

A Search Theory of Suicide

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Abstract: Existing economic models of suicide provide no systematic means of addressing how suicidal persons choose their suicide methods. In this article, the tools of search theory are used to characterize suicidal persons' choices about when, how, and whether to commit suicide in a dynamic context. The theory has implications for policies affecting the availability of suicide methods such as guns. Among other things, the theory indicates that a reduction in a method's availability may induce some individuals to commit suicide sooner – possibly leading to a higher overall suicide rate.

JEL Classification: I12, I18, K42

1. Introduction

Suicide has been a popular topic among social scientists ever since Emile Durkheim's (1897) seminal work *Le Suicide*. Sociologists and psychologists, in particular, have produced an enormous literature on the subject. But economists' contributions to the study of suicide have been few and far between, especially in the realm of theory. With the exception of a handful of works¹, economists have largely steered clear of the subject. Yet economists possess a set of tools, mostly from the field of decision theory, that are especially suited to the study of how persons make choices in dynamic situations characterized by uncertainty. Suicide is undoubtedly such a choice.

The few existing economic models of suicide typically focus on the factors that influence the value an individual places on his life – age, income, unemployment, and so forth. While these models are useful as far as they go, they do not provide a systematic means of addressing how suicidal persons choose their methods of suicide, or how changes in the availability and cost of those methods affect the choice of method and whether to commit suicide at all. This is unfortunate, since questions like these relate in a crucial way to current policy debates and discussions about how to reduce the incidence of suicide.

For example, gun control laws are often advocated on grounds that they will reduce suicide rates. Interestingly, a wide range of studies on guns and suicide rates have shown a consistent relationship between gun ownership and firearm suicide rates, but they have usually failed to show a statistically significant relationship between gun ownership and total suicide rates. This pattern

has been especially pronounced in cross-sectional studies that attempt to measure gun ownership using survey data, gun accident rates, and other proxies: “Of thirteen [cross-sectional] studies, nine found a significant association between gun levels and rates of gun suicide, but only one found a significant association between gun levels and rates of total suicide (plus the Kleck/Patterson [1993] study, which obtained mixed results).”² The results of studies that employ measures of the strictness of gun control laws are less uniform, but still ambiguous at best. While several have shown a statistically significant association between gun-control strictness and total suicides³, most of these⁴ do not control for other explanatory variables. Studies that control for other variables have generally failed to show a statistically significant relationship.⁵ In a similar vein, a number of analysts have studied the relationship between suicide and the detoxification of domestic gas in European countries, and the results have again been mixed.⁶ It is clear that detoxification led to a reduction in gas suicides, but the effect on total suicide rates is not as clear.

What could explain these results? Is the magnitude of the reduction in suicides just too small to achieve statistical significance? Or are suicidal persons simply switching to other methods when their first choice methods are not available? And if so, does this imply that suicidal persons are indifferent among suicide methods? After all, if a particular method were substantially preferred to other methods of suicide by some segment of the suicidal population, it seems intuitive that a reduction in its availability should induce at least some of them not to commit suicide at all, even if others did switch methods.

In this article, I attempt to extend the economic literature on suicide to address questions like these. In section 2, I consider existing economic theories of suicide in greater depth, and I explain why they are insufficient to answer the questions posed. In section 3, I present a new model of suicide. In this model, I employ the tools of search theory to characterize the suicidal person's choice about when and how to commit suicide in a dynamic context. I conceptualize the suicidal choice process as a search for methods, in which the agent must sometimes decide whether to take a present opportunity to commit suicide or wait for a better opportunity in the future. I then explore the model's implications for how changes in various factors – such as permanent income, companionship, the disutility of different methods of suicide, and the availability of those methods

– affect the suicidal person's search strategy and likelihood of committing suicide. Among other things, the theory indicates that a reduction in the availability of a preferred method of suicide (e.g., guns) could induce some individuals to commit suicide sooner – possibly even leading to an increase in the overall suicide rate. In section 4, I examine the relationship between suicidal strategies and suicide rates. In section 5, I perform a cross-sectional analysis using state-level data on suicide rates, gun ownership, and other relevant variables in 1996, the results of which provide mixed support for the hypotheses advanced in sections 3 and 4. Finally, in section 6, I summarize and offer suggestions for future research.

2. Earlier Economic Models of Suicide

Hamermesh and Soss's (1974) article provides the earliest, and still the most sophisticated, treatment of suicide from the perspective of economic theory. In their model, an agent weighs the present discounted value of continued living (which is presumably zero or negative for a potentially suicidal person) against his distaste for suicide.⁷ If the former outweighs the latter, the agent commits suicide; otherwise, he continues living. To be more specific, Hamermesh and Soss define $b_i \sim N(0; \frac{1}{4})$ as individual i 's taste for living or distaste for suicide. This individual will commit suicide when and if his present discounted value of continued living is sufficiently negative to outweigh b_i .⁸

Hamermesh and Soss's model is ideally suited to the questions they wish to address; specifically, they are interested in demonstrating the impact of increasing age and changes in permanent income on the suicide rate. Other questions, however, cannot be answered within this model. Most importantly, it cannot address the question of an agent's choice of suicide method. Since the distaste for suicide parameter is fixed for any one individual, the model does not allow for the possibility that some methods of suicide may be more or less distasteful or difficult to employ than others. Nor can the model address the policy-related question of how changes in the availability of different suicide methods can affect an agent's choice of when, and whether, to commit suicide.

More recently, Yang and Lester (Yeh and Lester [1987], Yang and Lester [1996], Lester and Yang [1997], B. Y. Lester [2001]) propose a supply-and-demand model of suicide. In this approach, the

“demand-side” is characterized by a positive relationship between the perceived benefits of suicide, such as alleviation of suffering, and the probability of suicide. The “supply-side” is characterized by a negative relationship between the perceived costs of suicide, such as the painfulness of committing the act, and the probability of suicide. Yang and Lester argue that the intersection of the supply and demand curves yields an equilibrium probability of suicide. But their “supply and demand” are best understood as simple metaphors for costs and benefits of suicide, because a probability of suicide really only makes sense when costs and benefits are considered together. Supply-and-demand is a model of social equilibrium, not individual equilibrium. In the context of a single person’s choice of action, the supply-and-demand metaphor is superfluous and possibly misleading.

Among Yang and Lester’s conclusions is that any increase in the perceived “price” of suicide, such as “the cost of losing your life, collecting information about how to commit the act, purchasing the means for suicide, etc.” (Lester and Yang [1997], 48), should lead to a reduction in the probability of suicide. It is apparent that they wish to address the questions raised earlier about choice of methods and the effects of policies affecting their availability. But the costs associated with some methods of suicide may not be associated with others, so it is unsatisfactory to speak of a simple relationship between costs in general and the decision to commit suicide. And even for a single method of suicide, the “cost” is not a unitary parameter; there is a distinction to be made between the disutility of actually using the method and the difficulty of getting access to it.

