Do Your Neighbors Influence Your Health?

HEATHER L. BEDNAREK
Saint Louis University

ROWENA A. PECCHENINO
National University of Ireland, Maynooth

SALLY C. STEARNS
University of North Carolina at Chapel Hill

Abstract

When individuals make decisions regarding their allocation of time and income, the health investment and health that they achieve may fall short of the goals prescribed by medical guidelines and health policymakers. Instead of the oft-observed policy responses such as additional spending on public awareness campaigns, it may be more fruitful to determine how individuals can be induced to choose behaviors that will lead to the prescribed health. That is, one must recognize the trade-offs between health investment and consumption or leisure today in the face of factors such as social norms, job stress and advances in health technology.

1. Introduction

Health policy sometimes falls short of its intended goals. For example, medical guidelines regarding markers for optimal health (e.g., cholesterol levels,

blood pressure levels, body mass index) are introduced with the implicit message that if you achieve these markers you will be healthier and happier than your peers who do not. However, subsequent reports often find that many individuals do not achieve these markers for good health. Are these less healthy individuals really less happy? Most likely they are not.

When individuals make decisions concerning the allocation of their resources of time and income, the level of health investment and health that they achieve may fall short of what is prescribed by medical guidelines. Such policy goals may be particularly challenging in the face of social norms of consumption and leisure (the markers actually used in individuals' decision making), job stress, and advances in health technology. The public policy response is often additional spending on public awareness campaigns, even when the public is already aware. Even though more medical research to improve the health of individuals is an admirable goal in and of itself, it may not be a cure for a poorly designed policy. Instead, it may be more fruitful to determine how individuals can be induced to choose behaviors that will lead to the prescribed health while acknowledging the trade-offs between health investment and consumption or leisure today.

In the spirit of Grossman's (1972) health investment model, we suggest a theoretical framework where one makes investments today in terms of healthy activities and medical care to achieve one's desired health tomorrow while considering factors that can potentially prevent one from achieving or further encourage one's health investment. First, let us consider why social norms of consumption and leisure matter. An individual perceives a level of consumption and leisure obtained by individuals around her and as such she makes her own consumption and leisure decisions based on the norms she views. In other words, what consumption and leisure must she obtain in order to "keep up with the Joneses." In the context of a health investment model, such social norms are a mechanism that may alter decisions regarding medical expenditures and time spent in healthy activities such as exercise, which ultimately affect health in both positive and negative manners.

Second, our model suggests that greater education may not always be associated with greater health, as was found by Grossman (1972), if forces such as job stress are present. There may also be complementarity or substitutability between leisure or consumption and health. That is, some individuals choose consumption and leisure that have positive spillovers to health, such as a high fiber/low fat diet, gardening, or playing tennis. These choices may result in individuals foregoing direct investments in medical care or exercise time. Lastly, we find that individuals may view increases in health technology as the "silver bullet" whereby they can increase consumption and leisure today while believing they are still making adequate investment in health for tomorrow; this, unfortunately, may not come to pass.

2. Background

The application of the human capital model (Becker 1964, 1967) to health largely began with Grossman's (1972) model of health capital as a component of human capital (see discussion in Grossman (2000) and numerous extensions thereof). In his basic model of the demand for health, health is a capital good that generates a stream of health services. Production of health takes time and money, and thus determines the amount of time available for market and non-market activities as well as the amount of income available to purchase non-health goods. The production of health outputs is determined by an individual's innate abilities and/or characteristics, which define her personal health production function, and by health inputs such as medical care, diet, and exercise.

In most models of health capital, consumption of non-health goods and leisure generally yield unambiguous utility benefits, i.e., more is always better. Muurinen (1982) suggests, however, that some behaviors such as smoking or overeating might be causes of use-related deterioration of health. Similarly, Forster (2001) acknowledges such behaviors where, in a model with health in the utility function, utility-maximizing individuals choose healthy or unhealthy consumption, though unhealthy consumption is utility reducing. However, we observe that individuals choose to engage in certain behaviors or lifestyles, whether smoking, overeating, or no physical activity, that may be health reducing, but which enhance overall well-being.

Several explanations have been put forth in trying to explain the propensity to engage in unhealthy behaviors at the expense of current and future health. If the rate of time preference is sufficiently high such that agents discount the future health risks associated with current, possibly, unhealthy consumption and inactivity, then the prevalence of unhealthy conditions such as obesity could increase (Levy 2002, Komlos, Smith, and Bogin 2004). Alternatively, individuals may have time-inconsistent preferences or varying rates of time preference (Gruber and Koszegi 2001, Frederick, Lowenstein, and O'Donoghue 2002). Becker and Murphy (1988) suggest, in their rational addiction model, that unhealthy behaviors such as overeating or underexercising can rationally occur. For example, past caloric intake provides increased marginal utility of calories consumed and thus has a positive impact on current and future calorie consumption. Agents could have problems with self-control (Thaler and Shefrin 1981, O'Donoghue and Rabin 2000), or they may perceive the behavioral adjustment costs to be too great to adjust their consumption and leisure toward more healthful living (Bednarek, Jeitschko, and Pecchenino 2006).

