Litigation Economics Review
Volume 5, Number 2: 2-8

On the Application of the "Adjusted Winner" Conflict Resolution Methodology to Divorce Cases: An Introduction for Forensic Economists

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Abstract

This paper examines the application of a recently patented conflict resolution methodology, known as "Adjusted Winner (AW)", to the equitable distribution of assets and efficient resolution of contentious issues in divorce cases. The AW procedure is the only known resource allocation methodology whose output, at least in two-party disputes, is guaranteed to satisfy three meaningful criteria of fairness. The AW methodology is described, and then applied in a hypothetical divorce case.

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Many forensic economists, at one time or another, have been asked by an attorney to apply their expertise to issues arising in a marital dissolution case. The 1996 Brookshire and Slesnick survey of forensic economists indicated that respondents earned an average of 6% of their forensic consulting business revenues from divorce cases,[1] a small but not insignificant percentage. And with well over one million divorces in the United States every year,[2] the opportunity for economists to ply their wares in these kinds of cases is not likely to disappear anytime soon.

The types of economic analyses performed in marital dissolution matters vary fairly widely, yet, beyond business valuation, scant attention in the forensic economic literature has been paid to the specialized economic analysis divorce cases often entail. The work that has appeared in print has tended to focus on the equitable distribution of future income streams and other human capital issues.[3] While these issues are certainly germane to economic work in divorce matters, forensic economists may find themselves involved in other, less traditional economic aspects of divorce proceedings.

[1] Brookshire and Slesnick (1996), p. 23.
[2] U. S. Census Bureau, *Statistical Abstract of the United States: 1999*, Table No. 155, p. 110.
[3] See, for example, Bartlett (1996), Means (1989), and Pepin (1995).

Noticeably absent from the literature of divorce economics is analysis involving the distribution of existing marital assets and the efficient resolution of other contentious marital issues. Since these problems are fundamentally about value, it is somewhat surprising that economics appears to have so little to say about them. Forensic economists practicing in the area of divorce may therefore find of interest a recent asset distribution and conflict resolution methodology, patented by mathematician Alan D. Taylor and political scientist Steven J. Brams. This procedure, called Adjusted Winner (AW), satisfies a number of properties economists are sure to find attractive. Indeed, at least in two-party disputes, it is the only currently known allocation procedure to satisfy three important criteria of fairness.

AW has been applied to the distribution of assets and conflict resolution in a number of contexts, including the Egyptian-Israeli negotiations at Camp David in 1978, the Clinton-Dole negotiations over the format of the 1996 Presidential debates, the division of territory after World War II, and the current dispute over the division of the Spratly Islands in the South China Sea.[4] Mediators have also recently used AW successfully in divorce cases.[5]

The purpose of this paper is to introduce forensic economists to the AW procedure in the context of divorce litigation. First, the fairness criteria that AW satisfies are briefly described. The AW methodology itself is then presented, and applied to a hypothetical divorce case. We then turn to a number of issues pertaining to the practical implementation of AW in divorce matters. A brief conclusion comments on ways in which forensic economists might facilitate the use of AW in divorce negotiations.

Emphatically, the exposition is not meant to be exhaustive. Rather, the intent is to briefly describe a workable asset distribution and conflict resolution procedure that some forensic economists may wish to explore further, should they be asked to assist with these problems in a marital dissolution case. Economists interested in a more thorough explanation of AW, or in examples outside the realm of divorce litigation, are referred to the two Brams and Taylor books and the references cited therein.[6]

Allocation Properties

AW can be applied to the distribution of assets, the resolution of issues, or a combination of the two. For our purposes, assets will be defined as tangible objects, while issues will be matters about which the parties disagree. Thus, AW can be applied in the common divorce situation involving both common marital assets and disputed issues, such as the custody of a child or the choice of the school a child will attend.

Although AW can be utilized in negotiations involving multiple parties, we limit our discussion here to the divorce case of just two sides. It should be noted that some of the properties AW satisfies in two-party disputes cannot be guaranteed in situations involving three or more parties.[7]

Although the AW methodology itself is described in some detail later in this paper, having a general understanding of this procedure will facilitate discussion of the properties AW satisfies. Briefly, AW requires that each party distribute 100 "points" across a list of contested assets and issues, which we will call "goods". The points assigned reflect the relative subjective values the individual places on the various goods. Once the parties privately allocate their points, the AW procedure assigns each of the goods to one party or the other. As mentioned above, in two party situations the allocation satisfies a number of attractive fairness criteria, to which I now turn.[8]

Envy-Freeness[9]

An allocation is *envy-free* if each party prefers its own allocation to the allocation assigned to the other party. In two-party negotiations, envy-freeness implies that each party perceives that it is receiving at least 50% of the total available value, a property sometimes called *proportionality*. As we will see later, this guarantee of proportionality provides a strong incentive for each party to refrain from attempting to strategically manipulate the process by assigning point totals that do not reflect one's true subjective values. Moreover, an allocation that is envy-free is especially attractive in divorce cases, where feelings and emotions are often particularly salient.

Equitability

Consider an allocation of assets and issues between two parties, *A* and *B*. An allocation is *equitable* if the percentage of the total available value that *A* perceives he has received is equal to the percentage of the total available value that *B* perceives she has received. That is, *A*'s subjective valuation of his share is equal to *B*'s subjective valuation of her share. While envy-freeness implies that *A* and *B* both perceive that they have received at least 50% of the total available value, equitability ensures that each side perceives that its share exceeds 50% by the same amount. In situations of divorce, where individuals may often be as concerned with how content the other side appears to be as they are about their own happiness, this can be quite an appealing property.

Efficiency

An allocation is *efficient* if there is no other allocation that is better for one party without being worse for the other party. In common economic parlance, the allocation resulting from AW is Pareto-optimal.

4 Brams and Taylor (1999).
5 Lavery (1996 and 1997).
6 Brams, Steven J. and Alan D. Taylor, *The Win-Win Solution: Guaranteeing Fair Shares to Everybody*, W. W. Norton & Company, 1999, and *Fair Division: From Cake-Cutting to Dispute Resolution*, Cambridge University Press, 1996.

7 These properties also do not necessarily hold if one or more parties are not truthful about the valuations they place on some of the items or issues in dispute. For more on this possibility, see the discussion on potential strategic manipulation of point assignments in section IV.
8 Readers interested in the proofs that AW satisfies the listed properties are referred to Brams and Taylor (1996). See, specifically, pp. 70-75.
9 I use the term "envy-freeness" to be consistent with the Brams and Taylor exposition. Different terminology has been utilized by economists in other contexts. For example, envy-free allocations are called "fair" by Feldman and Kirman (1974) and Crawford (1977), and "superfair" by Baumol (1986).

One final additional attractive attribute of the AW methodology is that it assures that at most one item (an asset or an issue) be divided between the two parties. Rather than requiring a divorcing couple to liquidate a host of assets to reach an amicable parting, a divorce negotiation utilizing the AW procedure will require that at most one item be divided. In many cases, it is possible to reach a settlement in which no asset or issue need be divided.

The AW Procedure

Suppose that two parties, *A* and *B*, are to allocate *n* items we will call "goods". These goods could be either tangible assets, or well-defined issues. Before commencing with the allocation scheme itself, *A* and *B* must agree on the definitions of the *n* goods, and what it means to "win" each of the *n* goods. For example, if one of the goods is custody of a minor child, both sides have to agree that winning this good means that the loser will never see the child, or see the child only on weekends, etc.