On a radically different tack, Wei-Chiao Huang (1997) analogizes the choice of a person whether or not to continue living to the choice of a worker whether or not to participate in the labor force. Just as a worker must decide how much of his time to put into work, the potentially suicidal person must decide how much effort to put into living. When the worker chooses the corner solution of putting zero hours into work, he is unemployed; when the suicidal person chooses the corner solution of putting zero effort into life, he commits suicide. Although intriguing, this approach runs into difficulties when the analogy is pressed. For instance, Huang analogizes non-labor income such as welfare benefits and inheritance (which are received even if one chooses not to work) to non-effort benefits of living such as having naturally good health and parents who love you no matter what. The difficulty here, of course, is that these non-effort benefits of living can only be experienced

if one is still alive.⁹ Not observing this difficulty, Huang concludes that an increase in non-mort benefits of living could make a person more likely to commit suicide. Aside from the oddness of this conclusion, the more relevant matter is that Huang's approach (like the others discussed above) cannot take account of differential costs and availabilities of suicide methods, and thus it cannot explain choice of method. Huang's model is also static, and therefore it cannot address issues of timing.

Finally, R. W. Rosenthal (1993) introduces a signalling model of suicide. An individual may deliberately engage in a gamble with some probability of death because, in the event that he lives, his attempt will have sent a message – a cry for help – to a sympathetic observer. Thus, the perceived benefits of an unsuccessful suicide attempt may outweigh the chance of death. Though fascinating (and in my view very plausible), this approach has limited applicability. It does not model people who actually want to be dead, only people willing to take a risk of death in return for greater benefits in life. Although suicide and attempted suicide are obviously related (since at least some people who don't intend to succeed do, and some who intend to succeed don't), attempted suicide – or “parasuicide” – is often regarded as a distinct phenomenon because the motivations of the people involved apparently differ substantially.¹⁰

In addition to the economic models above – which are, to my knowledge, the only formal treatments of suicide from the perspective of economic theory – there are at least two “folk models” of suicide, by which I mean informal and widely held theories of suicidal choice. Unlike the more formal models, these do address the choice of methods issue. The first, which I will call Folk Model I, is embodied in the common assertion that “anyone who really wants to commit suicide will find a way to do it.” The implicit assumption of Folk Model I is that different suicide methods are essentially perfect substitutes, so that any reduction in some method's availability will result in displacement to other methods. Any individual who can't use method A will just switch to method B. So long as there is always a method B available, the total number of suicides will not change.

Folk Model II results from allowing for suicide methods that are not perfect substitutes. If some methods are preferable to others, then reduced availability of a preferred method will not necessarily cause total displacement to other methods. Instead, while some individuals may switch

methods, others will choose not to commit suicide at all. This is especially likely if there is a method that is substantially better than other methods (in the eyes of suicidal persons). To the extent that there is anything less than total displacement, reduced availability of a suicide method should deter at least some suicides.

Much of the empirical literature on suicide can be viewed as a contest between Folk Models I and II. As indicated earlier, the evidence is mixed: although some studies apparently show reductions in total suicidal rates resulting from reduced availability of certain methods, numerous others find no significant association. These results provide (weak) support for Folk Model I, but they are also something of a puzzle. It is difficult to believe that suicidal persons are completely indifferent among suicide methods; yet to the extent that they are not indifferent, suicide rates should fall when a method becomes less available. One explanation is that the magnitude of any deterrent effect is just too small to achieve statistical significance, meaning that in practice Folk Model I might as well be true. Another explanation is that other parameters have changed so as to push suicide rates up at the same time reduced availability of a method drove them down – but of course, the impact of other factors can be captured through regression analysis, so this explanation is not really satisfying. In this paper, I will suggest an alternative explanation: reduced availability of a suicide method can actually create offsetting effects, so that the total impact on the suicide rates is ambiguous in theory, not just in practice. This is true because (not in spite) of suicidal persons preferring some suicide methods to others. The reason, in a nutshell, is that reduced availability of some methods of suicide can induce individuals to opt for substitute methods that will become available sooner, thus hastening the suicidal act.

3. A Search Model of Suicide

This article models suicide as a “rational” choice in a narrow sense: individuals act to satisfy their subjective preferences as they perceive them, subject to constraints as they perceive them. All variables and parameters used in the model should be construed as the agent’s internal perceptions of them. This does not imply that an individual’s perceptions are necessarily correct in the sense of

corresponding to the external world. A suicidal person may be unduly pessimistic about her future life prospects, underestimate the pain associated with committing the act of suicide, and so on. Her valuation of the future relative to the present may differ substantially from that of other people. She may be considered irrational, even insane or mentally ill, because an external observer finds that her beliefs are unjustified by actual circumstances. Nonetheless, her actions are still rational in the narrow sense. Perceived prospects, not actual ones, drive the suicidal person's choices.

Various methods exist for committing suicide, from shooting oneself with a firearm to overdosing with medicine to jumping off a bridge. Some methods may be more desirable or less distasteful than others – though of course the ranking will differ from individual to individual. Although many Americans seem to prefer guns (57 percent of suicides in 1998 were with firearms), such preferences are not universal; they apparently differ substantially along gender lines, for example (78 percent of male suicides were with guns, versus 34.8 percent of female suicides)¹¹. Naturally, a suicidal individual would like to use the method perceived as least costly (in utility terms), but there may be more costly methods he would also use. Other methods may be considered so undesirable that they would never be used at all, even in the absence of other methods.

Not every method of suicide will be available at all times. A teenager may only get the opportunity to use a gun on the rare occasion when the gun closet is left unlocked. Someone who wishes to overdose on pills may only rarely get an opportunity to do so without a substantial likelihood of being discovered and stopped. Thus, someone who wishes to commit suicide faces the possibility of being unable to use his preferred method, at least for some period of time. As a result, he may sometimes have to choose between using a less preferred method immediately and waiting for the chance to use a more preferred method later.

The facts just outlined direct our attention to the economic theory of search, which is ideally suited for examining choices in dynamic settings characterized by uncertainty. Suicidal choice obviously involves dynamic considerations, as committing suicide means sacrificing a stream of future utility or disutility in favor of an instantaneous outcome; and it also involves uncertainty, as the means of committing the act may not always be available. A person who wishes to commit suicide may be regarded as engaging in a search for methods. Each period, he tries to find a method

– perhaps passively, by waiting for an opportunity to appear. Maybe he will find a method, maybe he won't. If he does, he will have to decide whether or not to use it. If he has found his most preferred method, the choice is obvious. But if he encounters a less desirable method, he will have to decide whether to use it or not. If he waits, he will have to incur a search cost; specifically, the disutility of living one more period of misery. The wait could be worth it if a better method appears later. Whether the suicidal person decides to act now or wait will depend, among other things, on the likelihood of encountering different methods and the cost (disutility) associated with each method.