It has been recognized that social norms also matter. Individuals have a natural tendency to compare their situation—whether consumption, income, leisure, saving, or health—to that of those around them. Individuals make these social comparisons for self-enhancement and/or self-improvement purposes (Falk and Knell 2004). Easterlin (1974) was one of the first economists

to suggest that social norms matter for an individual's happiness or well-being. In particular, he found that one's own income—absolute income—influences happiness, but perhaps, more importantly, one's income relative to that of one's neighbors also affects one's happiness. More recent studies (e.g., Easterlin 1995, Clark and Oswald 1996, Blanchflower and Oswald 2004) have found further evidence confirming that relative income, and not just absolute income, matters for an individual's happiness.

Another line of research in the public health and economics literature has suggested that relative income, more than absolute income, is associated with the health of individuals. Using aggregate data Wilkinson (1996, 1997a, 1997b) and others (see, e.g., Kaplan et al. 1996, Kennedy, Kawachi, and Prothrow-Stith 1996) found that greater income inequality is associated with poorer health. To this extent, social norms dictate that individuals use their resources to achieve a minimum level of income or consumption. However, these findings have been challenged by others such as Deaton (1999). In particular, support of the relative income–health association is much weaker, based on micro-level analyses of individuals, for a range of health measures including individual mortality, self-reported health, and infant birth weight (see Meara 2001, Mellor and Milyo 2002, Gerdtham and Johannesson 2004). In all of these studies, aggregate measures of income inequality such as state or metropolitan indicators are employed. Although the evidence is mixed with regard to the degree to which comparisons, (i.e., social norms of income matter)—whether for overall well-being or for narrowly defined health—it is clearly worth considering the ways in which social norms influence one's consumption and leisure decisions and, ultimately, health.

3. The Model

Agents live for two periods and have preferences defined over consumption, time spent at leisure, and health. The value of consumption and leisure activities is affected by social norms of consumption and leisure: agents try to keep up with the Joneses. Agents' initial health stocks are given and they invest today in their health tomorrow by engaging in health-improving activities and by purchasing medical care. One's health is not only influenced directly by time and money spent on health today but also indirectly *via* other consumption and leisure. Specifically, some consumption is health enhancing, as is some leisure; the extent of this enhancement depends on the healthiness of one's lifestyle, which can be interpreted as a socially influenced preference parameter. Further, the quality of health production technology, which includes one's genes, the state of medical knowledge, public health, and access to health care, also influences future health.

The agent's preferences are defined by

$$U\big(c_1 - c_1^*, \ell_1 - \ell_1^*, H^1\big) + \delta V\big(c_2 - c_2^*, \ell_2 - \ell_2^*, H^2\big), \tag{1}$$

where c_t is the consumption of goods in period t, ℓ_t is leisure in period t, H^t is the agent's health stock in period t, H^1 given, c_t^* is social norm level of consumption in period t, ℓ_t^* is the social norm for leisure activities in period t, and δ is the agent's rate of time discount; where $t = 1, 2$. Assume,

$$U_i > 0, \; U_{ii} \leq 0, \; U_{ij} > 0; \; i, \; j = 1, \; 2, \; 3 \;\; \text{and}$$
$$U_1 \to \infty \text{ as } c \to 0, \;\; U_2 \to \infty \text{ as } \ell \to 0;$$

$$V_i > 0, \; V_{ii} \leq 0, \; V_{ij} > 0; \; i, \; j = 1, 2, 3 \;\; \text{and}$$
$$V_1 \to \infty \text{ as } c \to 0, \; V_2 \to \infty \text{ as } \ell \to 0.$$

The agent produces future health by making health-augmenting investments today. Let

$$H^2 = h(m + \beta c_1, e + \mu \ell_1, \theta) + (1 - \sigma)H^1, \tag{2}$$

where

$$h_i > 0, \; h_{ii} < 0, \; h_{ij} < 0; i, \; j = 1, \; 2, \; 3; \text{ and } \beta, \mu > 0, \; 0 < \sigma < 1$$

and m is expenditures on physical and mental health care, e is time spent in healthy activities, β and μ measure the healthiness of one's lifestyle (i.e., the indirect benefit to one's health of one's non-health consumption and leisure choices), σ is the rate at which one's initial health depreciates and is a measure of the stressfulness of one's life, which may depend on job characteristics or social pressures, and θ measures the quality of one's individual health production technology. By assumption, medical care, healthy activities, and technology are substitutes in the production of health.