Parties *A* and *B* begin by placing subjective values on winning each of the *n* goods. Let the values that parties *A* and *B* place on the *n* goods be $X_1, X_2, \ldots, X_n$ and $Y_1, Y_2, \ldots, Y_n$ respectively. Then define

$$x_i = 100\frac{X_i}{\sum_{j=1}^{n} X_j} \text{ and } y_i = 100\frac{Y_i}{\sum_{j=1}^{n} Y_j}, \quad i = 1, 2, \ldots, n$$

That is, the $x's$ and $y's$ are normalized to sum to 100. These $x's$ and $y's$ are referred to as "points" in the AW procedure.

Next, reorder the *n* goods such that $\frac{x_1}{y_1} \ge \frac{x_2}{y_2} \ge \ldots \ge \frac{x_n}{y_n}$. In some sense, the *n* goods are ordered from *A*'s relative favorite to *B*'s relative favorite.

At this point, all the goods for which $\frac{x_i}{y_i} \ge 1$, $i = 1, 2, \ldots, n$ are initially assigned to party *A*. The remaining goods are initially assigned to party *B*. In other words, if *A* places at least as high a value on the good as *B* does, initially assign it to *A,* while if *B* places a higher value on the good than *A* does, initially assign it to *B*. This is the "winner" part of the AW procedure.

Suppose that the first *k* goods are initially assigned to party *A*. Define $X = \sum_{j=1}^{k} x_j$ and $Y = \sum_{j=k+1}^{n} y_j$. If $X = Y$, the procedure stops. If $X > Y$, then some goods must be transferred from *A* to *B* until $X = Y$. Likewise, if $Y > X$, then some goods must be transferred from *B* to *A* until $Y = X$. This transfer process, the "adjusted" portion of AW, is what guarantees equitability.

Suppose $X > Y$ after the initial allocations. Then, begin by transferring good *k* from *A* to *B*. Continue to transfer good $k-1$, $k-2$, etc. until $X = Y$. If $Y > X$ after the initial allocations, then begin by transferring good $k+1$ from *B* to *A*. Continue to transfer good $k+2$, $k+3$, etc. until $X = Y$. The order in which these goods are transferred is what guarantees efficiency. That is, the transfer order assures that the value gained by one party minimizes the value given up by the other party.

It may well be that to achieve $X = Y$ a fraction of a good needs to be transferred from one party to the other. In the AW methodology, this is the one item which may need to be divided. A hypothetical example might better illustrate how these precise division percentages are determined.

Hypothetical Divorce Case

Suppose that Adam and Beth have decided to end their marriage and have agreed on the division of most of their assets and the resolution of most of the issues pertaining to the divorce. Seven assets and issues remain to be divided between or resolved by Adam and Beth: 1) a house, 2) a vacation condominium, 3) custody of their one minor child, 4) a sailboat, 5) a collection of antique shaving mugs, 6) two pet dogs, and 7) stock options, currently in both their names. These items are listed in column 1 of Table 1. After careful consideration, Adam and Beth have placed subjective values on these seven items. Their respective monetary valuations are shown in columns 2 and 4 Table 1.[10] Given these monetary valuations, the normalized points for the two parties are shown in columns 3 and 5 of Table 1. As described in the AW methodology above, the seven items listed in column 1 of Table 1 are arranged in descending order of the ratio of Adam's point assignment to Beth's point assignment. These ratios are shown in column 6 of Table 1.

Initially, the stock options, the antique shaving mug collection, the vacation condominium, and the boat are assigned to Adam (these four goods are shown in bold in column 1), leaving him with 65 of his points. The house, the dogs, and custody of the minor child are initially assigned to Beth, granting her 62 of her points. Because Adam's initial point total exceeds Beth's initial point total, some item or items must be transferred from Adam to Beth, until their point allotments are equal. The item initially assigned to Adam with the smallest ratio of Adam's point assignment to Beth's point assignment is the boat. If the boat were entirely transferred from Adam to Beth, Adam's point total would drop to 60, while Beth's point total would rise to 66. Thus, only a fraction of the boat needs to be transferred. It is the only good being allocated that must be divided. Let α be the portion of the boat that needs to be transferred from Adam to Beth to equate the final point allocations of the two parties. Thus, the portion, α, of the boat that needs to be transferred from Adam to Beth is the solution to the equation $65 - 5\alpha = 62 + 4\alpha$, or $\alpha = 1/3$. That is, one third of the boat must be transferred from Adam to Beth to achieve equitability. In the end, then, Adam is allocated the stock options, the mug collection, the condo, and 2/3 of the boat. Beth receives the house, the dogs, custody of the minor child, and 1/3 of the boat. Both Adam and Beth receive 63.33% of the subjective value each assigns to the pool of goods to be divided.[11]

[10] Note that the subjective valuations need not be equal.

[11] The degree to which the final allocations exceed 50% depends in part on the disparity between the values the two parties assign to the goods. The

Table 1. Adam's and Beth's Valuations

(1)	(2)	(3)	(4)	(5)	(6)
Item	Adam's Assigned Value	Adam's Points	Beth's Assigned Value	Beth's Points	Adam to Beth Ratio
Options	$ 60,000	10	$ 20,000	4	**2.50**
Antiques	150,000	25	70,000	14	**1.79**
Vacation Condo	150,000	25	80,000	16	**1.56**
Boat	30,000	5	20,000	4	**1.25**
House	150,000	25	200,000	40	0.63
Dogs	6,000	1	10,000	2	0.50
Custody	54,000	9	100,000	20	0.45
Total	**$600,000**	**100**	**$500,000**	**100**	

Note that the sailboat need not be liquidated to achieve equitability. If Adam and Beth are told that one of them is to receive 1/3 of the sailboat and that the other is to receive 2/3, but not which of them is to receive which portion, they may very well reach an agreement as to what a 1/3 share and a 2/3 share mean. For example, they may agree that a 1/3 share means having full access to the boat four months out of the year, while a 2/3 share implies exclusive rights for the other eight months. Of course, if such an agreement could not be reached, the boat could either be sold, with Adam receiving 2/3 of the price, or one party could opt to purchase the other party's share.

Practical Considerations

In this section, I discuss some issues economists may find germane in utilizing AW in divorce cases.

Potential Strategic Manipulation of Point Assignments

Is it possible for one party to strategically manipulate its point assignments so as to increase his or her final point assignment? Brams and Taylor show that while it is theoretically possible for one party to gain by assigning carefully-calculated false values to some items,[12] they argue that a party who follows this strategy will almost always end up with a smaller percentage of the total available value than he would have received if he had assigned point values honestly. They conclude that in virtually all applications, including situations of divorce where each party is apt to possess knowledge about the relative values the other party places on the goods in question, successful strategic manipulation is virtually impossible.[13]

In practice, a party attempting to gain by strategic point manipulation exposes himself to three risks. First, assigning false values removes the guarantee of envy-freeness and proportionality. That is, it becomes possible that the strategic manipulator will receive less than 50% of the total available subjective value. Second, since the number of available points to be allocated is fixed, increasing the point assignment on one good to increase the chances of winning it necessarily entails a reduction in the points assigned to other goods, thereby raising the possibility that the manipulator will lose a good he would otherwise have won. Finally, because the final allocation is equitable, increasing the perceived number of points a manipulator is initially assigned implies that he will lose a correspondingly larger share during the "adjustment" phase of AW.