With these thoughts in mind, I propose the following search model of suicide. Define

$$v_t = v(x_t) \tag{3.1}$$

as the one-period utility of living. The variable x_t is a vector of factors that influence the value of life. These factors could include one's age and permanent income (as in Hamermesh and Soss's model), marital status, health, etc. As it is not the object of this paper to determine which factors affect the value of one's life, I will leave the exact content of x_t unspecified. Since the agent under consideration is presumably unhappy with his life, I will assume provisionally that v_t is negative.¹² Also, I assume that v_t is additive over time with discount factor δ , and let V_t be the present value of the stream of utility. The discount factor should be construed to include the possibility that the agent will die of causes other than suicide.

Let c_i be the cost (disutility) associated with using a particular method of suicide m_i . Since c_i is utility-valued, it can differ from person to person. Let M be the set of all methods of suicide, which for any particular person implies a set C of all method costs. These costs can be arranged from lowest to highest, with the lowest cost corresponding to the most desirable method and the highest to the least desirable.

If an individual engages in a search for methods, a probability distribution determines the likelihood of each method being found. Though the probability distribution is independent of the agent's preferences (it operates on the elements of M), it can be used to find the induced probability

of finding a method with any given cost. So let $f(c)$ be the probability, in one period, of the agent encountering a method with utility cost c .¹³ There is some remaining probability of finding no method at all, in which case the agent has no choice but to wait. This probability is given by

$$\Pr[\text{no method}] = 1 - \sum_{c \in C} f(c) \quad (3.2)$$

Finally, let $V_t(c)$ be the present value of having found a method with cost c at time t , and let $V_t(\text{nm})$ be the present value of not having found any method at time t .

To analyze the behavior of suicidal persons, consider the position of a person who has just encountered a method of cost c^0 . If he commits suicide, his entire disutility is an instantaneous $-c^0$. If he does not commit suicide, then he experiences the immediate one-period disutility of living v_t , plus the discounted value of having another draw at the method distribution next period. Thus,

$$V_t(c^0) = \max \left(-c^0; v_t + \delta \sum_{c \in C} V_{t+1}(c) f(c) + \delta \left(1 - \sum_{c \in C} f(c) \right) V_{t+1}(\text{nm}) \right) \quad (3.3)$$

For some methods, the first term in the maximum will be higher (less negative), so the agent will commit suicide using such methods. For other methods, the second term will be less negative, so the agent will wait another period. Since methods can be arranged from least costly to most costly, and since an agent who uses a method will necessarily use any less costly method, it is convenient to characterize the agent's strategy in terms of a reservation cost. He will use any method whose cost is lower than the reservation, and he will reject any method whose cost is higher than the reservation. Call this reservation cost c_t^* (the t subscript is necessary because the reservation cost may change over time in response to changes in underlying variables). The reservation cost corresponds to a method¹⁴ that the agent would just barely be willing to use, because the cost is exactly equal to the present value of waiting; that is, it is the cost that sets the two terms in the maximum above equal to each other:

$$c_t^* = -v_t + \delta \sum_{c \in C} V_{t+1}(c) f(c) + \delta \left(1 - \sum_{c \in C} f(c) \right) V_{t+1}(\text{nm}) \quad (3.4)$$

Further, by the definition of the reservation cost we can say that

$$\begin{aligned}
 &= \sum_i c_t^a \text{ if } c = nm \\
 V_t(c) &= \sum_i c_t^a \text{ if } c \geq c_t^a \\
 &= \sum_i c \text{ if } c < c_t^a
 \end{aligned} \tag{3.5}$$

This way of stating the problem allows for an alternate interpretation of the reservation cost: it is the magnitude of the expected utility of choosing to live (at least) one more period. This is true even for “corner solutions.” One corner solution would be an agent who commits suicide using any available method; for such an agent, the first term of 3.3 is always greater than the second term, and the first two lines of 3.5 are moot. The other corner solution would be an agent who will not commit suicide with any method; for this sort of agent, the first term of 3.3 is always less than the second term, and the third line of 3.5 is moot.

3.1. Effects of Changes in Variables Affecting the Value of Life

The structure above can be used to derive a number of conclusions about the behavior of suicidal persons. The first conclusions follow from finding the impact of changes in x_t , the set of variables that affect the value of living, on the reservation cost. If a change causes the reservation cost to fall, the individual becomes less likely to commit suicide, because fewer methods of suicide will satisfy the requirement of having a cost smaller than the reservation cost. On the other hand, if a change causes the reservation cost to rise, the individual becomes more likely to commit suicide, because more methods will satisfy the requirement.

To see the effect of a generic factor x_t^i on the reservation cost, consider the derivative:

$$\frac{\partial c_t^a}{\partial x_t^i} = \sum_i v_t^0(x_t^i) \tag{3.6}$$

This derivative could be positive or negative, depending on the impact of x_t^i on the instantaneous value of life v_t . For instance, a higher income would presumably have a positive impact on v_t , and

therefore a downward effect on the reservation cost. Consequently, the agent would be less likely to commit suicide. Conversely, a loss of companionship would probably have a negative impact on v_t , causing an upward effect on the reservation cost, thus increasing the likelihood of suicide. For expositional purposes only, I assume henceforth that the effect of the variable x_t^i on v_t is negative.

With more difficulty, it can be shown that the effect of changes in future values of x on the present reservation cost is the same: anything that diminishes the one-period value of life at some point in the future will cause an increase in the present reservation cost – and thus increases the likelihood of suicide in the present. Suppose there is a change in x_{t+j}^i , where j shows how far in the future the change is expected to take place. If the expression in 3.6 (the effect of a change in the current value of x^i) is positive, then it can be shown that

$$\frac{\partial c_t^a}{\partial x_{t+j}^i} > 0 \quad (3.7)$$

as well. (Proofs of this and subsequent propositions are available from the author on request.)

The result here duplicates that of Hamermesh and Soss (1974), who showed that an increase in permanent income will tend to decrease the suicide rate. In the present model, an increase in permanent income takes the form of an increase in future values of the income variable x_t^i , which causes an increase in the value of life in future periods, thus reducing the present reservation cost of suicide (c_t^a) and lowering the likelihood of suicide.

Similar conclusions can be drawn about changes in any other factor that affects the value of one's life in the future. Consider, for example, a man who has been recently widowed. The loss of companionship in the present reduces the current value of his life, thus increasing his reservation cost and making him more likely to commit suicide. Moreover, if the man does not expect to find another companion in the future, this expectation will reduce his reservation cost further and make him yet more likely to commit suicide in the present. On the other hand, the expectation that he will eventually be able to find a new companion will have the opposite effect, making him relatively less likely to commit suicide.

3.2. Effects of Changes in the Availability of Suicide Methods

The availability of methods is represented in the model by the distribution $f(c)$. For a method with cost c^0 , the likelihood of having an opportunity to use that method is given by $f(c^0)$. Changes in the method's availability should correspond to changes in $f(c^0)$. For instance, suppose that a change in gun policy causes guns to be less available for use in suicides than before; then the probability of encountering the opportunity to use a gun falls, meaning $f(\text{gun})$ is now smaller than before. What effect will such a change have on the likelihood of suicide for a person currently willing to use the method in question?

