may have been encouraged by the initial improvements in the early 1970s, but such improvements were then reversed in the late 1970s and early 1980s. The result was a marked increase in the cost of medical care, which has led to increased efforts to control medical expenditures. One approach to this problem is the use of managed care programs, which involve the use of employment-based insurers to negotiate lower prices for medical services. This approach has been successful in some cases, but it has also raised concerns about the quality of care provided under these programs.

In conclusion, the relationship between medical care expenditures and employment is complex and multifaceted. While there is some evidence that employment is associated with lower medical care expenditures, other factors such as economic conditions, demographic characteristics, and individual health behaviors also play a role. Future research could benefit from further exploration of these factors and their interrelationships.
tainties of health and medical care expenditure. However, Zuckhauser, as well as Arrow and Cook and Graham, did not draw out the implications of their analyses with respect to interpreting the welfare effects of existing insurance policies. If they had done so, it would have made clear that the prevalent interpretation of welfare loss is based on the unlikely assumption that the welfare elasticity of medical care expenditure is zero and that the no-insurance level of expenditure continues to be the optimal one in the presence of insurance.\footnote{This is analogous to arguing that the no-insurance expenditure on housing to replace that destroyed by fire continues to be the optimal one in the presence of fire insurance.}

The present paper builds upon the works of Zuckhauser, Arrow, and Cook and Graham to demonstrate how insurance may alter the optimal level of medical care expenditure.\footnote{The efficient effects of insurance were also considered by Hibbard (1973). His analysis is based on the assumption that insurance redefines individual income over time, thereby allowing for an efficient increase in medical care expenditure in those periods in which the preference for these services are the strongest. However, the existence of this effect of insurance, as demonstrated in his two-period model, rests on the implicit assumption that the representative individual cannot transfer his income between the two periods in the absence of insurance. The model in the present paper uses lifetime wealth as the budget constraint on medical care expenditure and thereby subsumes intertemporal income transfers. Utility maximization under insurance is therefore expressed in terms of equating the marginal utilities of wealth rather than the marginal utilities of income. The efficient effect of insurance on medical care expenditure need not depend on any restrictions on an individual's ability to select a redistribution of income over time or on the existence of any other imperfections.}

It is shown that the optimal level of medical care expenditure under insurance is simply that which is consistent with the equation of the marginal utility of wealth in the insured state to that in other states. The extent to which this level of medical care expenditure diverges from the no-insurance level is shown to depend on the welfare elasticity of such expenditure and on the probability of the insured state. The welfare effects of existing insurance policies, as represented by Pauly, Feldstein, and Rotset and Huang, are reevaluated in light of the above.

II. The Model

A. Assumptions

The insurance against an event depends on how it affects the utility of wealth, since compensation must be in the form of wealth. Health status may affect the marginal utility of wealth in three basic ways, through its effects on: (1) the utility derived from medical care consumption; (2) the utility derived from all other consumption; and (3) the ability to earn income. The following holds constant the other channels through which health status may affect the marginal utility of wealth and concentrates on its effect through medical care consumption.\footnote{If the other potential effects of health status were allowed to operate, this would not detract from the implications of a change in utility derived from medical care expenditure. These other effects would simply alter the willingness and ability of the individual to purchase medical care in the unhealthy state. A deterioration in ability to earn income would certainly cause a greater gain than would otherwise exist between the individual's ability to purchase medical care at point of insurance and his ability at point of illness. Under such conditions, the efficient effect of insurance on medical care expenditure would be greater. The influence of a change in the utility derived from other consumption, with respect to the effect of insurance on medical care expenditure, depends on the direction of this change in utility. Since the utility of other consumption would increase or decrease, depending on the nature of the change in one's health status, no useful purpose is served in allowing for this effect.}

Health state, medical care expenditure, and the purchase of insurance are considered for a single representative individual. For simplicity, only one health loss event necessitating medical care expenditure is assumed.\footnote{If the positive effects of health status were allowed to operate, this would not detract from the implications of a change in utility derived from medical care expenditure.}

To provide an appropriate benchmark or starting point for evaluating existing policies, insurance is assumed to function under ideal conditions. This means that the markets for medical care and insurance are free of all imperfections: (1) they are competitive and free of externalities, (2) the individual has full knowledge concerning the probability of the health loss and the related benefits from medical care consumption, (3) insurance is provided as a lump sum payment contingent on the occurrence of the unhealthy state — so as to avoid the price distorting effects of cost sharing formulas, and (4) the introduction of insurance does not affect the probability and/or nature of the unhealthy state. Two additional assumptions are made to simplify the analysis: (1) insurance is actuarially fair and (2) utility is additive.