As a concrete example of potential strategic manipulation, suppose that Beth were to try to exploit her knowledge that Adam's relationship with his child is somewhat rocky, and that he therefore is likely to place a relatively low value on custody of the child. In fact, suppose that Beth knows exactly the value that Adam will assign to custody. She then reduces the value she strategically assigns to custody from her true valuation of $100,000 down to $55,000, which is just above the true value Adam places on custody ($54,000). She then assigns the extra $45,000 value to the stock options, which allows her to increase her strategic valuation of the options from $20,000 to $65,000, which is just high enough to have the options initially assigned to Beth, rather than Adam. Beth's strategic valuations are shown in column 4 of Table 2.

more the values differ, the greater will be the percentage of the total available value each party perceives it has won.

12 The problem of not inducing honest responses is common in mechanism design (see Osborne and Rubinstein (1994), Chap. 10). According to the so-called "revelation principle" (Myerson (1991), Chap. 6 or Fudenberg and Tirole (1991), pp. 253-7), honesty can always be induced, but in so doing efficiency is often sacrificed (Tadenuma and Thomson (1995)).

13 To be more precise, they argue that in practice *perfect* knowledge about the other party's assigned values is necessary for manipulation to be successful.

Table 2. Beth's Strategic Point Assignments

(1) Item	(2) Adam's Assigned Value	(3) Adam's Points	(4) Beth's Assigned Value	(5) Beth's Points	(6) Adam to Beth Ratio
Antiques	$150,000	25	$ 70,000	14	**1.79**
Vacation Condo	150,000	25	80,000	16	**1.56**
Boat	30,000	5	20,000	4	**1.25**
Custody	54,000	9	55,000	11	0.82
Options	60,000	10	65,000	13	0.77
House	150,000	25	200,000	40	0.63
Dogs	6,000	1	10,000	2	0.50
Total	**$600,000**	**100**	**$500,000**	**100**	

Now, only the antiques, the condominium, and the boat are initially assigned to Adam. The options are now initially assigned to Beth, as are the house and the dogs, and custody of the child. Note that, although she reduced the value she placed on custody of the child, that item is still initially assigned to Beth. Adam initially receives 55 of his points. The false values that Beth places on the goods initially assigned to her indicate that she is initially assigned 66 of her points. Since she is initially assigned more points, some good or goods must be transferred from Beth to Adam. The good initially assigned to Beth with the highest ratio of Adam's point assignment to Beth's point assignment is custody of the child. If custody were entirely transferred from Beth to Adam, Adam's point total would increase to 64, while Beth's announced point total would fall to 55. (In fact, her true point total would fall by 20 points, since the strategic valuation she placed on custody was artificially low). Therefore, a fraction of custody must be transferred from Beth to Adam. The appropriate portion is given by the solution to the equation $55 + 9\alpha = 66 - 11\alpha$, or $\alpha = 11/20 = 55\%$. Adam ends up with the antiques, the condo, the boat, and 55% custody of the child, giving him 59.95 points. Beth is assigned the options, the house, the dogs, and 45% custody. It appears, based on her strategic point assignments, that she also receives 59.95 of her points. Yet, her final allocation yields just 55 of her *true* points (these come from Table 1, not Table 2), which is less than the 63.33 points she would have received had she assigned her values truthfully.

Separable Goods

For the final point assignments in AW to be meaningful, the goods themselves must be separable for both parties. A good is *separable* for a party if the value that party assigns to winning the good does not depend on whether the party wins or loses any of the remaining goods. For example, in the Adam and Beth divorce, if the house is landlocked and the vacation condominium is located adjacent to water, then the value Adam or Beth place on the boat might be higher if the winner also receives the condominium. In this case, the boat is not separable from the condominium. In practice, if not all items are separable, separability can usually be achieved by lumping goods together into larger packages. In the Adam and Beth example, the boat could be bundled with the condominium to forge a vacation package, separable from the remaining goods. However, the fewer and the larger the items on the list of goods to be allocated become, the smaller the final point totals are likely to be. That is, the extent to which the final allocations exceed 50% of the total available value depends in part, and is directly related to, the number of goods to be assigned.

Advantages of Using AW in Divorce Negotiations

AW is an attractive procedure in divorce cases for a number of reasons. Perhaps most important, the rigid, formal methodology utilized by AW is in stark contrast to the informal and ad-hoc negotiations often utilized in actual marital dissolution proceedings. The fixed procedure implies that it is pointless for any party to devote time or energy trying to influence or otherwise mold the AW procedure to his or her advantage. Moreover, because it is virtually impossible to gain by misrepresenting the true values one places on the items to be allocated, AW minimizes the posturing and other strategic behavior often found in less structured procedures. Indeed, in analyzing the informal processes in actual divorce negotiations, one study concludes:[14]

> Based on open-ended interviews with the parties and lawyers in twenty-five informally settled divorce cases, this study finds that the informal process is often contentious, adversarial, and beyond the perceived control of one or both parties. Although settlement in some cases reflects flexibility, party participation, and true agreement, in most cases it reflects unequal financial resources, *procedural support,* or emotional stamina. *Parties*

[14] Erlanger, et. al. (1987), p. 585.

report settling issues such as child support according to nonlegal, situational factors -- particularly their relative impatience to finalize the divorce -- and mutual satisfaction with settlement terms is low. (emphasis added)

Another study found that the standard, largely ad-hoc negotiations relied upon in divorce cases left one-third to over one-half of divorced individuals "seriously unhappy" with the final settlement.[15]

Further, the subjective valuation and point allocation aspects of the AW methodology should help divorcing individuals separate the assets and issues in dispute from the powerful emotions and bittersweet feelings attached to them. Requiring participants to allocate hard points to the goods and issues forces each party to think long and hard about what is truly most important.

Moreover, when AW is facilitated by a neutral third party, such as a mediator or even a forensic economist, the values the parties place on the goods and issues need not be made public. This aspect could be useful in situations in which one party would find a subjective valuation embarrassing if discovered by an outside party, i.e., Adam would probably prefer that his child not learn of the relatively low value he placed on custody of that child.

Because the final allocation under AW depends on the subjective values each party places on the list of available goods and issues, rather than values determined by a judge or the market or any other external party or other mechanism, it is quite possible for each party to receive two-thirds to three-fourths of what he or she perceives to be the total available value. This result alone may be enough for divorcing parties to be willing to give AW a try.

Conclusions

Forensic economists who practice in the area of divorce may find themselves asked to assist in the equitable distribution of common assets or the resolution of other contentious marital issues. In these circumstances, divorcing individuals or their agents might wish to explore the possibility of utilizing the Adjusted Winner procedure. Indeed, frustrated divorcing parties may actually be quite anxious to listen to an independent and learned forensic economist's description of a new settlement methodology arising from within academia. If so, the forensic economist should be able to facilitate the application of AW in a number of ways. First, the forensic economist could assist in defining the goods and issues to be divided, help the parties decide what it means to win each item, and assure that each item is separable for both parties. The economist could explain to both sides the fairness criteria that AW satisfies. He or she could illustrate, perhaps through a hypothetical example or two, the futility of attempting to strategically manipulate the process by assigning false valuations to any good in question. The economist could work with one or both parties to assure that the assigned valuations or allocated points are proper and accurate, and that the final point assignments reflect correct relative valuations. If a mediator is not employed, the economist could actually perform the AW procedure. Finally, the forensic economist may help prevent liquidation of the sole asset or issue to be divided by suggesting various ways in which appropriate percentages could be reached through shared ownership or utilization. To be sure, the multiple aspects of AW assure that any forensic economist involved in its application in a divorce case will be required to use at least some skills not often utilized in the more typical kinds of cases in which forensic economists are usually retained.