Health investments pay off in a number of ways. First, since one values health for its own sake, the higher is your investment in health today, the better off you are tomorrow. Second, having a higher health stock improves one's productivity. Thus, an investment in health today increases your income and purchasing power tomorrow. Finally, the healthier you are, the more you enjoy your time spent at leisure; that is, good health increases the quality of leisure. Overall, the greater your health investments today, the more goods you can buy, the greater the value of each unit of leisure, and the healthier you are tomorrow.

The agent is endowed with one unit of time in each period, supplies w_t units of labor inelastically in period t, and divides his remaining time between leisure and healthy activities. He divides his current income, y_1, between consumption of goods and medical care to maximize (1) subject to (2) and

$$1 - w_1 = \ell_1 + e \tag{3}$$

$$y_1 = c_1 + p^m m \tag{4}$$

$$1 - w_2 = \ell_2 \tag{5}$$

$$c_2 = y(H^2); \; y' > 0, \; y'' \leq 0 \tag{6}$$

$$\ell_2^* = \hat{\ell} k(H^2); \hat{\ell} > 0, k' < 0, k'' \geq 0, \tag{7}$$

where p^m is the price of medical care, the price of consumption having been normalized to unity, and Equation (6) represents the relationship between one's health and one's future productivity (income), which is positive but decreases at the margin. Equation (7) represents the link between one's health and the perception of the quality of one's leisure time. That is, the healthier one is, the less onerous one finds the impingement of social norms on one's time.

Substitute Equations (3) and (4) into Equation (2) to yield

$$H^2 = H(c_1, \ell_1, \theta) = h\left(\frac{y_1 - c_1}{p^m} + \beta c_1, 1 - w_1 - (1 - \mu)\ell_1, \theta\right) + (1 - \sigma)H^1, \tag{8}$$

where

$H_{c_1} = h_1\left(-\dfrac{1}{p^m} + \beta\right) < 0$ by $-\dfrac{1}{p^m} + \beta < 0$ (direct effect of medical care

is greater than indirect effect of healthy lifestyle)

$$H_{\ell_1} = -h_2(1 - \mu) < 0$$

$$H_{c_1\ell_1} = -\left(-\frac{1}{p^m} + \beta\right)(1 - \mu)h_{12} < 0$$

$$H_{w_1} = -h_2 < 0$$

$$H_{c_1 w_1} = -h_{12}\left(-\frac{1}{p^m} + \beta\right) < 0$$

$$H_{\ell_1 w_1} = h_{22}(1 - \mu) < 0$$

$$H_\sigma = -H^1 < 0$$

$$H_\theta = h_3 > 0$$

$$H_{c_1\theta} = h_{13}\left(-\frac{1}{p^m} + \beta\right) > 0$$

$$H_{\ell_1\theta} = -h_{23}(1 - \mu) > 0$$

$$H_\beta = h_1 c_1 > 0$$

$$H_{c_1\beta} = h_{11}\left(-\frac{1}{p^m} + \beta\right) + h_1 > 0$$

$$H_{\ell_1\beta} = -h_{21}(1 - \mu)c_1 > 0$$

$$H_\mu = h_2\ell_1 > 0$$

$$H_{c_1\mu} = h_{12}\left(-\frac{1}{p^m} + \beta\right)\ell_1 > 0$$

$$H_{\ell_1\mu} = -h_{22}(1 - \mu)\ell_1 > 0$$

$$H_{H^1} = (1 - \sigma) > 0$$

$$H_{y_1} = \frac{h_1}{p^m} > 0$$

$$H_{c_1 y_1} = h_{11} \left(-\frac{1}{p^m} + \beta \right) \frac{1}{p^m} > 0$$

$$H_{\ell_1 y_1} = -h_{21}(1 - \mu) \frac{1}{p^m} > 0$$

$$H_{p^m} = -h_1 \left(\frac{y_1 - c_1}{(p^m)^2} \right) < 0$$

$$H_{c_1 p^m} = -h_{11} \left(-\frac{1}{p^m} + \beta \right) \left(\frac{y_1 - c_1}{(p^m)^2} \right) + \frac{h_1}{(p^m)^2} < 0 \text{ (if first term is large)}$$

$$H_{\ell_1 p^m} = h_{21}(1 - \mu) \left(\frac{y_1 - c_1}{(p^m)^2} \right) < 0$$

Substitute Equations (5)–(7) into $V()$ to define

$$W(c_1, \ell_1, \theta) \equiv V(y(H(c_1, \ell_1, \theta)) - c_2^*,$$
$$1 - w_2 - \hat{\ell}k(H(c_1, \ell_1, \theta)), H(c_1, \ell_1, \theta)). \qquad (9)$$