B. The Risk

A loss in wealth will usually cause medical care to be added to the commodities that an individual normally consumes, the objective of medical care consumption being to restore health.\footnote{In fact, on balance, it may strengthen the argument emphasizing the efficient effect of insurance on medical care expenditure. These other effects would simply alter the willingness and ability of the individual to purchase medical care in the unhealthy state. A deterioration in ability to earn income would certainly cause a greater gain than would otherwise exist between the individual's ability to purchase medical care at point of insurance and his ability at point of illness. Under such conditions, the efficient effect of insurance on medical care expenditure would be greater. The influence of a change in the utility derived from other consumption, with respect to the effect of insurance on medical care expenditure, depends on the direction of this change in utility. Since the utility of other consumption would increase or decrease, depending on the nature of the change in one's health status, no useful purpose is served in allowing for this effect.}

The curve labeled $b$ in the lower left hand quadrant of Figure 1 traces the individual's marginal utility of health as his health status changes. The total utility derived from health level $H^*$ may therefore be expressed as:

$$\int_0^{H^*} h(x)dx$$

$W$ is the individual's lifetime wealth. With perfect financial markets, it is the appropriate budget constraint for purposes of spending on medical care.\footnote{The curve labeled $y$ in the upper right hand quadrant traces the marginal utility of other expenditure as this expenditure is reduced and medical care expenditure is increased. The total utility that the individual would derive from $W$ in the absence of any medical care expenditure may be expressed as:}

$$\int_0^{y} y(x)dx$$

The individual's total utility in the healthy state is expressed as:

$$\int_0^{H^*} h(x)dx$$

In actuality, some individuals may be very limited in their ability to draw against expected future income to finance medical care expenditure in the absence of insurance. If insurance reduces or nullifies this restriction, its efficient effect on medical care expenditure may be considerably greater than that demonstrated in this paper. This additional effect of insurance on medical care expenditure is analyzed in another paper by the present author.
on the effectiveness of additional dollars of medical care in improving health. Under conditions where many types of treatment are possible, each differing in effectiveness and costliness, it cannot be easily argued that the wealth elasticity of medical care expenditure is zero or insignificant.6

$M_f$, is that medical care expenditure which maximizes the individual's utility in the absence of insurance. It is determined by the intersection of $m$ and $y$, where the marginal utility of medical care expenditure is equated to the marginal utility of other expenditure. $M_f$ corresponds to an (expected) health gain of $H_f = H_0$. The individual's utility in the unhealthy state is therefore:

$$
\int_0^\infty h(x)dx + \int_0^\infty y(x)dx
$$

In the absence of insurance the individual's expected utility is:

$$
(1 - p) [\int_0^\infty h(x)dx + \int_0^\infty y(x)dx] + p [\int_0^\infty h(x)dx + \int_0^\infty y(x)dx]
$$

where $p$ is the probability of the unhealthy state. Since the marginal utility of wealth in the unhealthy state (measured by the vertical distance $t$) exceeds the marginal utility of wealth in the healthy state (measured by the vertical distance $r$), insurance can increase expected utility by transferring wealth from the healthy state to the unhealthy state. Expected utility is maximized when the marginal utilities of wealth in each state are equated. The optimal level of medical care expenditure under insurance is that which is consistent with the equation of marginal utilities.

C. Optimal Insurance

Given that the other potential effects of health loss have been conveniently held constant, the optimal transfer of wealth under medical insurance can be demonstrated within the more appealing context of efficiently financing medical care expenditure through insurance. Because of diminishing marginal utility with respect to normal expenditure, the individual will experience a welfare gain if he finances medical care expenditure through insurance. The welfare gain is due to the reduced utility cost of medical care and the additional expenditure that this allows. The optimal medical care expenditure, determined at point of insurance, is that which maximizes this welfare gain.7 The welfare gain and the related increase in medical care expenditure are demonstrated in Figure 2 which is reconstructed from the upper right hand quadrant of Figure 1.

As well as measuring actual medical care

Note that this welfare gain is the difference between the individual's expected utility under insurance and his expected utility in the absence of insurance.