[15] Kressel (1985), p. 12.

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Litigation Economics Review
Volume 5, Number 2: 9-14

A Proposed Methodology to Measure Damages for Option Traders Alleging Securities Fraud

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Abstract

There are well-known methodologies for measuring per-share damages to common stock in Rule 10b-5 claims of securities fraud. In this paper, we propose a methodology to measure the damages for an option trader alleging that the fraud also affected the value of her option. Consideration of the economic loss suffered by the option trader in conjunction with the standard out-of-pocket measure of loss under Rule 10b-5 leads to a set of rules for damages to option traders. The framework also serves as a basis from which rules for other derivative products may be derived.

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The authors would like to thank Marcia Kramer Mayer, Louis Guth, Peter Rothemund, Tsvetan Beloreshki, and Christoph Muelbert at NERA for comments on the text and their work on the underlying analyses. We also thank two anonymous referees for comments.

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The 1933 Securities Act and the 1934 Securities Exchange Act (the "Securities Acts") provide for damages in cases where a security has been traded at an artificial price due to fraud. Since the 1988 *Basic v. Levinson* decision, in which the Supreme Court accepted the fraud-on-the-market theory, there has been a large increase in securities fraud cases. Although many securities fall within the purview of the Securities Acts, most of the study of securities fraud has been focused on shares of stock. Recently, however, an increasing number of shareholder class actions, as well as cases for individuals, include options.[1]

In this paper, we attempt to extend the analysis of securities fraud damages to transactions involving options. We focus first on transactions involving a call option in cases where the underlying stock price is inflated. While the analysis appears to generalize to other options, extensions to other derivative products may require additional considerations beyond the scope of this paper.

As of yet, there is little guidance on how to handle options in securities fraud suits.[2] As shown below, the calculation of damages is not as straightforward as one might think. This is true for both legal and economic reasons.

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[1] Underlying data from a recent study found that 18% of securities class actions settled in 1998 included options and/or warrants. (Todd S. Foster, Denise N. Martin, Vinita M. Juneja, Frederick C. Dunbar, and Lucy P. Allen, "Trends in Securities Litigation and the Impact of the PSLRA", *Class Actions & Derivative Suits*, Summer 1999.)

[2] One notable exception is "Derivatives in Securities Class Actions," by Stephen E. Usher, published in *Litigation Services Handbook: The Role of the Financial Expert*, Roman L. Weil, Michael J. Wagner, and Peter B. Frank, Eds. (2001). This article discusses the magnitude of

In this paper, we discuss different methods of calculating damages to option traders with a securities fraud claim, focusing on various events that may or may not be considered transactions within the meaning of the Securities Acts and economically may or may not be a source of a damage claim. Specifically, we examine option purchases (sales), exercises (being exercised against), and cases where an option expires worthless due to a fraud. In each case, we focus principally on the economics of the damage calculation, with supporting discussion of how various legal theories may impact on that calculation. Where possible, we highlight the legal theory that best serves to fairly compensate option traders who have been damaged by fraud.

Damages to Option Purchasers and Sellers

We begin our analysis of the economic damages to option traders alleging securities fraud with the most obvious transaction: the purchase or sale of an option. As a concrete example, we examine an investor who purchases a call option at a time when the underlying stock price is artificially inflated by some fraud. We note that, with appropriate adjustments, similar results will hold for sellers as well as investors trading in puts.

An investor who purchases a call option has clearly engaged in a transaction in a security within the meaning of the Securities Acts. Moreover, based on the Black-Scholes or any other generally accepted option-pricing method, it is trivial to show that if the underlying stock price is inflated, then, ceteris paribus, the price of the call is inflated above its true value as well. Therefore, under the commonly-used out-of-pocket measure of damages in securities fraud cases,[3] the investor suffered a loss when she purchased the call option equal to the level of the inflation in that option. As discussed below, calculating the inflation in the call by observing how its premium responded to events such as previous misstatements or later corrective disclosures, as is usually done with stocks, is an incredibly difficult, if not impossible, exercise. After reviewing the difficulties with such a methodology, we examine an alternative, calculating the inflation in the underlying stock price and using that information to determine the inflation in the option.

Option Inflation Based on Applying Event Study Techniques to Option Premiums

In cases of securities fraud, the most common and generally accepted technique for measuring stock price inflation is an event study. An analyst will typically use an event study to calculate the change in a stock's price upon a corrective disclosure as the first step in estimating the inflation in the stock.[4] He may then adjust the price change to remove concurrent industry and/or market effects, and may separate the resulting price decline into the part for which the defendant may be held liable and the additional portion, if any, that is not due to the fraud. The analyst then uses the inflation at the time of the disclosure to estimate the inflation at earlier times. Typically, this is done by assuming that in periods that do not contain any omissions, misstatements, or disclosures, inflation remains constant, either in dollar terms or as a percentage of the stock price.

Using a similar methodology to calculate the inflation in a call option is likely to be more complicated, and more subject to debate, than the analogous procedure for the underlying stock. The result is likely to be intractable. Among the principal difficulties are the following:

- Unlike stock, options often do not trade every day, making estimates of both a market model and price reactions more difficult.
- If the option expires before the corrective disclosure, it becomes impossible to measure the change in the option's premium at the time of the corrective disclosure since the option was not trading at that point.[5]
- Parameters estimated from a market model are unlikely to remain constant as the option's time to maturity and the degree to which it is in or out of the money change.
- A premium response to a disclosure at one point in time may not reflect the effects the information in that disclosure would have had at a different point in time.

Given these difficulties, we now turn to our proposed methodology for measuring option inflation, tracing the

potential damages to investors in various derivative products in a case study and examines some of the legal arguments for including or excluding such claimants.

[3] See, for example, *Greene v. Occidental Petroleum Corp.* 541 F.2d 1335, 1341 (9th Cir. 1976) and Bradford Cornell and R. Gregory Morgan, "Using Finance Theory to Measure Damages in Fraud on the Market Cases," *UCLA L. Rev.*, 1990.

[4] See Cornell and Morgan, *op. cit.*

[5] This leads to the interesting legal question of whether option purchasers are entitled to all the inflation in the option at the time of purchase or only to that portion that could have left the option's premium before maturity. The former position is supported by a literal interpretation of the out-of-pocket loss definition: the difference between the premium and true value of the option at the time of purchase. The latter position is supported by one interpretation of plaintiff's loss causation requirement: if the fraud was not altered or revealed during the option's lifetime, then it can be argued that the fraud did not cause the option holder any damage. Courts have encountered similar situations in dealing with stock. For example, consider a case where a plaintiff spends $1,000 to purchase shares of a company that later goes bankrupt, rendering those shares worthless. Suppose it is later proven that the stock price was inflated when plaintiff made her purchase, but that the company would have gone bankrupt and plaintiff's entire investment would have been lost even if there had been no fraud. Is plaintiff entitled to recover the amount by which she overpaid for her stock, or is her entire investment lost anyway with no legal avenue available for recovery? While the courts have considered such cases, unfortunately they have not reached a uniform conclusion. (See, e.g., *The Ambassador Hotel Company, Ltd. v. Wei-Chuan Investment*, 189 F.3d 1017, 1999: "In fact, some securities fraud cases do state that if the plaintiff would have lost its investment despite any misrepresentation by the defendant, plaintiff has failed to prove loss causation." A potentially opposing view is given in *Stanley Knapp v. Ernst & Whinney*, 90 F.3d 1431, 1996: "Plaintiffs who bought and sold stock before any corrective statements had been made and the stock price plummeted may have suffered losses as a result of market forces operating on misrepresentations.") Unless stated otherwise, for the purposes of this paper, we will consider the entire inflation in the option as our measure of damages.

effects of the fraud on an option by first examining the effects of the fraud on the underlying stock.