Then, it is straightforward, if tedious, to show that if

$$V_{11}(y')^2 + V_1 y'' - 2V_{12} y' \hat{\ell}k' + V_{22}(\hat{\ell}k')^2$$
$$- V_2 \hat{\ell}k'' - 2V_{23}\hat{\ell}k' + 2V_{13} y' + V_{33} = \Omega < 0,$$

and since

$$V_1 y' - V_2 \hat{\ell}k' + V_3 = \omega > 0,$$

then

$$W_{c_1} = \omega H_{c_1} < 0$$

$$W_{c_1 c_1} = \Omega H_{c_1}^2 + \omega H_{c_1 c_1} < 0$$

$$W_{\ell_1} = \omega H_{\ell_1} < 0$$

$$W_{\ell_1 \ell_1} = \Omega H_{\ell_1}^2 + \omega H_{\ell_1 \ell_1} < 0$$

$$W_{c_1 \ell_1} = \Omega H_{c_1} H_{\ell_1} + \omega H_{c_1 \ell_1} < 0$$

$$W_{c_1 w_1} = \Omega H_{c_1} H_{w_1} + \omega H_{c_1 w_1} < 0$$

$$W_{\ell_1 w_1} = \Omega H_{\ell_1} H_{w_1} + \omega H_{\ell_1 w_1} < 0$$

$$W_{c_1 \sigma} = \Omega H_{c_1} H_{\sigma} < 0$$

$$W_{\ell_1 \sigma} = \Omega H_{\ell_1} H_{\sigma} < 0$$

$$W_{c_1 p^m} = \Omega H_{c_1} H_{p^m} + \omega H_{c_1 p^m} < 0$$

$$W_{\ell_1 p^m} = \Omega H_{\ell_1} H_{p^m} + \omega H_{\ell_1 p^m} < 0$$

$$W_{c_1\theta} = \Omega H_{c_1} H_\theta + \omega H_{c_1\theta} > 0$$
$$W_{\ell_1\theta} = \Omega H_{\ell_1} H_\theta + \omega H_{\ell_1\theta} > 0$$
$$W_{c_1\beta} = \Omega H_{c_1} H_\beta + \omega H_{c_1\beta} > 0$$
$$W_{\ell_1\beta} = \Omega H_{\ell_1} H_\beta + \omega H_{\ell_1\beta} > 0$$
$$W_{c_1\grave{\imath}} = \Omega H_{c_1} H_\mu + \omega H_{c_1\mu} > 0$$
$$W_{\ell_1\mu} = \Omega H_{\ell_1} H_\mu + \omega H_{\ell_1\mu} > 0$$
$$W_{c_1 y_1} = \Omega H_{c_1} H_{y_1} + \omega H_{c_1 y_1} > 0$$
$$W_{\ell_1 y_1} = \Omega H_{\ell_1} H_{y_1} + \omega H_{\ell_1 y_1} > 0$$
$$W_{c_1 H^1} = \Omega H_{c_1} H_{H^1} > 0$$
$$W_{\ell_1 H^1} = \Omega H_{\ell_1} H_{H^1} > 0$$

and if $V_{12} y' - V_{22} \hat{\ell} k' + V_{32} < 0$ (direct effects of an increase in w_2 exceed indirect effects),

$$W_{c_1 w_2}, \; W_{\ell_1 w_2} < 0,$$

if $V_{11} y' - V_{21} \hat{\ell} k' + V_{31} < 0$ (direct effects of an increase in c_2^* exceed indirect effects),

$$W_{c c_2^*}, \; W_{\ell c_2^*} < 0,$$

and if $V_{12} y' k - V_{22} \hat{\ell} k' + V_2 k' + V_{32} k < 0$ (direct effects of an increase in $\hat{\ell}$ exceed indirect effects),

$$W_{c\hat{\ell}}, \; W_{\ell\hat{\ell}} < 0.$$

Substitute (9) into (1), thereby specifying the agent's lifetime utility as a function of his current consumption and current leisure. The individual's objective is to choose c_1 and ℓ_1 to maximize

$$U\big(c_1 - c_1^*, \ell_1 - \ell_1^*, H^1\big) + \delta W(c_1, \ell_1, \theta). \tag{10}$$

The first-order conditions of the agent's problem are

$$U_c + \delta W_c = 0,$$

$$U_\ell + \delta W_\ell = 0.$$

The individual's consumption, and thus medical care, decisions and his leisure, and thus healthy activity, decisions today will determine not only his happiness today but also his health, income, and the quality of his leisure time, (i.e., his happiness tomorrow). These are strong inducements to invest in health. But one's happiness today also matters creating a tension between happiness today versus happiness in the future and current happiness and future health.