The answer might seem obvious – a decrease in the availability of a suicide method should decrease suicides, so the derivative must be positive. But the obvious conclusion is not correct. Thinking of suicide as a form of search generates the conclusion that reducing availability of a suicide method has an ambiguous effect. On the one hand, lower availability means that a person who wishes to use that method will be less likely to have the chance to do so. On the other hand, lower availability may also change the suicidal person's optimal search strategy, causing him to use methods he would not otherwise have employed.

Consider the analogy with a job search. Suppose a person must choose between accepting a low wage now or searching longer in the hope of getting a higher wage. If the probability of getting offered a higher wage in the future decreases, the person may become more willing to accept a low wage now. Similarly, if the probability of finding a more desirable (less costly) method in the future decreases, the suicidal person may become more willing to employ a less desirable (more costly) method in the present.

Assume that $c^0 < c_t^a$ for all t , meaning that c^0 is a method the agent will always be willing to use. Taking the derivative of 3.4 with respect to $f(c^0)$, it turns out that:

$$\frac{\partial c_t^a}{\partial f(c^0)} < 0$$

This means an increase in the availability of the method with cost c^0 causes a decrease in the agent's reservation cost, so that the agent is willing to use fewer suicide methods. On the other hand, if

the method becomes less available, then the reservation cost rises, making the agent willing to use more suicide methods. This conclusion must be qualified by the observation that, since there is a finite number of suicide methods, a change in the reservation cost will not necessarily cross a threshold, causing a method to switch from “usable” to “not usable” or vice versa.

What happens if there is a change in the availability of a suicide method that an agent will never use? This means that $c^0 < c_t^a$ for all t . A similar proof shows that

$$\frac{\partial c_t^a}{\partial f(c^0)} = 0$$

This result makes intuitive sense: If there is a method that an agent is unwilling to use, finding that method is equivalent to finding no method at all, so the total probability of remaining alive under the current strategy (either because no method is found or because no acceptable method is found) does not change.

The two cases considered so far – a change in the likelihood of a method the agent would always use, and a change in the likelihood of a method the agent would never use – are polar cases. There are infinitely many intermediate cases, such as: a change in the likelihood of a method the agent will use now, but will not use at some point in the future; a change in the likelihood of a method the agent will not use now, but will use at some point in the future; etc. The outcome in such intermediate cases will necessarily lie between the outcomes of the polar cases. An increase in the likelihood of any method that an agent will at some point in time be willing to use causes a decrease in the reservation cost, and vice versa. The magnitude of the effect depends (among other things) on the number of future periods in which the agent is willing to use the method in question.

3.3. Effects of Changes in the Utility Cost of Suicide Methods

A third question is how changes in the perceived costliness of suicide methods will affect the suicidal person's behavior. For instance, suppose a public education campaign emphasizes the pain and discomfort that often result from attempting to commit suicide via a drug overdose. This campaign might increase the disutility that a suicidal person associates with that suicide method.

What will be the overall effect on this person's behavior?

Consider a suicide method, with associated disutility c^0 , that the agent is currently willing to use at any point in time (that is, $c^0 < c_t^a$ for all t). It can be shown that:

$$\frac{\partial c_t^a}{\partial c^0} > 0$$

This means an increase in the perceived disutility of a suicide method that an agent is currently willing to use will increase the suicidal person's reservation cost, hence making him willing to use more methods than before. This somewhat perverse result is closely akin to the result, from the previous section, that a decrease in the availability of a suicide method could make an agent willing to use more methods. Intuitively, when a favored method becomes less favorable, its relative superiority to other methods is no longer as great. As a result, the suicidal person is less inclined to wait for a chance to use it, and more willing to go ahead and use other methods now. Suppose, for instance, that a suicidal person is currently planning to use a gun when the opportunity presents itself. But then she learns that death from a gunshot is not always instantaneous and could involve an extended period of pain. Although she is still willing to use a gun, she is no longer willing to pass up the opportunity to use some other method, such as pills, in order to use a gun later. (The analogy with a job search may again be useful. If the size of a high wage offer shrinks, someone searching for a job will be less inclined to wait for the high wage and more willing to take a low wage immediately.)

The result is different if the disutility changes for a method the agent is currently unwilling to use. If $c^0 > c_t^a$ for all t , then

$$\frac{\partial c_t^a}{\partial c^0} = 0$$

which means the change will have no effect. This, too, makes intuitive sense. If an agent is already unwilling to use a particular suicide method because it is perceived as too costly, then it does not matter if that method becomes even more costly. The agent will continue to forgo using it, and thus his optimal search strategy does not change. For instance, suppose that an agent is currently

unwilling to jump off tall buildings. If the agent reads a magazine article that confirms his belief that plummeting through the air is an incredibly scary experience, this will have no effect on his choice of methods; he will continue to forgo jumping from buildings and waiting for more favorable methods of suicide to become available.

3.4. Effects of Changes in the Time Discount Rate

It might seem obvious that suicidal individuals must have a very high discount rate, or at least that persons who discount the future highly are more prone to commit suicide. But actually, a higher rate of discount can make an individual either more or less likely to commit suicide.

Consider, for instance, an individual whose perceived one-period value of life, v_t , is negative and constant over time. For this person, discounting the future more (i.e., having smaller δ) would make the individual less inclined to commit suicide, because the discounted sum of future disutility from continued living would be smaller. On the other hand, consider an individual who expects to have negative value to her life in the near future, but positive value to her life in the distant future. For this person, a higher rate of discount would make her more likely to commit suicide, because the future years of happiness would be given less weight.

The impact of a person's discount rate depends, then, on the value of other variables, especially the stream of life utility or disutility over time. In light of this result, the common belief that suicidal persons must not place enough weight on the future needs reinterpretation. One possibility is that the observer thinks that the suicidal person's perceived future life prospects are positive, in which case a higher δ would indeed reduce the likelihood of suicide. Another possibility is that the observer thinks the suicidal person's perceptions of her life prospects are negative but incorrect. If this latter explanation is the right one, then it's worth noting that however mistaken a person's subjective beliefs may be, they are the ones that matter in determining her behavior. Encouraging a person who places a negative value on her future life prospects to "think more about the future" would make her more likely to commit suicide, not less.

4. From the Individual to Society: Effects on Suicide Rates

4.1. Avoided and Induced Suicides

So far, this paper has discussed only the suicide choices of individuals. How those choices affect overall suicide rates has been hinted at but not discussed directly. I will now turn attention to this question, which bears directly on efficacy of policies proposed to reduce the incidence of suicide. In all that follows, the term “policy” should be construed broadly. It refers not just to government policy, but also to the policies of private organizations, communities, and families – in short, anything that could affect the agent’s assessment of the underlying variables such as availability of suicide methods.