Option Inflation Based on Inflation in the Underlying Stock

A Simple Calculation

Fortunately, given the inflation in a stock, there is a rather straightforward way to calculate the inflation in any option whose premium is known or estimable. As discussed above, stock price inflation is often measured directly, generally through an event study, and the stock's true value is then calculated as the stock's observed price minus the measured inflation. For options, it may be easier to measure or calculate the option's actual price and its true value and then to take the difference between the two to determine the inflation in the option premium. One tool for doing so is the Black-Scholes formula, which relates a call's premium to the call's strike price, the price of the underlying stock, the call's time to maturity, the risk-free rate over the remaining life of the option, and the volatility of the underlying stock. The first four of these inputs are easily measurable. Often the volatility of the underlying stock is measured over some period of time and then plugged into the Black-Scholes formula. In an alternative calculation, one uses the call premium and the four measurable inputs to solve for what is called the underlying stock's "implied volatility."

In order to calculate the inflation in an option, an analyst can use the option's observed (inflated) premium and the observed (inflated) price of the underlying stock to calculate the implied volatility of the stock. He can then replace the inflated stock price with its calculated true value and use the Black-Scholes formula with the implied volatility to calculate a new, lower option premium. This new premium would represent the option's true value and the difference between the observed and true premiums would represent the inflation in the option. This procedure can be repeated to account for all individual transactions or for all days in the class period in a shareholder class action.

Accounting for Volatility

The reader may notice that in performing the calculation described above, we took the implied volatility from the inflated option premium and stock price and then plugged this same volatility into the Black-Scholes formula in order to determine the option's true value. This, of course, depends on the implicit assumption that the fraud did not affect the volatility of the underlying stock. This assumption can often be tested by comparing the implied volatilities of the underlying stock before and after a disclosure. If the underlying volatility has changed significantly, the analyst can then examine whether this was due to market and/or industry forces or was due to some non-fraudulent news. If the analyst determines that all or some part of the change in volatility is due to the disclosure of the fraud, he may wish to calculate a "true volatility" at the time the option was purchased.

As a first pass, if the inflation is likely to be a constant percentage of the stock price (e.g., because the fraud relates to the company's overall profit margin), then, following an initial price shock, the stock's volatility should be unaffected by the fraud. At the other extreme, if the inflation is likely to be a constant dollar amount (e.g., falsely claiming the existence of a product or deal with a known contribution to profit), then the stock's volatility probably will be affected by the fraud. If a change in volatility is measured following a disclosure, then the earlier actual implied volatility could be adjusted up or down by a constant percentage or percentage point difference to estimate the true volatility. To the extent that the actual implied volatility does not change much over time, these two choices should yield similar results. If the actual implied volatility was varying over time, the analyst should consider whether the causes of that variation are likely to impact on the addition or reduction of volatility due to the fraud. Analysis of the proper method for adjusting the volatility will likely depend on the specific attributes of the alleged fraud and the reasons that observed volatility varied in the case at hand. For the purposes of this paper, going forward we will take the simple assumption that volatility is unchanged by the alleged fraud.

Accounting for the Strike Price

It could be argued that the strike price of an option would have been set differently had the true value of the underlying security been known. Following this approach, the true (non-inflated) strike price would replace the actual (inflated) strike price in determining the option's true value. While a legitimate damage calculation could be performed based on this methodology, a call option with a different strike price is in fact a different security, and so this approach does not represent the out-of-pocket measure we discuss in this paper. We therefore do not include a discussion of such a methodology in this analysis.

Option Exercise: Is There a Damage?

Is the Exercise of an Option a Damageable Transaction?

Perhaps the first question to ask in looking at an option exercise is whether it represents a legally damageable transaction. To answer the question of whether a damage occurs upon exercise, we invoke the loss causation requirement of the Securities Acts. Specifically, we ask whether the transaction would have been made in the but-for world where there was no inflation in the underlying stock, and whether an economic loss resulted from the exercise of the option given that the underlying stock price was inflated. Sticking to our example of an investor who purchased a call option, let's assume that she purchased a call option with a strike price of $8 prior to the existence of any fraud. Further assume that when our investor decides to exercise her option, the stock's true value was $10, but that the stock was trading at $20 due to the fraud. Should she be allowed to press a damage claim?

Legally, it would appear that the investor has engaged in a transaction: she has given up her call option and $8, and received stock in exchange. On the other hand, the transaction described in the previous sentence is exactly what the plaintiff agreed to when there was no fraud. It then appears that the investor was not harmed by the fraud at all and therefore has no basis for a claim. (For those who would argue that such reasoning would appear to prevent purchasers of common stock from pressing a claim, we note that the key difference is that the $8 price for the option exercise was set in a non-fraudulent transaction while the $20 stock price was a product of the fraud. Another way of looking at this is to note that if the stock had been further inflated from $20 to $25, a stock purchaser would overpay by a greater amount and have a larger claim while the investor who exercises her previously acquired option presumably would not be able to claim larger damages under the out-of-pocket measure.)

If, on the other hand, we assume that the option above had been purchased while the stock *was* inflated, would the investor be entitled to damage compensation for the exercise given that the terms of the contract were set in a fraudulent environment? Because the value of an option is determined by, among other things, the terms of the exercise, we argue that as long as the investor is compensated for the initial purchase, as described above, and the exercise was still reasonable, she has no remaining claim. She has been fully compensated for the mispricing of the option due to the fraud, and any further claim on the option would lead to a double recovery.

We believe that the proper legal bases for whether an option exercise constitutes a transaction for which a damage claim can be pressed should be based on whether an economic loss has been suffered specifically due to the exercise. In particular, the analyst should be concerned with whether the fraud has left the investor in a better or worse position than she would have been in the absence of the fraud. We address this issue in more detail below.

Economics of Damages to Option Exercisers

Exercise Would Still Be in-the-Money in the But-For World

We first consider the case where even in the but-for world, where the stock price was not inflated; the call exercise could still have been a rational transaction because the stock price exceeded the call's strike price. To illustrate our assumptions, consider Figure 1 below.

Figure 1

Time	A	B	C
Observed Stock Price	10	20	10
Stock True Value	10	10	10
Call Strike	8	8	
Observed Call Premium	9	12	
Call True Value	9	2	

Consider an investor who purchases a call option at time A, when there is no fraud. Suppose that she decides to exercise her call option at B, when the call matures, and when the stock is inflated.[6] Finally, suppose that she holds the stock received in the exercise past the corrective disclosure, finally selling it at C.

In actuality, our investor paid $9 for the call, paid another $8 to exercise the option, and received $10 when she sold the stock, all for a net loss of $7. Had our investor engaged in these same transactions in the but-for world, she would have had the same cash flows, and the same $7 net loss. Therefore, she has not been economically damaged by the fraud.

Exercise Would Be Out-of-the-Money in the But-For World

Consider now a similar example, but where exercise would probably not have been rational in the but-for world.

Figure 2

Time	D	E	F	G
Observed Stock Price	10	20	10	12
Stock True Value	10	10	10	12
Call Strike	12	12		
Observed Call Premium	7	8		
Call True Value	7	0		

In this example, our investor purchased the call at D, exercised at E (when the call matures), and sold the stock at F. Thus, our investor paid $7 for the call, paid $12 to exercise, and finally received $10 for selling the stock, resulting in a net loss of $9.

