of constraints. Equation 2.6 defines the budget constraint for the household. Equation 2.7 defines the individuals time constraint.

The employee receives a wage multiplied by the number of hours worked. With this wage the employee pays for consumption, the cost of food ($p_f f_t = p_f^b(3f_t^1 + 2f_t^2 + f_t^3) + p_f^g(f_t^2 + 2f_t^3 + 3f_t^4)$), insurance premiums ($P^I(B_t, A_t)$ = insurance premiums), the cost of exercise ($p_x x_t$ = cost of exercise - e.g. gym memberships), and other medical costs. Note that if the individual experiences a health shock in period $t-1$ then he/she automatically incurs the cost of medical care $P^m(I_t)m(B_t, S_{t-1})$.

This budget constraint is also where the model incorporates the bulk of the incentive programs:

- **Education and personal health assessment**: If the individual get educated or goes in for a health assessment the firm would reduce the premium price for insurance $P^I(B_t, A_t)$
- **Plan based incentives**: Similarly, if the individuals BMI or other health indicators are favorable they would also receive lower premiums via $P^I(B_t, A_t)$.
- **Action based incentives**: If the firm provides financial action based incentives for the individual, they receive a transfer of $z(x_t)$ which is a function of the amount of exercise.

$$c_t = w_t h_t - p_f f_t - p_x x_t + z(x_t) - P^I(B_t, A_t) - P^m(I_t)m(B_t, S_{t-1}) \tag{2.6}$$

The individual also faces a time constraint, where total time is given as T_t. The price in terms of time is denoted by p_t. Each individual pays a time cost for hours of work, leisure, exercise and finally to get educated.

$$T_t = p_t^h h_t + p_t^\ell \ell_t + p_t^x x_t + p_t^a a_t \tag{2.7}$$

Now, the employee maximizes the discounted lifetime expected utility with respect to the choice variables, a_t, c_t, h_t, f_t, and x_t. This value function is a function of the state variables and the heterogeneity reflected in the ϵ_t^{xfha} term.

$$
\begin{aligned}
V^S_{xfha}(\Omega_t,\epsilon_t) \quad = \quad & \bar{U}(c_t,\ell_t,f_t=f,x_t=x|B,X)+\epsilon_t^{xfha} \\
& +\beta\int_w\int_b[\pi_t^S V^1(\Omega_{t+1}|d_t^{xfha}=1)+(1-\pi_t^S)V^0(\Omega_{t+1}|d_t^{xfha}=1)] \\
& B(B_{t-1},x_{t-1},X_{t-1},f_{t-1},A_{t-1})W(E_t,h_t,B_t)\partial b\partial w
\end{aligned}
$$

Where:

$$
V^S(\Omega_{t+1})=\mathbf{E}_t[\max_{xfha}V^S_{xfha}(\Omega_{t+1},\epsilon_{t+1})|S]
$$

The probability of a health shock is π_t^S. The value function integrates over the continuous variables: BMI and wage as well as accounts for the possibility getting a health shock.

This section discusses the trade-offs related to each one of the choice variables of interest. If the employee chooses to eat mostly bad food, then he/she may gain direct utility from eating bad food and may even benefit from more money to allocate in the budget constraint. However, the trade-off for such food consumption may be a greater probability of increased BMI and a greater probability of a health shock in the future.

Similarly, if an employee chooses to exercise, he/she may increase utility from exercise and may have better expected future health. With the added benefit from employer provided health incentive programs the employee may also gain transfers for each health producing activity. Less direct benefits from exercise may include lower premiums due to a lower BMI and better health. However, the potential trade-offs include the cost of exercising (e.g. gym membership), the time it takes to exercise, and any health shocks caused therein (e.g. a pulled muscle or heat exhaustion).

The cost to receiving education in this context is generally time expended in the current period. An employee must see a doctor, complete a questionnaire, etc. The costs of these activities are already included in the employee's insurance policy expenditures. However, the benefits of education can come through exercise, BMI, future lower premiums, and an improved allocation of time spent working, exercising, leisure, and eating.

3 Possible Future Research Application

This model would be useful for exploring the costs and benefits of certain types of employer provided health incentive programs and answering a number of emerging questions around this new trend: Are incentives more effective than disincentives? Are action based incentives more effective in improving personnel health than program based incentives?

Young professionals at the debut of new careers often do not analyze the most detailed of firm benefits when making a decision, but may consider them at the margin especially among highly competitive and similar companies. With this in mind, a future empirical research could focus on the practices of major legal and accounting firms who rely on the slightest of advantages over their competitors in luring in new talent. These firms also provide additional nuances which would make research particularly interesting:

- Young Demographics: 60% of the work force at accounting firms such as Deloitte, PricewaterhouseCoopers, Ernst and Young, and KPMG is 30 years old or younger and for many new hires it is their first full time job away from the university.
- Stressful Nature of Work: The industry standard for employee assessment is loosely based on billable hours. The structure for promotion often contradicts the incentives the health programs promote.
- Possible Natural Experiments: These firms are very similar, allowing for differences in health promoting programs to be compared with minimal contextual differences.
- Stratification of the workforce: Firms such as these provide clear demarcation among skill levels and work experience of each employee (intern, associate, senior associate, manager, senior manager, etc.).

Future research could attempt to model the effects of these health promoting programs at the various strata. Is the program more effective for interns and associates when payoffs are further removed from revenue of billable hours? For example, might a younger employee participate in a health program more readily than an older employee when the rewards for such participation are immediate but future promotion is not? These types of answers could more effectively allocate a firm's resources and provide greater customization of health wellness incentives within its various departments and management levels.

Sources:

Baum, C. L. and Ford, W. F. (2004), The wage effects of obesity: a longitudinal study. Health Econ., 13: 885-899. doi: 10.1002/hec.881.

Gilleskie, D., E. Han, and E. Norton. 2014. "Disentangling the Contemporaneous and Life-Cycle Effects of Body Mass on Earnings." Working paper.
Katherine Baicker, David Cutler and Zurui Song. Workplace Wellness Programs can Generate Savings, Health Affairs, 29, no.2 (2010):304-311 (published online January 14th, 2010; 10.1377/hlthaff.2009.0626).

Wieczner, Jen "Your Company Wants to Make you Healthy", Wall Street Journal, April 8th, 2013. Assessed online: November 1, 2013 - online.wsj.com/news/articles/SB10001424123