A suicidal person’s behavior will only respond to changes in policy if he understands that the policy has in fact changed relevant variables. A reduction in handgun availability, for example, will only change a suicidal person’s search strategy if he realizes that $f(\text{gun})$ is smaller than it used to be. If a person’s beliefs are radically at odds with (or utterly unaffected by) the external world, as may be the true for the severely mentally ill, the policy change could have no effect on the person’s plans at all. For present purposes, I will assume only that the agent’s perceptions of method availabilities bear some correspondence to reality, while other variables (such as the perceived value of life) may or may not correspond to reality.

With this caveat, policies that affect suicide method availabilities, perceived utility costs, and the perceived value of life can induce changes in a suicidal individual’s choice of search strategy. In some cases, the individual may switch to a strategy of never committing suicide at all. In many other cases, however, the individual just constricts or expands the set of methods he is willing to use. How does this affect whether the individual commits suicide in the long run?

It is useful to consider a simplified version of the model to answer this question. Suppose that there are only two methods of suicide, with likelihoods of θ and $1 - \theta$ respectively (and a $1 - \theta - \theta$ of ...nding no method). Assume that the ...rst method is the preferred method, and also (for the time being) that the one-period value of life v_t is ...xed. Take the case of an individual who is currently willing to use only the ...rst method. Each period there is an θ chance of suicide and a $(1 - \theta)$

chance of continued life. So the expected lifetime of this individual is $(1 - \theta) = \theta$. Now suppose a policy change reduces the perceived availability of the first method, causing the individual to switch to using both methods. Then his expected lifetime becomes $(1 - \theta - \phi) = (\theta + \phi)$. It may appear that this person's expected lifetime is shorter than before. If θ and ϕ were the same as before, that would be certainly true. But since it was a change in θ that resulted in the new search strategy, the result is ambiguous. If a relatively small reduction in θ caused the shift in strategy, then the expected lifetime is probably shorter, because the reduced likelihood of the person getting a chance to use the first method is outweighed by the person's newfound willingness to use the other method. But if the reduction in θ was large, then the expected lifetime might increase.

In the long run, though, there may be little difference. Both before and after the policy change, this person has some probability of committing suicide. Given a long enough time, the probability of his doing so approaches one, regardless of which methods he's willing to use, unless he dies of other causes first. The shift in policy and search strategy can only postpone or hasten the inevitable.

However, this conclusion ignores the possibility that other changes in underlying variables may take place. Although the simplified model rules out this possibility, an individual's expectation of the valuation of his life (v_t) can change over time. If so, then a decrease in the per-period probability of suicide could potentially avert suicide altogether, because the individual's outlook on life may change in the meantime. Conversely, an increase in the per-period probability of suicide could result in suicides that would otherwise have been averted, since the individual's outlook might have changed if given more time. I will refer to these effects as "avoided" and "induced" suicides.

Without the effect of avoided or induced suicides, policy changes could only cause temporary fluctuations in the suicide rate. A policy change that merely caused an increase in expected lifetimes of suicidal persons would reduce suicide rates in the short run, but in the long run the increased number of present suicides from delaying them in the past would approximately counterbalance the decreased number of suicides from delaying them in the present (unless the preemption effect from deaths by other causes were sufficiently large). Likewise, a policy change that caused a decrease in expected lifetimes of suicidal persons would increase suicide rates in the short run, but in the long

run the decreased number of present suicides from hastening them in the past would approximately counterbalance the increased number of suicides from hastening them in the present (again controlling for deaths by other causes). In short, absent avoided and induced suicides, policy changes would mainly create impulse effects instead of permanent shifts in the suicide rate.

Policy changes can have different effects on different individuals' suicide choices, and these effects may offset each other in the aggregate. Suppose, for instance, that a new policy restricts access to handguns. Some suicidal individuals may be totally unaffected, since they never would have used a handgun for suicide anyway. Others may experience an increase in expected lifetime, because it will take longer for them to get the opportunity to use a handgun. And still others may experience a decrease in expected lifetime, since the reduced availability of handguns induces them to expand the set of suicide methods they will use. Some suicides will be avoided, others induced. Whether the overall suicide rate increases or decreases in the long run depends on the characteristics of the population, which will determine how many individuals fall into each category.

Thus, the model's prediction of the impact of policy changes on overall suicide rates is ambiguous. The story is different for the rate of suicides committed by a particular method. Consider again the example of a policy that reduces the perceived availability of handguns. For the group of individuals who do not change their search strategy, there will be fewer suicides, and handguns will certainly be used to commit a smaller fraction of them (because they will be encountered less often). Therefore, the total number of handgun suicides in this group must decrease. For the group of individuals who do change their search strategy, the effect is similar but more dramatic. While they remain willing to use handguns, they add other methods they were not willing to use before. The fraction of them who commit suicide using handguns decreases for two reasons – first because handguns are more difficult to obtain, and second because they increase the number of other methods they will use. If the total number of suicides in this group (of individuals who change their search strategy) decreases, then clearly the total number of handgun suicides will also fall. If the total number of suicides in this group increases, any increase must be attributable to the inclusion of additional non-handgun methods that would not have been used otherwise, so there still cannot be any increase in handgun suicides from this group. Consequently, the model predicts that the gun

suicide rate will fall, even if the overall suicide rate increases. For similar reasons, the percentage of all suicides committed with handguns should also fall unambiguously.

4.2. The Search Model versus the Folk Models

In what sense does the search model presented here differ from the Folk Models discussed earlier? Both of the Folk Models include the possibility of suicidal individuals switching from one method to another in response to changes in their environment. The difference between them is that Folk Model I treats methods as perfect substitutes, while Folk Model II treats them as imperfect substitutes. In this respect, the search model is more akin to Folk Model II.

The conclusions, however, differ starkly. Folk Model II suggests that a reduction in the availability of a suicide method would at worst have no effect, and at best would deter some suicides on the margin. The search model, however, points to the possibility of worse outcomes. Reduced availability of a method might reduce suicides or have no effect, or it might instead lead to an increase in suicides.

What accounts for the difference in conclusions is the dynamic character of the substitution effect. In both Folk Models, which are essentially timeless, anyone who commits suicide – regardless of method – does so immediately. As a result, any method substitution is a wash with respect to the overall suicide rate. But in the search model, substitution of one method for another implies a change in timing, because a person willing to use a greater variety of methods will have more opportunities to commit suicide sooner. This kind of intertemporal substitution effect is not possible in a static model like Folk Model I or II.

5. Suicide and Gun Availability in 1996

In this section, I test the model's implications for the relationship between suicide and the availability of firearms. The results of restricting access to firearms are not, of course, the model's only implications. As indicated earlier, there are also implications for policies (not just of governments, but of families, communities, and private organizations) that affect the perceived costliness of different suicide methods, such as educational campaigns. Nonetheless, the gun debate is certainly

responsible for a great deal of public interest in the issue of suicide.

A persistent problem in the literature on the relationship between guns and violence (suicide and otherwise) is the lack of a reliable measure of gun prevalence, especially for cross-sectional research. Although there exist national surveys (Gallup and National Opinion Research Center) that regularly ask respondents questions about gun ownership, these surveys are problematic for researchers because (a) the surveys are not conducted every year, and (b) the resulting data is at the national or regional level, rather than state or county. Also, in years that both surveys have asked the same or similar questions about gun ownership, they have sometimes produced conflicting results. In any case, the only study of the relationship between suicide and gun ownership using the Gallup/NORC time-series data, Yang and Lester (1989), show no significant relationship between gun ownership and the overall suicide rate.