3.1. Comparative Statics

Totally differentiating the first-order conditions we have

$$
\begin{bmatrix} U_{c_1 c_1} + \delta W_{c_1 c_1} & U_{c_1 \ell_1} + \delta W_{c_1 \ell_1} \\ U_{c_1 \ell_1} + \delta W_{c_1 \ell_1} & U_{\ell_1 \ell_1} + \delta W_{\ell_1 \ell_1} \end{bmatrix} \begin{bmatrix} dc_1 \\ d\ell_1 \end{bmatrix}
$$

$$
= \begin{bmatrix} -\delta W_{c_1 w_1} \\ -\delta W_{\ell_1 w_1} \end{bmatrix} dw_1 + \begin{bmatrix} -\delta W_{c_1 \sigma} \\ -\delta W_{\ell_1 \sigma} \end{bmatrix} d\sigma + \begin{bmatrix} -U_{c_1 H^1} - \delta W_{c_1 H^1} \\ -U_{\ell_1 H^1} - \delta W_{\ell_1 H^1} \end{bmatrix} dH^1
$$

$$
+ \begin{bmatrix} -U_{c_1 c_1^*} \\ -U_{\ell_1 c_1^*} \end{bmatrix} dc_1^* + \begin{bmatrix} -U_{c_1 \ell_1^*} \\ -U_{\ell_1 \ell_1^*} \end{bmatrix} d\ell_1^* + \begin{bmatrix} -\delta W_{c_1 \theta} \\ -\delta W_{\ell_1 \theta} \end{bmatrix} d\theta + \begin{bmatrix} -\delta W_{c_1 \beta} \\ -\delta W_{\ell_1 \beta} \end{bmatrix} d\beta
$$

$$
+ \begin{bmatrix} -\delta W_{c_1 \mu} \\ -\delta W_{\ell_1 \mu} \end{bmatrix} d\mu + \begin{bmatrix} -\delta W_{c_1 y_1} \\ -\delta W_{\ell_1 y_1} \end{bmatrix} dy_1 + \begin{bmatrix} -\delta W_{c_1 w_2} \\ -\delta W_{\ell_1 w_2} \end{bmatrix} dw_2 + \begin{bmatrix} -\delta W_{c_1 p^m} \\ -\delta W_{\ell_1 p^m} \end{bmatrix} dp^m
$$

$$
+ \begin{bmatrix} -\delta W_{c_1 \hat{\ell}} \\ -\delta W_{\ell_1 \hat{\ell}} \end{bmatrix} d\hat{\ell} + \begin{bmatrix} -U_{c_1 c_2^*} \\ -U_{\ell_1 c_2^*} \end{bmatrix} dc_2^* + \begin{bmatrix} -W_c \\ -W_\ell \end{bmatrix} d\delta.
$$

It is straightforward to show the following:

PROPOSITION 1: *Assume* $U_{c_1 c_1} U_{\ell_1 \ell_1} + \delta U_{c_1 c_1} W_{\ell_1 \ell_1} - \delta U_{c_1 \ell_1} W_{c_1 \ell_1} > (U_{c_1 \ell_1})^2$.

(i) *The higher the demands of the social norms on an individual's current income,* c_1^*, *(current time,* ℓ_1^* *), the more he consumes (the more time he spends in leisure pursuits), but he compensates by spending more time in healthy activities (more on medical care) to maintain his future health. The net effect on future health, income, and the quality of leisure is ambiguous.*

(ii) *The higher the demands of the social norms on an individual's future income,* c_2^*, *(future time,) the less he consumes in terms of both goods and leisure today, instead investing in health, increasing future income, health, and the quality of leisure.*

As members of society, we measure ourselves relative to our peers. The higher the bar of the social norm placed on an individual, even if self-imposed, the more the external show of consumption and leisure activities matters relative to the internal and future benefit of good health; being healthy tomorrow does not make one happy today. Thus, when investments in health are made, they are made only after the imperatives of the social norms are met.

When these imperatives are, at least to some extent, self-imposed as a result of one's choice of identity (Akerlof and Kranton 2000), those with a strong innate sense of self that does not rely on equaling or surpassing others (with low c^* and ℓ^*) will be both happier and healthier than their less-secure peers. Thus, as is consistent with Graham, Eggers, and Sukhtanhar (2004), the happier among us today will be the healthier and happier tomorrow.

However, if those behavioral norms of income and leisure are restricted to or are stronger in the future, one is induced to invest in health today in order to reduce the burden of meeting the norm in the future. Knowing today what the social imperative is tomorrow, conceivably, could be reinterpreted as a positive goal to be achieved. Incentives to ensure good behavior are effectively in place whereby the discount rate is effectively lowered to achieve greater health tomorrow.