What would have happened in the but-for world? The investor still would have bought the call for $7. At E, however, she certainly would not have exercised her option, which would have meant paying $12 to acquire a stock then worth $10. There are two reasonable alternative courses of action that the investor could have taken in the but-for world. The first assumes that if the call were out of the money, the investor would never have exercised the call or otherwise acquired the stock. Her net loss is then $7, $2 less than in the actual world. The second alternative follows from the assumption that a proper but-for scenario requires the investor to still acquire the stock. So, in the but-for world, she buys the stock on the open market for $10, its true value, at E, and then presumably sells the stock at F. Her net loss in this case is again $7. At his point, it would seem like there is no difference in the damages, $2, calculated under the two scenarios.

Suppose, however, that rather than selling at F, our investor had sold at G. Her actual net loss would have been $7; under the first alternative (never acquire stock), her net loss would be $7, implying no damage; under the second

[6] The exercise need not be made at maturity for the analysis presented here to hold. An exercise before maturity can be rational, for example, for non-tradable options.

(buy stock at E), her loss would have been $5, again implying a $2 damage. The difference between these results and those discussed in the previous paragraph is due to a change in the true value of the stock from $10 to $12. Since securities fraud damages under the out-of-pocket measure are typically predicated on changes in inflation and not on changes in a stock's true value, the second alternative, which assumes that rather than exercising the investor would have bought on the open market, is more in line with the out-of-pocket measure of damages, which is essentially based on changes in inflation.

As such, our proposed damage rule for option exercises is as follows[7]:

- If the option would have been in the money in the but-for world at the time of exercise, there is no damage.
- If the option would have been out of the money in the but-for world at the time of exercise, the damage claim equals the difference between the strike price and the stock's true value at the time of exercise.

It is important to note here that if any subsequent sales of shares acquired through exercise are made at a point when the stock price is still inflated, the investor has received a benefit on those sales that should be used to offset the damage claim from the option purchase and/or exercise.

Finally, we note that one of the benefits of assuming that the investor would have purchased the stock if the option would have been out of the money is that it keeps the stock portion of her transactions unchanged between the actual and but-for worlds. In both cases, she acquires the stock at E and sells it at F (or G). One problem with this analysis, however, is that in cases where the option was not about to expire, it leaves the investor with an unused call option. In some cases, the but-for world will have this option expire in the money unexercised. While this is an undesirable result, the alternative would be to somehow decide whether and when the call would be exercised and, if exercised, whether and when the shares acquired would be sold. On the whole, we feel that it is better to not attempt such a speculative exercise which would have the investor potentially engaging in two stock acquisitions (a stock purchase at the time she actually exercised and an exercise of the option at some alternative date) unless there is strong evidence that she would have done so.

Is There a Damage if the Fraud Causes an Option to Expire Worthless?

The final case we examine is when a fraud causes an option to expire worthless. As an example, consider an investor who purchases a put option with a strike price of $12 at a time when there is no fraud. Suppose that at maturity, the stock's true value is $10 but that a fraud has inflated the market price of the stock to $20. In the actual world, the investor allows the put to expire worthless, rather than pay $20 on the open market to acquire a stock that she can then sell at $12 according to the terms of the put. However, in the but-for world, she would presumably pay $10 to acquire the stock and then exercise the put so as to obtain a $2 profit. Clearly, then, the investor has been damaged by the fraud.

The first question we face is whether the expiration of the put is a legal "transaction" covered by the Securities Acts. In fact, because nothing is exchanged when the put expires worthless, the investor is really claiming that the fraud misled her into not engaging in what would have been a profitable transaction in the but-for world. The courts have generally not looked favorably on a claim that but for a fraud a transaction would have occurred, regarding such claims as inherently speculative. However, in the case where an investor was faced with a clear decision to engage in a transaction at a certain point or throw away a valuable asset (i.e., have an in-the-money option expire unexercised), that argument carries less force. Moreover, any options that would expire sufficiently in the money[8] are automatically exercised upon expiration by the OCC unless instructed otherwise. Therefore, a claim that an investor would not have exercised a reasonably in-the-money option at expiration is actually the more speculative position.[9] If we accept that an in-the-money option would generally have been exercised rather than allowed to expire worthless, then an investor should be able to make a damage claim for options that expired worthless due to the fraud. The damage claim is simply the amount by which the option would have been in the money in the but-for world.[10]

Finally, we note that an investor who writes an option will benefit if the fraud causes the option to expire worthless. Presumably, in the but-for world the option would have been exercised (and we assume at expiration). The investor was then benefited by the amount that she saved by not being exercised against. As above, we would calculate that benefit, which could be used to offset damages from other transactions by the same investor, as the amount that

[7] This is the basic damage claim, ignoring any limitations placed, for example, by the 90-day bounce-back provision of the 1995 Private Securities Litigation Reform Act.

[8] According to Options Clearing Corporation rules, $0.125 for institutions and $0.375 for individuals.

[9] Of course, the investor may have exercised before expiration in the but-for world. However barring evidence of a trading strategy (e.g., instructions to a broker about when to exercise), the determination of when the investor would have exercised is typically a highly uncertain endeavor. A recent ruling in the Supreme Court of Delaware, *Duncan v. TheraTx* 775 A.2d 1010 (2001), argued that where a defendant's actions resulted in a "restriction on a stockholder's ability to sell his or her shares … the stockholder is not required to show that she actually would have sold the shares," thereby resolving the uncertainty in favor of the plaintiff. Here we can rely on such reasoning to support the straight-forward position that, at the very least, the plaintiff would not have stood by and let options with positive value expire without exercise. A potentially more aggressive, and more speculative, approach would be to let the plaintiff assume she would have exercised her options and sold at some other point in time.

[10] One might note a contrast with the previous section, where we argued against determining when an option would have been exercised in the but-for world. The difference is that in that section we were dealing with what would have been a second stock acquisition for an investor who may not have ever planned to make two acquisitions. In this section, we are only concerned with whether an option purchaser would have exercised her option once, which was presumably the point in acquiring the option in the first place.

the option would be in the money at maturity in the but-for world.

Conclusion

Based on the analyses discussed above, we conclude that an investor can be damaged upon the purchase or sale of an option and whenever an option is (is not) exercised because it was (was not) in the money solely due to fraud. Under an out-of-pocket method that recognizes all inflation in a security at the time of a transaction, damages for purchases or sales of options should equal the difference between the option premium and the option's true value at the time of the transaction. For option exercises, damages should only accrue if the option would not have been in the money in the but-for world. In that case, the damage should equal the amount by which the option would have been out of the money. Finally, when an option expires worthless *due to the fraud*, damages should be allowed, with the amount of the damage equal to the amount that the option would have been in the money in the but-for world. The formalization of these rules would provide clear and correct guidance for the calculation of damages for option transactions.

Litigation Economics Review
Volume 5, Number 2: 15-26

The Forensic Economics of Medical Monitoring Protocols

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Abstract

In major legal cases nationwide, a new category of economic damages has emerged: the costing of medical monitoring protocols. In this paper, the background of, importance of, and (sparse) literature on this topic will be briefly reviewed. Calculations and testimony issues that are similar to cost-of-care issues will be discussed. Then, the new and special issues of costing medical monitoring protocols will be reviewed in detail. These issues include the chain-of-expert flow to the forensic economist, in-flows and leakages, special cost issues, and such complexities as Markov and Monte Carlo modeling.