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6The assumption that, for any given health loss, there is a continuum of medical care expenditure and corresponding degrees of improvement in health state may appear to be unrealistic for some. However, many would agree (especially physicians) that, for any given illness or injury, the medical care provided may vary considerably in terms of the quantity and quality of services provided. This variation is generally reflected in the public system of whether or not the poor are receiving adequate medical care. Hence, "adequate" refers to differences in the quality and quality of services provided and their effectiveness. On the first approximation it may seem that the variation in treatment for any, appendixes is very limited. However, this is true only if we narrowly define treatment as the surgical procedure required. The conditions under which this surgery takes place will surely affect the quality of the surgery and the patient's chances for success. The individual under which diagnostic tests are provided and post-operative care taken place will also affect the patient's chances for success. For other types of illnesses major differences in the medical treatment exist. Hence, it is an example. The least and most expensive treatment involves periodic whole blood transfusions. Paster VIII treatment is much more expensive. Affluent individuals, depending on financial constraints, use either whole blood transfusions, Factor VIII, or some combination of the two.

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expenditure, the horizontal axis in Figure 2 also measures its expected value. In the absence of insurance this is equal to the expected value of the corresponding reduction in other expenditure, while under insurance it is equal to the premium that must be paid to cover the actual expenditure. In the present example the probability of the unhealthy state is assumed to be \( \frac{1}{2} \).

In the analysis that follows, the utility of medical care expenditure in the presence of insurance is contrasted to its utility cost in the absence of insurance. This difference in utility cost is shown to account for the efficient increase in medical care expenditure under insurance. The curves labeled \( m^u \) and \( y^u \) are constructed to facilitate this demonstration. Before we proceed, these curves are defined.

For any medical care expenditure with a probability of \( \frac{1}{2} \), the expected utility of that expenditure is measured by:

\[
\frac{1}{2} \int_0^{\infty} m(x)dx
\]

The expected utility of medical care expenditure can also be measured with respect to \( m^u \), which traces the marginal expected utility of medical care expenditure as the expected value of this expenditure increases.*

\[
\int_0^{\infty} m^u(x)dx
\]

Since the probability of medical care expenditure \( \frac{1}{2} \), \( m^u \) is equivalent to between \( m \) and the vertical axis. \( m^u \) is constructed to facilitate the comparison between the expected utility loss associated with an uncertain reduction in other expenditure and the utility loss associated with the payment of an insurance premium which is equal to the expected value of this uncertain reduction in other expenditure.

The marginal expected utility would be depicted by a curve which, given the assumed probability of \( \frac{1}{2} \), is equivalent to between \( m \) and the horizontal axis. For the present analysis, however, only marginal expected utility is relevant in that it is consistent with the measurement of expected expenditure on the horizontal axis. A similar argument applies to \( y^u \).

According to the marginal expected utility theorem, \( m^u \) is equivalent to an expected utility of \( \int_0^{\infty} m^u(x)dx \) which is the marginal expected utility of medical care expenditure at \( \psi_M \) is equal to the expected utility of other expenditure at \( W - \frac{1}{2}M_M \) as determined by point of insurance, the entire insurance payment of \( M^* \) will be spent on medical care. This will leave the individual’s marginal utility of wealth and other expenditure unchanged at \( s \) and \( W - \frac{1}{2}M_M \), respectively.

\[
\frac{1}{2} \int_0^{\infty} y(x)dx
\]

The expected utility cost of medical care expenditure can also be measured with respect to \( y^u \), which traces the marginal expected utility loss from reducing other expenditure as the expected reduction in this expenditure increases:

\[
\int_0^{\infty} y^u(x)dx
\]

Since the probability of medical care expenditure is \( \frac{1}{2} \), \( y^u \) is equivalent to between \( y \) and the vertical axis. \( y^u \) is constructed to facilitate the comparison between the expected utility loss associated with an uncertain reduction in other expenditure and the utility loss associated with the payment of an insurance premium which is equal to the expected value of this uncertain reduction in other expenditure.

For any medical care expenditure with a probability of \( \frac{1}{2} \), the utility cost of that expenditure under insurance is measured by:

\[
\int_0^{\infty} y(x)dx
\]

where

\[
\int_0^{\infty} y(x)dx - \int_0^{\infty} y^u(x)dx
\]

For any value of \( M \), the area between \( y^u \) and \( y \) from 0 to \( \frac{1}{2}M \) measures the extent to which insurance reduces the utility cost of medical care expenditure. This reduction in utility cost allows the individual to efficiently increase his level of medical care expenditure under insurance. The magnitude of this efficient increase depends on the wealth elasticity of this expenditure, reflected by the slope of \( m \) and therefore \( m^u \), and on the probability of the unhealthy state.