Analysts have therefore used a variety of proxies for gun prevalence, including the death rate from firearm accidents, percentage of homicides committed with guns, percentage of robberies and assaults committed with guns, percentage of stolen property taken by offenders using guns, and rates of subscription to gun-oriented magazines. These are all, of course, highly imperfect measures. There simply does not exist a truly reliable measure of gun prevalence, and I will not remedy that deficiency in the present study.

Instead, I have chosen to use four different indices of gun ownership from the year 1996. I selected the year 1996 because in that year, the Voter News Service conducted a survey of voters exiting presidential election polls that included a question about household gun ownership. These data are available at the state level, though unfortunately only 14 states had enough respondents to make cross-state comparisons. Lott (2000) adjusted the data to account for demographic differences between voters and the general public, and I have used this data for one set of regressions. The other three proxies employed in this paper are: the gun accident rate, the percentage of homicides committed with guns, and the rate of subscription to *Guns & Ammo*, a major handgun-interest magazine. For these indices, data is available from all 50 states and the District of Columbia.

In the first set of regressions, I performed standard OLS regression of the overall suicide rate per 100,000 persons on the following variables:

- ² The gross state product per capita (GSPPC)¹⁵, as a measure of general economic performance. Higher values of GSPPC are expected to be associated with lower rates of suicide.
- ² The state unemployment rate (UNEMPL)¹⁶, a second measure of economic performance, included because the experience of unemployment often results in depression and dissatisfaction for the affected individuals. Higher values of UNEMPL are expected to be associated with higher rates of suicide.
- ² The state divorce rate (DIVORCE)¹⁷, since divorce is often a traumatic event for the individuals getting divorced as well as other affected parties, like children. Higher values of DIVORCE are expected to be associated with higher rates of suicide. Data on divorce were not available from four states¹⁸, which reduced the sample size to 47 in most cases.
- ² An index of gun prevalence: percentage of homicides committed with guns (GUNHOM)¹⁹ in Model 1, gun accident rate per 100,000 persons (GUNACCID)²⁰ in Model 2, percentage of state's residents with a gun in the home according to the Voter News Service survey (GUNSURV)²¹ in Model 3, and rate of subscriptions to Guns & Ammo per 1000 population (GUNMAG)²² in Model 4. The expected sign of the gun prevalence coefficient is theoretically ambiguous.

The results of these four regressions are summarized in Table 1. The F-statistics for all four regressions were significant at the 5% level or better. All coefficients of non-gun variables, with the exception of UNEMPL in Model 3, have the expected sign. Neither of the economic variables is significant, except for marginal (10% level) significance for GSPPC in Model 4. Divorce, however, appears to be an excellent predictor of suicide: the DIVORCE coefficient is highly significant in every regression except the small-sample GUNSURV regression. Interestingly, three out of four gun prevalence indicators have negative coefficients, though none are significant. The one exception is GUNMAG, which has a positive and significant coefficient.

These results raise the question of what the GUNMAG variable actually measures. If it measures gun prevalence, the implication is that higher gun prevalence leads to higher overall suicides. But

this conflicts with the negative coefficients achieved by the other measures of gun prevalence. Significantly, such contradictory results appear elsewhere in the guns-and-violence literature. Of all the proxies for gun ownership used in previous studies of suicide, gun magazine subscription rates are the only proxy to have yielded positive and significant associations with overall suicide rates (Lester 1989b). Similarly, while Lott and Mustard's (1997) results show that "shall-issue" laws – which presumably increased gun prevalence – decreased violent crime rates in the states that adopted them, Duggan (2000) reverses these results when he uses Guns & Ammo subscription rates as a measure of gun prevalence.

The systematic divergence of results between gun magazine subscription rates and other proxies for gun prevalence suggests that the magazine subscriptions might be measuring something else, such as intensity of interest in guns. If so, then the subscription rates could actually serve as a control variable that separates gun interest from gun prevalence. To test this hypothesis, I performed a second set of regressions using the same variables, but including two gun variables in each one. Model 5 includes both GUNHOM and GUNMAG, Model 6 includes both GUNACCID and GUNMAG, and Model 7 includes both GUNSURV and GUNMAG. The results are dramatic. As before, all F-statistics are significant at the 5% level or better. In Models 5 and 6, the GUNMAG coefficient is positive and highly significant, while the other gun variables' coefficients are negative and highly significant. In the small-sample Model 7, the results are similar but insignificant (as expected with such a small sample). With only one exception, the adjusted R-squared is always higher when two gun variables are included than when just one is included (the exception is Model 3 versus Model 7). These results lend support to two propositions. First, gun magazine subscriptions do appear to provide a control for gun interest. Second, decreased gun prevalence (as measured by the other indices) can actually increase overall suicides, as predicted by this paper's model.

To test the robustness of these results, I tried some different specifications (complete results of these regressions available from the author on request):

² I replaced UNEMPL, which had not yet yielded a single significant coefficient, with POVERTY²³, the state poverty rate in 1995 (the closest year available). GUNMAG was also maintained as

a measure of gun interest. The POVERTY coefficient is positive in all cases (as expected), and it is significant in one regression, marginally significant in another. The results for other variables are largely unchanged: DIVORCE and GUNMAG remain highly significant and positive, the other gun variables highly significant and negative. Significance levels of F-statistics were unchanged.

² I added a set of demographic variables: TEEN (teen-aged percentage of population), SENIOR (senior percentage of the population), BLACK (black percentage of the population), and ABORIG (native American percentage of the population)²⁴. None of these variables achieves statistical significance except ABORIG, whose coefficient is negative and significant in two regressions, positive and marginally significant in the third. The negative coefficients are unexpected, since native Americans have a higher rate of suicide than the general population. In any case, inclusion of the demographic variables does not substantially alter the results for other variables. The F-statistics remained significant (at the 1% level) for the first two regressions but was insignificant in the third (the small sample case).

² I added a set of regional dummy variables: MIDWEST, SOUTH, and WEST (with northeast states as the default). With the exception of SOUTH, which was positive and significant in two of the regressions, the regional variables do not achieve significance. As with the demographic variables, adding the regional variables does not substantially alter the results for other variables. Significance levels of F-statistics were unchanged.

The results from the first three sets of regressions provide support for this paper's hypothesis that gun prevalence could be inversely related to the total suicide rate. Although the model's theoretical prediction is ambiguous in this regard, an inverse relationship is an empirical result that distinguishes the present model from other models.

The next task is to test the relationship between gun prevalence and the gun suicide rate. This paper's model does not differ from other suicide models on this question: all predict a positive relationship. And indeed, that is what previous empirical studies have found. Oddly, the results of the present study are not so clear. Table 3 shows the result of regressing the states' gun suicide

rates on the same set of variables as in the second regression set described above. In all three regressions, F-statistics are significant at the 1% level. Although the gun prevalence coefficients are always positive, and significant in the case of gun magazine subscriptions, they are otherwise insignificant.