PROPOSITION 2:   *Assume $\partial c_1/\partial y_1 < 1$. Higher income (or a lower price of medical care) today increases consumption of goods and leisure today while reducing time spent in healthy activities and increasing expenditures on medical care, but has an ambiguous effect on future health, income, and the quality of leisure.*

Higher income (either directly or via a lower price of medical care) today allows an individual to consume more today, both in terms of goods and medical care, while the effect on future health is ambiguous. As Grossman (1972) first noted, an increase in medical care does not necessarily translate into an increase in health. As more is spent on medical care, a substitute for healthy activities, higher income will lead to less time being spent on health-augmenting behaviors, since consumption of goods and leisure are complementary. In other words, more medical care is purchased as a result of greater income (or a lower price); however, medical care spending distorts the amount of dollars spent on health investment relative to healthy activities.

The net effect on future health depends on the substitutability of medical care and healthy activities in the production of health. The more substitutable they are, the more likely that future health, and thus income and the quality of leisure, will rise. This suggests that a secular rise in income would be accompanied by a secular increase in expenditures on medical interventions and a secular decrease in behavioral modifications to promote good health. Thus, such trends could be accompanied by increases, or decreases, in measured health. Our result challenges the conventional wisdom that higher income is unequivocally associated with better health (see, e.g., Gerdtham and Johannesson 2004, Viscusi 2006). In fact, our result may be more in line with Wilkinson (1997a) who suggests that, at least in developed countries, absolute income is not associated with health. Instead, relative incomes or income inequality may matter for health, possibly through the mechanism of social norms and the psycho-social stresses of relative circumstances. As has been pointed out in literature (e.g., Mellor and Milyo 2001), one should tread cautiously in any empirical test of the relationship between income and health as it is not clear whether income, *per se*, affects health or whether income and health are correlated with one or more other unobserved variables.

PROPOSITION 3:   *A healthier lifestyle (higher β or μ) increases consumption of goods and leisure, thereby reducing medical expenditures and time spent in healthy activities. The effect on future health, income, and leisure quality will be positive if the direct effect of the healthier lifestyle outweighs the indirect effect of lower specific health investments.*

A healthier lifestyle, whether an intrinsic preference or one adopted to meet social norms, is captured in the beneficial spillover from one's consumption and leisure choices onto one's health. Such a lifestyle is often touted as a road to happiness *via* better health and the benefits to health in terms of greater income and a higher quality of leisure. However, this may not be the case since a healthier lifestyle today enables one to have one's cake and eat more of it today, but at the possible expense of lower health tomorrow. At first glance this may seem counterintuitive, yet one's healthier lifestyle intensifies one's pleasure in life today, thus making the present loom larger in the decision calculus, thereby reducing the incentives to make direct investments in one's future health. Since an individual receives some benefits to future health indirectly through healthy consumption and leisure, one can, to some extent, play a naming game of reclassifying consumption and leisure as health investment. The result, however, may be to cheat one's own future health by spending leisure time at tennis or consuming brussels sprouts rather than making direct health investments by expending time in exercise or purchasing medical care such as a doctor's visit.

Enjoying healthy living today while refusing to take the time and money to go to the doctor for check-ups, obtain medical screenings, or refuse to take medications may mean you are a "young invincible". This term was coined by Blue Cross organizations (2004), offering a set of health insurance plans known as TONIK in three states in order to appeal to "active, young healthy 19- to 29-year olds." These plans insure only against catastrophic illness and include little to no incentive for policyholders to make preventive visits to the doctor because of restrictions on the number of reimbursable visits. The design of these health insurance plans suggests that healthy behaviors beget greater future health, but, as our result suggests, the jury should still be out on this.

PROPOSITION 4:   *Assume* $|\frac{d\ell}{dw_1}| < 1$.

   (i)   *An individual with a high-stress job or lifestyle (high σ), or one who works long hours today (high w_1) spends more on medical care and more time in healthy activities today, thereby spending less on consumption or in time at leisure. These compensations ameliorate the effects of the stress (work) on future health, income, and the quality of leisure, but may not completely offset them.*

   (ii) *An individual who foresees long work hours in the future (high w_2) will compensate by consuming fewer goods and spending less time at leisure today, thereby increasing health investments and increasing future health, income, and the quality of leisure.*

Stress, whether induced by one's job or by social pressures to conform to some ideal, and long work hours are undoubtedly bad for you, and uncompensated, they make you worse off since you must give up consumption and leisure today to offset their effects. This explains why high-stress jobs and jobs requiring long work hours are often compensated with higher salaries and

better benefits. Stress and long work hours are often associated with high total compensation jobs, and these jobs are most often filled with well-educated individuals. To the extent that an individual is inadequately compensated for the stress or greater time at work, either through higher income or cheaper (and/or better) health care, stress and the demands of work diminish the positive health effects that education and health knowledge generate. Even if the stressed worker goes to the doctor more often and exercises regularly as compared with a less-stressed worker, she may not heed the doctor's advice to slow down, take a vacation, or cut back on hours.