In the absence of insurance the efficient expected medical care expenditure, which is consistent with utility cost denoted by \( y^u \), is \( y_M \). This is determined by the intersection of \( m^u \) and \( y^u \) where the individual equates the marginal expected utility of medical care expenditure to the marginal expected utility loss from reducing other expenditure. \( y_M \) corresponds to an actual expenditure of \( M \) if the unhealthy state occurs. In the presence of insurance the efficient expected medical care expenditure, which is consistent with utility cost denoted by \( y \), is \( y_M \). This is determined by the intersection of \( m^u \) and \( y \) where the individual equates the marginal expected utility of medical care expenditure to the marginal utility loss from paying the premium necessary to cover that expenditure. The payment of a premium of \( \frac{1}{2}M_M \) entitles the individual to an insurance payment and medical care expenditure of \( M \) in the event that the unhealthy state occurs.

The payment of a premium of \( \frac{1}{2}M_M \) raises the individual’s marginal utility of wealth in the healthy state from \( r \) to \( s \) and reduces his other expenditure from \( W \) to \( W - \frac{1}{2}M_M \). The receipt of an insurance payment of \( M \) increases the individual’s wealth in the unhealthy state to \( W + \frac{1}{2}M_M \) (causing \( y \) to shift to \( y^u \)). Since the marginal utility of medical care expenditure at \( M \) is equal to the marginal utility of other expenditure at \( W - \frac{1}{2}M_M \) (as determined by point of insurance), the entire insurance payment of \( M^* \) will be spent on medical care. This will leave the individual’s marginal utility of wealth and other expenditure unchanged at \( s \) and \( W - \frac{1}{2}M_M \), respectively.

*The marginal expected utility of medical care expenditure, depicted by \( m^u \), is distinct from the expected marginal expected utility of medical care expenditure:

\[
\frac{1}{2} \int_0^{\infty} \text{M}(x)dx
\]

\[
\int_0^{\infty} m^u(x)dx
\]

Expected marginal utility would be depicted by a curve which, given the assumed probability of \( \frac{1}{2} \), is equivalent to between \( m \) and the horizontal axis. For the present analysis, however, only marginal expected utility is relevant in that it is consistent with the measurement of expected expenditure on the horizontal axis. A similar argument applies to \( y^u \).
The welfare gain from financing medical care expenditure through insurance is maximized at the above values. This welfare gain is measured by the shaded area in Figure 2. The portion of the shaded area between \( m^* \) and \( y \) from \( \frac{1}{2} M \) to \( \frac{1}{2} M \) indicates that this welfare gain is in part due to the additional medical care expenditure allowed by insurance. This contrasts with prevailing views concerning the welfare effects of existing insurance policies.

From Figure 2 it can be deduced that the extent to which the efficient level of medical care expenditure under insurance exceeds the no-insurance level is (1) positively related to the wealth elasticity of the expenditure, (2) inversely related to the probability of the unhealthy state. As argued, the wealth elasticity of medical care expenditure is reflected by the slope of \( m^* \) and therefore \( m^* \). The more gentle the slope of \( m^* \) between \( y^* \) and \( y \), the greater the divergence between the intersection of \( m^* \) with \( y^* \) and its intersection with \( y \), and the larger the efficient increase in medical care expenditure under insurance. The probability of the unhealthy state is reflected by the position of \( m^* \) vis-à-vis \( m \) and the vertical axis. As the probability declines, \( m^* \) pivots toward the vertical axis. This causes the efficient premium (expected medical care expenditure) to decrease and the efficient actual medical care expenditure in the unhealthy state to increase. The implication of the above is that, the greater the wealth elasticity of medical care expenditure and the lower the probability of the insured state, the more misleading are any measures of welfare loss which are based on the assumption that the no-insurance level of expenditure continues to be the optimal one in the presence of insurance.

III. The Welfare Effects of Existing Policies

The implications of the preceding graphical proof, for evaluating the welfare effects of existing insurance policies, can be demonstrated within the context of the graphical analysis first presented by Pauly (1968) and later used by Feldstein (1973) and Rosett and Huang (1973). This graph is presented in Figure 3 and the related arguments follow. \( D \) is the individual's demand curve for medical care under existing policies as well as that which would exist in the absence of insurance. It is contingent upon the occurrence of the unhealthy state. \( P \) is the price per unit of medical care (which Pauly assumes to be constant and equal to marginal cost, \( MC \)). \( Q_i \) is the quantity of medical care purchased in the absence of insurance, and \( P_Q \) is the no-insurance expenditure (corresponding to \( M_i \) in Figure 2). As Pauly et al. argue, existing insurance policies are largely in the form of price reductions, i.e. the co-insurance rate indicates what percent of the market price of medical care is borne by the consumer. Let \( k \) be the co-insurance rate. Therefore, the price faced by the individual is \( kP \). Because of this lower price, \( Q_2 \) instead of \( Q_1 \) units of medical care will be demanded, and medical care expenditure will increase from \( P_Q \) to \( P_Q' \).