Adding some additional regressors like regional dummies and demographic variables – which had no major effect on the total suicide regressions – has the effect of making most coefficients on non-magazine gun prevalence indicators negative and, in one case (GUNHOM), significant. This result is inconsistent not just with the current model, but with other models of suicide (e.g., Folk Models I and II) as well. The strangeness of this result is enough to cast some doubt on the previous results showing an inverse relationship between gun prevalence and total suicide rates, since there is a high correlation between gun suicides and total suicides. The problem might be that the gun prevalence proxies are flawed, or perhaps other relevant variables have been excluded. However, the inclusion of other variables, including female labor force participation rate and percentage of population living in metropolitan areas, did not substantially alter the results.

As mentioned earlier, the suicidal behaviors of men and women differ substantially. Men are more likely to commit suicide, and when they do so, they are more likely to use guns.²⁵ These facts suggest the possibility of treating the genders separately for empirical testing. Doing so allows an additional test of the model. As demonstrated in section 3.2, a reduction in the availability of a suicide method will only change a person's search strategy if the method in question is one he was already willing to employ. If it is indeed the case that more men are willing to use guns than women, then the impact of changes in the availability of guns should be larger for men than women. Further, this should be true regardless of whether the effect of availability on the suicide rate is positive (as indicated by other models) or negative (which is possible only with the current model).

To test this hypothesis, I repeated regression Models 1 through 7 separately for male and female suicide rates. In all seven cases, a Chow test for structural change strongly rejects the hypothesis that the two populations are the same. Table 4 summarizes the results, showing the coefficients on gun prevalence measures for the two groups. As in the original regressions, the coefficients

are negative for three gun prevalence measures (GUNHOM, GUNACCID, and GUNSURV) and positive for one (GUNMAG). In every case, the absolute value of the coefficient for men is greater than that for women.

Significance test results mirror those of the original regressions: gun prevalence coefficients are significant when GUNMAG is used as a measure of gun interest (Models 5 and 6) except in the small sample case (Model 7). The t-statistics are, with one exception, always higher for men. The difference between the male and female coefficients is marginally significant in Models 5 and 6 as well. (Significance tests on the difference were impossible in the small sample models.)

Although the results here are not overwhelming, they do provide further evidence for this paper's model. The negative coefficients on gun prevalence in the earlier regressions might be attributed to strangeness or noise in the data. But it is more difficult to ignore the pattern of coefficients being more negative for men than for women. That outcome is not predicted (or even addressed) by any other existing model of suicide.

6. Conclusions

Existing theoretical models of suicide suffer from an inability to answer some central questions about suicidal behavior, specifically, how suicidal persons choose among different means of committing suicide, how they time their actions, and how changes in the perceived cost and availability of suicide methods affect their choices. This article creates a rubric for answering these questions by placing the suicidal choice in a dynamic context with differentiated methods of suicide.

Thinking of suicide in this way produces novel conclusions that differ in important ways from the conclusions of other models. The differences are especially marked with regard to the predicted relationship between a method's availability and the total suicide rate. Previously, the debate was between those who insisted the relationship would certainly be positive and those who said it would probably be zero. But the current model suggests that the effect could even be negative.

Of course, an ambiguous theoretical result puts a premium on empirical testing. Taken as a whole, this paper's empirical results show mild support for the hypothesis advanced, and they

should be taken in the context of the numerous previous studies that have failed to show a significant relationship between gun availability and total suicide rates. The negative relationship between total suicide rates and measures of gun prevalence appears repeatedly under many different specifications, and in many cases the association is statistically significant. Further, the magnitude of the negative relationship is strongest among men, another result consistent with the model. But the appearance of a negative (though usually insignificant) relationship between gun suicides and measures of gun prevalence – a result at odds with the present model of suicide, other popular models of suicide, and previous empirical work – casts a shadow on the reliability of the data used. Additional empirical research, hopefully drawing on better measures of gun prevalence, will be required to sort out this conundrum.

Further theoretical work may also prove useful. The model used here opens up the phenomenon of suicide to the use of more sophisticated economic tools, but the job is not complete. The model's treatment of time discounting may not be entirely appropriate for suicidal persons, as their weighting of future possibilities seems likely to be different from that of other persons. If the difference is merely that they place heavier weight on the present relative to the future, that can be handled by the present model as a smaller value of δ as discussed earlier; but if suicidal persons engage in hyperbolic discounting, then substantial changes to the model – and possibly results – could be required. It would also be desirable for future theoretical work to explore the consequences of including agents who measure their satisfaction relative to some benchmark level of satisfaction, perhaps set by observing the apparent success and satisfaction of others.

The approach advanced here focuses attention on the dynamic character of the suicidal choice. It is apparent that, at least for many, the decision to commit suicide involves an assessment of the future prospects of one's life, and those prospects may include future opportunities to commit suicide. As Harvey Fierstein wryly observes, "The great thing about suicide is that it's not one of those things you have to do now or you lose your chance. I mean, you can always do it later." But the opportunities one has later may be less desirable than the opportunities one has now. The model presented here is a first step toward understanding how these facts affect the behavior of suicidal persons.

Table 1. Effect of GSP per capita, unemployment, divorce, and gun prevalence on state total suicide rate

	Effect of explanatory variable on total suicide rate			
	Model 1	Model 2	Model 3	Model 4
Explanatory variable	n = 47	n = 47	n = 12	n = 47
GSPPC	-0.0000497 (-1.19)	-0.0000633 (-1.50)	-0.000363 (-1.83)	-0.00047 (-1.69)*
UNEMPL	0.283 (.84)	0.345 (.80)	-0.434 (-0.63)	0.193 (0.85)
DIVORCE	1.66 (5.73)***	1.61 (5.12)***	1.06 (1.67)	0.980 (4.79)***
GUNHOM	-5.15 (-1.39)	–	–	–
GUNACCID	–	-.434 (-0.41)	–	–
GUNSURV	–	–	-.0354 (-0.53)	–
GUNMAG	–	–	–	2.04 (7.33)***
constant	8.56 (3.28)***	6.16 (3.01)***	20.8 (2.46)**	3.63 (2.59)**
R ²	.5284	.5088	.7807	.7837
Adj. R ²	.4835	.4620	.6553	.7631

t-statistics shown in parentheses after coefficient estimates

F-statistics significant at 1% level for Models 1, 2, and 4; 5% for Model 3

*** indicates significance at 1% level

** indicates significance at 5% level

* indicates significance at 10% level

Table 2. Effect of GSP per capita, unemployment, divorce, gun prevalence, and gun interest on state total suicide rate