Grossman and Kaestner (1997) conclude that increases in education result in increases in health, and of course, education is also a determinant of occupation and income. We agree with this basic premise; however, we recognize in this proposition that some factors may erode the positive effect of education on health *via* work. Namely, if stress and long hours at work accompany greater education and higher paying jobs, then the effect on future health and income may not be so bright. For example, a recent study found a link between workplace stress and metabolic syndrome, which is a precursor to diabetes and cardiovascular disease (Chandola, Brunner and Marmot 2006). And yet, the demands of future work induce healthier behaviors today, since by investing in health today an individual can ameliorate the effects of longer work hours tomorrow *via* higher income and higher quality, if less total, leisure.

PROPOSITION 5:   *An individual with a low initial health stock invests more in his health (relative to an individual identical in all ways except initial health), but may not have higher future health or income or leisure quality. Yet improvements in the health production technology (higher θ) similar to a higher rate of time discount (higher δ) lead to compensating reductions in investments in health, with potentially (certainly) adverse effects on future health, income, and leisure quality.*

Both theoretical and empirical work (e.g., Grossman 1972, Russell and Chaudhuri 1992, Monheit 2003) show a negative correlation between medical expenditures and health and this is as it should be—the less healthy among us invest more in their health. In addition, lower initial health follows one through life. The sacrifices required, in terms of foregone consumption and leisure when young, to improve future health will generally not achieve the healthiness of one endowed with better initial health. Thus, those in poor health may remain less healthy, but still invest substantial resources in their health at the expense of some consumption and leisure.

If the health technology improves, less consumption and leisure has to be given up today to maintain one's health; thus, one may choose to enjoy greater current pleasures at the expense of lower future health. Thus, expected improvements in the health technology, similar to a high rate of time discount, allow one to focus on the present without worrying about the future. However, to the extent that the improvement in the health technology is perceived to

be greater today than it turns out to be in the future, there will be *ex post* underinvestment in health. Advances in health technology may not provide the "miracle cure" after all. For example, an individual may take a medication to fight obesity today without any other health investments such as exercise; yet improved future health may be at risk because of offsetting effects of the drug's long-term side effects or complications. This possibility should be a concern to agencies such as the Food and Drug Administration that oversee the approval of pharmaceuticals and to policymakers, given the increase in pharmaceutical advertising campaigns aimed directly at individuals.

4. Conclusion

Our model suggests that for policies designed to improve an individual's health and happiness to be successful, one must be rewarded for achieving the goal or penalized for missing it. Unfortunately, penalties that generate health investments are easier to design than rewards, but penalties force individuals to trade-off happiness for health, defeating the purpose of the policy. The problem is that any reward that improves one's happiness reduces the benefits of future health. So, how can both health and happiness be improved? Reductions in stress, in work hours (holding income constant), and in societal demands (peer effects and social norms) all free up resources and thus can lead to increases in both health and happiness. Living a healthier lifestyle can also be beneficial, but this requires a change in an individual's tastes or an internalization of social preferences. None of these lend themselves easily to policy, as policymakers who have sung the benefits of healthier lifestyles or suggested that we should work less and learn to relax, will attest. A policy that reduces health care costs today, both in terms of the monetary cost of medical care and the time cost of healthy activities, and that imposes a tax tomorrow to pay for the benefit, is the opposite of what most people face today but may provide the right mix of rewards and penalties to improve both healthiness and happiness.

References

AKERLOF, G. A., and R. E. KRANTON (2000) Economics and identity, *Quarterly Journal of Economics* **115**, 715–753.

BECKER, G. (1964) *Human Capital*. New York: Columbia University Press for NBER.

BECKER, G. (1967) *Human Capital and the Personal Distribution of Income: An Analytic Approach*. Ann Arbor, MI: University of Michigan.

BECKER, G., and K. MURPHY (1988) The theory of rational addiction, *Journal of Political Economy* **96**, 675–700.

BEDNAREK, H. L., T. D. JEITSCHKO, and R. A. PECCHENINO (2006) Gluttony and sloth vs. bliss? A theory of choice in the presence of behavioral adjustment costs, contributions to economic analysis and policy, *B.E. Journal* **5**, article 6, 1–42.

BLANCHFLOWER, D. G., and A. J. OSWALD (2004) Well-being over time in Britain and the USA, *Journal of Public Economics* **88**, 1359–1386.

BLUE CROSS OF CA AND CO (2006), Available at www.tonikhealth.com, Accessed January 2006.

CHANDOLA, T., E. BRUNNER, and M. MARMOT (2006) Chronic stress at work and the metabolic syndrome: Prospective study, *British Medical Journal* **332**, 521–525.