The purpose of this paper is to identify and explain the issues that confront a forensic economist in costing the present value of a medical monitoring protocol. The explanation builds upon a sample case, progresses beyond issues that are similar to those of costing life care plans for individuals, and hopefully takes neither a plaintiff-side nor defense-side perspective. The paper may also be of use to both attorneys and judges. In particular, one focus is the relationship between elements of a class definition and the costing process.

Medical monitoring, in the context of damages, can be defined as the recovery of long-term diagnostic testing necessary to detect latent diseases that may develop as a result of tortious exposure to toxic substances (*Bower*, 1999). Currently, appellate courts in ten states have determined that claims for medical monitoring are valid under each of their state's legal guidelines, while federal courts have interpreted state law in at least seven additional states and the District of Columbia as permitting claims for medical monitoring (*Badillo*, 2001). Table 1 lists the states in which appellate courts have allowed medical monitoring claims. This table is not intended to be exhaustive and may be subject to rapid change.

Despite the increasing relevance of discussions regarding medical monitoring damages, relatively few articles are devoted to the subject. It appears that the majority of these works are dedicated to the legal guidelines and status of such cases. One debate in the previous literature, however, focuses upon whether medical monitoring claims

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are completely separate from traditional elements of compensatory damages. Some argue that monitoring costs are so unusual and separate that they have no place in economic quantifications (Gonzalez and Valori, 2001). Others argue that medical monitoring costs easily and logically fit within compensatory damages – the costs are a direct and necessary compensation for the need to protect against a latent disease (Maskin, Cailteux, and McLaren, 2000).

Table 1. States in Which Medical Monitoring Claims Have Been Allowed Upon Appeal

State	Case With Medical Monitoring Claims Allowed
Arizona	Burns v. Jaquays Mining Corp., 752 P.2d 28 (Arizona Court of Appeals 1987)
California	Potter v. Firestone Tire & Rubber Co., 863 P.2d 795 (Supreme Court of California 1993)
Florida	Petito v. A.H. Robins Co., 750 So. 2d 103 (Florida District Court of Appeals, 3rd District 1999)
Louisiana	Bourgeois v. A.P. Green Industries, Inc., 716 So. 2d 355 (Supreme Court of Louisiana 1998)
Michigan	Meyerhoff v. Turner Construction Company, 534 N.W.2d 204 (Michigan Court of Appeals 1993)
New Jersey	Ayers v. Township of Jackson, 525 A.2d 287 (New Jersey Supreme Court 1987)
New York	Askey v. Occidental Chemical, 477 N.Y.S.2d 242, 102 A.D.2d 130 (Supreme Court of New York, Appellate Division, Fourth Department 1984)
Pennsylvania	Redland Soccer Club, Inc. v. Department of the Army, 696 A.2d 137 (Supreme Court of Pennsylvania 1997)
Utah	Hansen v. Mountain Fuel Supply Company, 858 P.2d 970 (Supreme Court of Utah 1993)
West Virginia	Bower v. Westinghouse Electric Corporation, 522 S.E.2d 424 (West Virginia Supreme Court of Appeals 1999)

DiPaola and Roberts (2000) attempt to assure economists that including medical monitoring damages in an economic assessment does not, in itself, lead to possible double-counting because medical monitoring expressly compensates not for future injury but only for the cost of future monitoring. Therefore, when a claimant brings a second suit seeking compensation for the losses incurred when disease actually develops, there is no double-count of damages; the monitoring, or detection, of the latent disease is simply a component of the harm done to the plaintiff by the culpable conduct of the defendant (Lee, 1994). Still, this issue of double-counting is complicated. There is the possibility that someone will have the opportunity to participate in a medical monitoring program and decline to participate. What then happens when this person discovers, at a future date, that the once latent disease is now present and making this individual ill? Wolfe (2000) argues that this person has failed to mitigate damages and therefore should not be permitted to seek full remedy of the illness because an opportunity was present to detect the disease before it reached an advanced state and therefore became much more costly to treat.

A final issue involves the method of funding the medical monitoring protocol in a given case. Lee (1994) points out complexities of administering such programs to large classes of persons, discusses the importance of proper measurement of class size, and believes that class size measurements should be the responsibility of scientific and medical experts. Alternatives to lump sums distributed to class members after a settlement or trial have also been discussed, such as administrative bodies following a prescribed set of rules. Both Klein (1998) and Tanner (1998), for example, argue that court-supervised funds, versus lump-sum payments to plaintiffs, are more likely to meet the objectives of medical monitoring protocols.

Court Guidelines

Table 1 illustrates the states in which claims for medical monitoring appear to be allowed; however, the standards for these claims to be acceptable to the court(s) require some additional investigation by a lawyer and expert in the particular state. Some guidance in establishing the viability of medical monitoring claims is available within existing case law. The Supreme Court of Louisiana has provided the following criteria for establishing the viability of such claims (*Bourgeois*, 1998).

1) Significant exposure to a proven hazardous substance.
2) As a proximate result of this exposure, plaintiff suffers a significantly increased risk of contracting a serious latent disease.
3) Plaintiff's risk of contracting a serious latent disease is greater than (a) the risk of contracting the same disease had he or she not been exposed and (b) the chances of members of the public at large of developing the disease.
4) A monitoring procedure exists that makes the early detection of the disease possible.
5) The monitoring procedure has been prescribed by a qualified physician and is reasonably necessary according to contemporary scientific principles.
6) The prescribed monitoring regime is different from that normally recommended in the absence of exposure and is contingent upon "expected" costs.
7) There is some demonstrated clinical value in the early detection and diagnosis of the disease.

These Louisiana criteria provide straightforward assistance in both liability issues and in the formulation of costing processes. Most states have similar standards for the introduction of medical monitoring claims and damages as in the above (*Petito*, 1999). Despite the lack of identical language regarding the admissibility of these damages, the criteria are the best available guidelines to enable an economist, with all related experts (toxicologists, epidemiologists, medical doctors, medical cost experts, life-care-planners, etc.), to establish the necessary "path" for those moving through the protocol, and its costs. For example, class definition and the resulting size of the ultimate class of individuals seeking future monitoring would obviously affect damages calculations (*Askey*, 1984). Also, legal criteria instruct damages experts to identify potential overlaps in the origin of potential disease to ensure that exposures suffered by the public at large, which increase the entire population's risk of disease, do not form the basis of medical monitoring claims (*Bourgeois*, 1998).

Given that existing legal language is quite explicit that only the incremental probabilities associated with the plaintiff's alleged increased exposure to a toxic substance should be considered in damages calculations, the economist must work closely with available, related experts to ensure that economic damages are accurately estimated. Historical disease contraction rates, existing environmental factors, and other factors such as migration and mortality rates, are all examples of potential variables which could affect the necessary funding of a medical monitoring protocol. The criteria also speak of the uniqueness of the testing and the fact that many diagnostic tests are part of annual physical examinations which would have been conducted regardless of the exposure. Such routine tests and screenings should be removed from the medical monitoring damages assessment. These adjustments to the damages calculation of a medical monitoring protocol increase the accuracy of the estimate.