Pauly et al. argue that \( P_Q - P_Q' \) measures excess medical care expenditure and that the triangle abc measures welfare loss. However, this is a correct evaluation only if the wealth elasticity of medical care expenditure is equal to zero (i.e., if \( M_i \) is vertical at \( M_i \) in Figure 2). Under this condition the probability of the insured state does not influence the optimal level of medical care expenditure. The no-insurance expenditure continues to be the optimal one in the presence of insurance, and excess medical care expenditure and welfare loss are appropriately measured relative to this value.

More realistically, the wealth elasticity of medical care expenditure is greater than zero. It may range from very large in some health states to near zero in others—depending on the diversity of available medical treatments, for example. The greater the wealth elasticity and the lower the probability of the insured state, the greater the divergence between the optimal level of medical care expenditure under insurance and the no-insurance level. Excess medical care expenditure and welfare loss must be gauged relative to this optimal expenditure. Assuming that insurance is ideally provided as defined in the preceding section, the demand for medical care is \( D \), and \( P_Q \) is the optimal level of medical care expenditure (corresponding to \( M_i \) in Figure 2).

To understand the nature of the welfare loss caused by existing policies it is first necessary to understand how they differ from ideal insurance. Existing policies, as defined by Pauly et al., differ from ideal insurance in two ways. First, existing policies are in the form of a price reduction while ideal insurance is provided as a lump sum payment. Second, the amount of compensation under existing policies does not, usually, equal that under ideal insurance. In the present example, the compensation under the existing policy is \( P - kPQ \) while the compensation under ideal insurance is \( PQ \).

To arrive at a first approximation of excess medical care expenditure and welfare loss, let us begin by assuming that the amount of compensation under the existing policy is equal to that under ideal insurance, i.e., \( P - kPQ \) equals \( PQ \). The only difference, then, is the manner in which this insurance compensation is provided. Its provision through a price reduction creates a substitution effect which is supplementary to the welfare effect of its provision as a lump sum. The welfare effect is equal to \( P_Q - P_Q' \). No welfare is associated with this effect. The substitution effect is equal to the expenditure \( P_Q - P_Q' \). The true welfare loss is measured in relation to this effect and not relative to the total effect of the price reduc-
tion. This welfare loss is measured by the smaller triangle cde instead of abc. Whether or not \( PQ_1 - PQ_2 \) is a reasonable approximation of \( PQ_3 - PQ_2 \), and abc, a reasonable approximation of cde, depends on the relative magnitudes of the wealth and substitution effects inherent in the price reduction. This is an empirical question.

If the amount of compensation under existing policies does not equal that under ideal insurance, the triangle cde will underestimate the total welfare loss. Because of the substitution effect and related welfare loss, the efficient amount of compensation under existing policies will be less than that under ideal insurance. Therefore, a welfare loss must be attributed to the lower level of compensation as well as the substitution effect. Since the magnitude of the substitution effect depends on the level of compensation, the level of compensation must be reduced (by raising the coinsurance rate) until the total welfare loss is minimized. Because of this trade-off between the substitution effect and the level of compensation, any measure of welfare loss based on the substitution effect of existing policies may underestimate the total welfare loss. Excess medical care expenditure, however, continues to be appropriately measured by \( PQ_1 - PQ_2 \).

IV. Concluding Remarks

The purpose of this paper has been to qualify what appear to be extreme views concerning the welfare effects of existing insurance policies. It has been shown that measures of excess medical care expenditure and welfare loss based on the no-insurance expenditure can be misleading—especially under conditions where the optimal level of medical care expenditure under insurance diverges substantially from the no-insurance level. To the extent that theoretical and empirical evaluations of the welfare effects of existing insurance policies influence controls on medical care demand, then such evaluations should be as precise as possible.

It is recognized that the present analysis of the effects of insurance, as well as other work on the subject, is limited by the many imperfections influencing the market for medical care. Ignorance on the part of the consumer concerning actual and potential needs for medical care obfuscates his role in demanding medical care and insurance. Under such conditions the usefulness of traditional economic criteria for measuring welfare effects becomes unclear.11

For further discussion of information constraints and consumer ignorance as they relate to insurance and medical care demand see Duenitz (1969) and Arrow (1963) and (1968).

References