CLARK, A. E., and A. J. OSWALD (1996) Satisfaction and comparison income, *Journal of Public Economics* **61**, 359–381.

DEATON, A. (1999) Inequalities in income and inequalities in health, *NBER Working Paper 7141.*

EASTERLIN, R. A. (1974) Does economic growth improve the human lot?, in *Nations and Households in Economic Growth: Essays in Honour of Moses Abramovitz*, P. A. David and M. W. Reder, eds. New York: Academic Press, Inc., 89–125.

EASTERLIN, R. A. (1995) Will raising the incomes of all increase the happiness of all? *Journal of Economic Behavior and Organization* **27**, 35–47.

FALK, A., and M. KNELL (2004) Choosing the Jones: Endogenous goals and reference standards, *Scandinavian Journal of Economics* **106**, 417–435.

FORSTER, M. (2001) The meaning of death: Some simulations of a model of health and unhealthy consumption, *Journal of Health Economics* **20**, 613–638.

FREDERICK, S., G. LOWENSTEIN, and T. O'DONOGHUE (2002) Time discounting and time preference: A critical review, *Journal of Economic Literature* **40**, 351–401.

GERDTHAM, U.-G., and M. JOHANNESSON (2004) Absolute income, relative income, income inequality, and mortality, *Journal of Human Resources* **39**, 228–247.

GRAHAM, C., A. EGGERS, and S. SUKHTANHAR (2004) Does happiness pay? An exploration based on panel data from Russia, *Journal of Economic Behavior and Organization* **55**, 319–342.

GROSSMAN, M. (1972) On the concept of health capital and the demand for health, *Journal of Political Economy* **80**, 223–255.

GROSSMAN, M. (2000) The human capital model, In *Handbook of Health Economics*, Volume 1, A. J. Culyer and J. P. Newhouse, eds. Amsterdam: Elsevier Science, 347–408.

GROSSMAN, M., and R. KAESTNER (1997) Effects of education on health, in *The Social Benefits of Education*, J. R. Behrman and N. Stacey, eds. Ann Arbor, MI: University of Michigan, 69–123.

GRUBER, J., and B. KOSZEGI (2001) Is addiction 'rational'? Theory and evidence, *Quarterly Journal of Economics* **116**, 1261–1303.

KAPLAN, G., E. R. PAMUK, J. M. LYNCH, R. D. COHEN, and J. L. BALFOUR (1996) Inequality in income and mortality in the United States: Analysis of mortality and potential pathways, *British Medical Journal* **312**, 999–1003.

KENNEDY, B. P., I. KAWACHI, and D. PROTHROW-STITH (1996) Income distribution and mortality: Cross sectional ecological study of the Robin Hood Index in the United States, *British Medical Journal* **312**, 1004–1007.

KOMLOS, J., P. SMITH, and B. BOGIN (2004) Obesity and the rate of time preference: Is there a connection? *Journal of Biosocial Science* **36**, 209–219.

LEVY, A. (2002) Rational eating: Can it lead to overweightness or underweightness?, *Journal of Health Economics* **21**, 887–899.

MEARA, E. (2001) Why is health related to socioeconomic status? The case of pregnancy and low weight birth, *NBER Working Paper 8231.*

MELLOR, J. M., and J. MILYO (2001) Reexamining the evidence of an ecological association between income inequality and health, *Journal of Health Politics, Policy and Law* **26**, 487–522.

MELLOR, J. M., and J. MILYO (2002) Income inequality and health status in the United States, evidence from the current population survey, *Journal of Human Resources* **37**, 510–539.

MONHEIT, A. C. (2003) Persistence in health expenditures in the short run: Prevalence and consequences, *Medical Care* **41**, III53–III64.

MUURINEN, J.-M. (1982) Demand for health: A generalized Grossman model, *Journal of Health Economics* **1**, 5–28.

O'DONOGHUE, T., and M. RABIN (2000) The economics of immediate gratification, *Journal of Behavioral Decision Making* **12**, 233–250.

RUSSELL, L. B., and A. CHAUDHURI (1992) The inequality of medical expenditures for several years in a healthy nonelderly population, *Medical Care* **30**, 909–916.

THALER, R. H., and H. M. SHEFRIN (1981) An economic theory of self-control, *Journal of Political Economy* **89**, 392–406.

VISCUSI, W. K. (2006) Regulation of health, safety, and environmental risks, *NBER Working Paper 11934*.

WILKINSON, R. G. (1996) *Unhealthy Societies: The Afflictions of Inequality*, London: Routledge.

WILKINSON, R. G. (1997) Socioeconomic determinants of health: Health inequalities: Relative or absolute material standards? *British Medical Journal* **314**, 591–595.

WILKINSON, R. G. (1997b) Commentary: Income inequality summarizes the health burden of individual relative deprivation, *British Medical Journal* **314**, 1727–1728.