	Effect of explanatory variable on total suicide rate		
	Model 5	Model 6	Model 7
Explanatory variable	n = 47	n = 47	n = 12
GSPPC	-0.0000332 (-1.26)	-0.0000258 (-2.23)**	-0.000327 (-1.67)
UNEMPL	0.226 (1.07)	0.286 (1.36)	-0.466 (-0.70)
DIVORCE	1.10 (5.62)***	1.16 (5.86)***	1.11 (1.81)
GUNHOM	-6.38 (-2.72)***	–	–
GUNACCID	–	-1.96 (-2.92)***	–
GUNSURV	–	–	-0.0685 (-0.97)
GUNMAG	2.09 (8.03)***	2.25 (8.45)***	1.59 (1.19)
constant	6.44 (3.86)***	3.03 (2.31)**	17.6 (2.03)*
R ²	.8167	.8209	.8224
Adj. R ²	.7944	.7991	.6744

t-statistics shown in parentheses after coefficient estimates

F-statistics significant at 1% level for Models 5 and 6; 5% for Model 7

*** indicates significance at 1% level

** indicates significance at 5% level

* indicates significance at 10% level

Table 3. Effect of GSP per capita, unemployment, divorce, gun prevalence, and gun interest on state gun suicide rate

	Effect of explanatory variable on gun suicide rate		
	Model 8	Model 9	Model 10
Explanatory variable	n = 47	n = 47	n = 12
GSPPC	-0.0000616 (-2.38)**	-0.0000568 (-2.23)**	-0.000174 (-1.10)
UNEMPL	0.128 (0.62)	0.208 (0.51)	-0.214 (-0.40)*
DIVORCE	1.05 (5.47)***	1.01 (5.17)***	1.14 (2.29)*
GUNHOM	0.806 (0.35)	–	–
GUNACCID	–	0.663 (0.86)	–
GUNSURV	–	–	.00481 (.08)
GUNMAG	1.69 (6.63)***	1.64 (6.24)***	2.03 (1.86)
constant	-0.454 (-0.28)	0.0755 (0.06)	3.68 (0.52)
R ²	.8008	.8038	.8921
Adj. R ²	.7766	.7798	.8022

t-statistics shown in parentheses after coefficient estimates

F-statistics significant at 1% level for all three models

*** indicates significance at 1% level

** indicates significance at 5% level

* indicates significance at 10% level

Table 4. Effects of gun prevalence on male versus female suicide rates

	Gun Prevalence Coefficient: Men	Gun Prevalence Coefficient: Women	t-statistic on Difference
Model 1	-8.62 (-1.96)*	-1.57 (-1.73)	-1.08
Model 2	-0.459 (-0.37)	-.404 (-1.59)	-0.03
Model 3	-0.0596 (-0.88)	-0.0212 (-1.30)	n/a
Model 4	3.37 (9.70)***	0.466 (5.21)***	5.56***
Model 5	-10.7 (-2.46)**	-1.85 (-1.60)	-1.97*
Model 6	-2.96 (-2.35)**	-0.777 (-2.40)**	-1.68*
Model 7	-0.126 (-1.12)	-0.0244 (-0.78)	n/a

Models 1 and 5: Gun prevalence measure is GUNHOM.

Models 2 and 6: Gun prevalence measure is GUNACCID.

Model 3 and 7: Gun prevalence measure is GUNACCID.

Model 4: Gun prevalence measure is GUNMAG.

t-statistics shown in parentheses after coefficient estimates

*** indicates significance at 1% level

** indicates significance at 5% level

* indicates significance at 10% level

Notes

¹See section 2, below.

²Gary Kleck (1997, 285). The thirteen studies referred to are: Markush and Bartolucci (1984), Lester (1987a), Lester (1988a), Lester (1988b), Lester (1988c), Clarke and Jones (1989), Lester (1989a), Lester (1989b), Lester (1990a), Kleck (1991), Moyer and Carrington (1992), Killias (1993), and Kleck and Patterson (1993). Two of these, Markush and Bartolucci (1984) and Moyer and Carrington (1992), required correction by Kleck; see Kleck (1997, 51-2). Lester (1989b), the only study to find a statistically significant relationship between gun levels and total suicide rates, used gun magazine subscriptions as a proxy for gun ownership. Other studies that showed a relationship between gun availability and gun suicides, while not addressing total suicides, include DeZee (1983), Sommers (1984), Lester (1985), and Yang and Lester (1989).

³Lester and Murrell (1980), Nicholson and Garner (1980), Medo and Magaddino (1983), Lester (1987a).

⁴All but Medo and Magaddino (1983).

⁵Geisel et al. (1969), Murray (1975), Lester (1988a), Rich et al. (1990), Kleck and Patterson (1993). The exception is Boor and Bair (1990).

⁶Kreitman (1976), Farberow and Simon (1969), Sainsbury et al. (1981), Stengel (1964), Fox (1975), Clarke and Mayhew (1989). See also Clarke and Lester (1987) and Lester and Frank (1989) on the subject of car exhaust suicides, which appear to have increased just when detoxification was nearing completion.

⁷The model's mathematical structure also allows for the existence of a person who has a taste for suicide (or distaste for life) great enough to outweigh a positive present value of continued life. Such a person would also commit suicide.

⁸That is, suicide occurs when $Z_i(a; Y_P) + b_i = 0$, where Z_i is the present discounted value of continued living. Since Z_i is decreasing in age (a), satisfaction of the equality guarantees that it will soon become negative.

⁹Graphically, there is a hole in the person's budget constraint at the point where no effort is expended on living.

¹⁰See Kreitman, et al. (1969).

¹¹CDC unpublished mortality data from the National Center for Health Statistics (NCHS) Mortality Data Tapes, cited at <http://www.cdc.gov/ncipc/factsheets/suifacts.htm>.

¹²This assumption is not crucial. The analysis can be extended to include individuals whose present utility of life is positive, but who expect to have negative utility of life at some point in the future.

¹³If more than one method is found, the agent will choose the less costly method. Hence, any probability of ...nding more than one method should be included in the probability of the less costly method, and not in that of the more costly method.

¹⁴Possibly a non-existent method. As the reservation cost is de...ned in 3.4, the reservation cost could lie in between the costs of two possible methods. This is a result of the fact there is a ...nite number of methods. Also, the reservation cost could be greater than the costs of all actual methods (for a person who will commit suicide with any and all methods) or less than the costs of all actual methods (for a person who won't commit suicide with any method).

¹⁵Source: Statistical Abstract of the United States.

¹⁶Ibid.

¹⁷Ibid.

¹⁸California, Colorado, Indiana, and Louisiana.

¹⁹Source: Centers for Disease Control, National Center for Injury Prevention and Control, Web-based Injury Statistics Query and Reporting System: <http://www.cdc.gov/ncipc/osp/data.htm>.

²⁰Ibid.

²¹Lott (2000), p. 41-2.

²²Source: Audit Bureau of Circulations, Magazine Publisher's Statement (Guns & Ammo), 31 December 1997.

²³Source: Statistical Abstract of the United States.

²⁴Ibid.

²⁵In addition, women attempt suicide more often than men, but men succeed more often. As noted earlier, this paper focuses on successful suicides.

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