Sample Case

A sample case has been developed, which has no known relationship to past or present cases involving medical monitoring. Assume that an industrial plant in Acme County has discharged a by-product chemical for many years, which has possibly contaminated the County water supply. The release of this by-product ceased on January 1, 2001. Assume the court has certified a class of persons who may require medical monitoring for liver cancer, based upon medical evidence. Further assume that, by order of the Court:

1) The Class includes all persons age 30 or over, who have lived or worked in the County for at least one of the five years prior to January 1, 2001. (This relates to the "significant" exposure standard in court guidelines.)
2) The monitoring would occur for ten years after its beginning, which is assumed to be January 1, 2002.Presumably, medical experts will testify that the disease would likely manifest itself in this period.
3) Monitoring costs are those likely to be incurred by persons in the class because of the increased risk of liver cancer.

Finally, assume that this class is expected to contain 50,000 persons. Based upon anticipated testimony by medical doctors, life-care-planners, and others, plaintiff economists have developed the 10-year medical monitoring protocol shown in Appendix I. The "Boxes" and "Arms" of the protocol are described in Appendices II and III, respectively. The costing model might be termed either an "Expected Value" or a "Decision Tree" model. It provides a straightforward format that does not require complicated, statistical analyses. The answer will be an expected value of costs in present value dollars. In this simplified example, only four medical tests will be administered over the 10-year period: an AFP test, a CT Scan, an Ultrasound, and a Liver Biopsy. The AFP test is a blood test which measures the level of alpha-fetoprotein, and it is assumed to be a good indicator of liver problems.

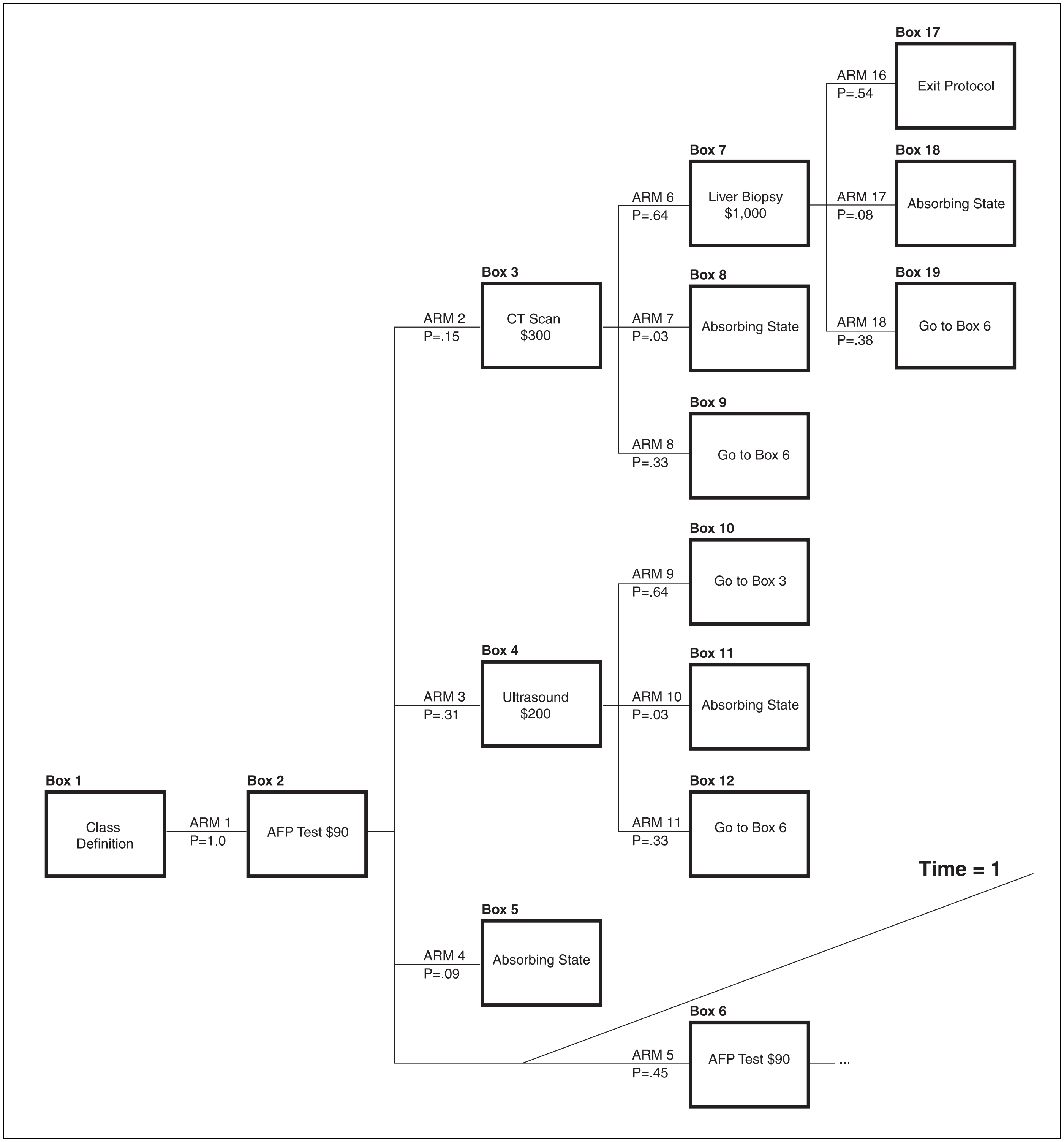
To explain the process, let us refer to Table 2, which is the first-year enlargement of the 10-year protocol in Appendix I. Note that Box 1 is the critical class definition, as described above. Importantly, the Plaintiff experts have assumed a 100 percent probability that eligible members of the class will proceed to the first AFP test. Given the "likely cost" standard from the Court, this is a poor assumption, and scientific data will be sought for the likely percentage of eligible class members who will even take the first test. Thus, a more realistic scenario would be two arms extending from Box 1. The portion of eligible class members who never begin the protocol would be assigned to an "Absorbing State" and thereby be deleted from the left-to-right path of monitoring costs.

For illustration, however, assume that 50,000 persons take an AFP blood test in the first year of the protocol. The cost of the test for each person is obviously an important variable in generating conclusions about the overall (present value) costs of the monitoring protocol. Four arms (2 – 5), with associated probabilities, now extend from the Box 2 test, and they are taken from expected medical testimony. Assume that an AFP "score" above 70 requires a follow-up CT Scan and that there is a 15 percent probability that the (exposed) class members will test 70 percent or above.

The CT Scan is expensive, but it is only used for the 15 percent of the path with the most worrisome results. For those whose initial AFP results are 20-70, an ultrasound follow-up is recommended at $200 per person; the plaintiff medical testimony will be that 31 percent of those AFP tested will fall into the 20-70 test range. In the first year, 9 percent of the cohort will be "absorbed" and not move further. For example, they may have voluntarily decided to stop further testing, because their first AFP test was good. And, of course, there is the probability of death at each age. These are "leakages" from the flow of costs but some of these persons could re-enter the protocol later in the 10 years (depending upon procedures imposed by the Court). Finally, medical experts say that 45 percent of exposed persons will test less than 20 on the initial AFP. Since this is a "latent" issue, by definition, they move to a second AFP test in year two. The sum of probabilities of the five arms extending from Box 2 totals 100 percent.

For further illustration, let's move back to Box 3 and the CT Scan testing, still in Year 1. Based upon expected medical testimony, assume that a tumor will be shown in 64 percent of these persons. They will have a liver biopsy. Three percent will, for whatever reasons, drop out of the testing. One-third of the CT Scans will be negative, and these persons will drop down to Box 6 - for their second year of the AFP test. Moving beyond the Box 7 liver biopsy, medical experts say 54 percent of tested persons will be positive and must move to treatment. These persons exit the monitoring protocol - they are absorbed - because they now require treatment.

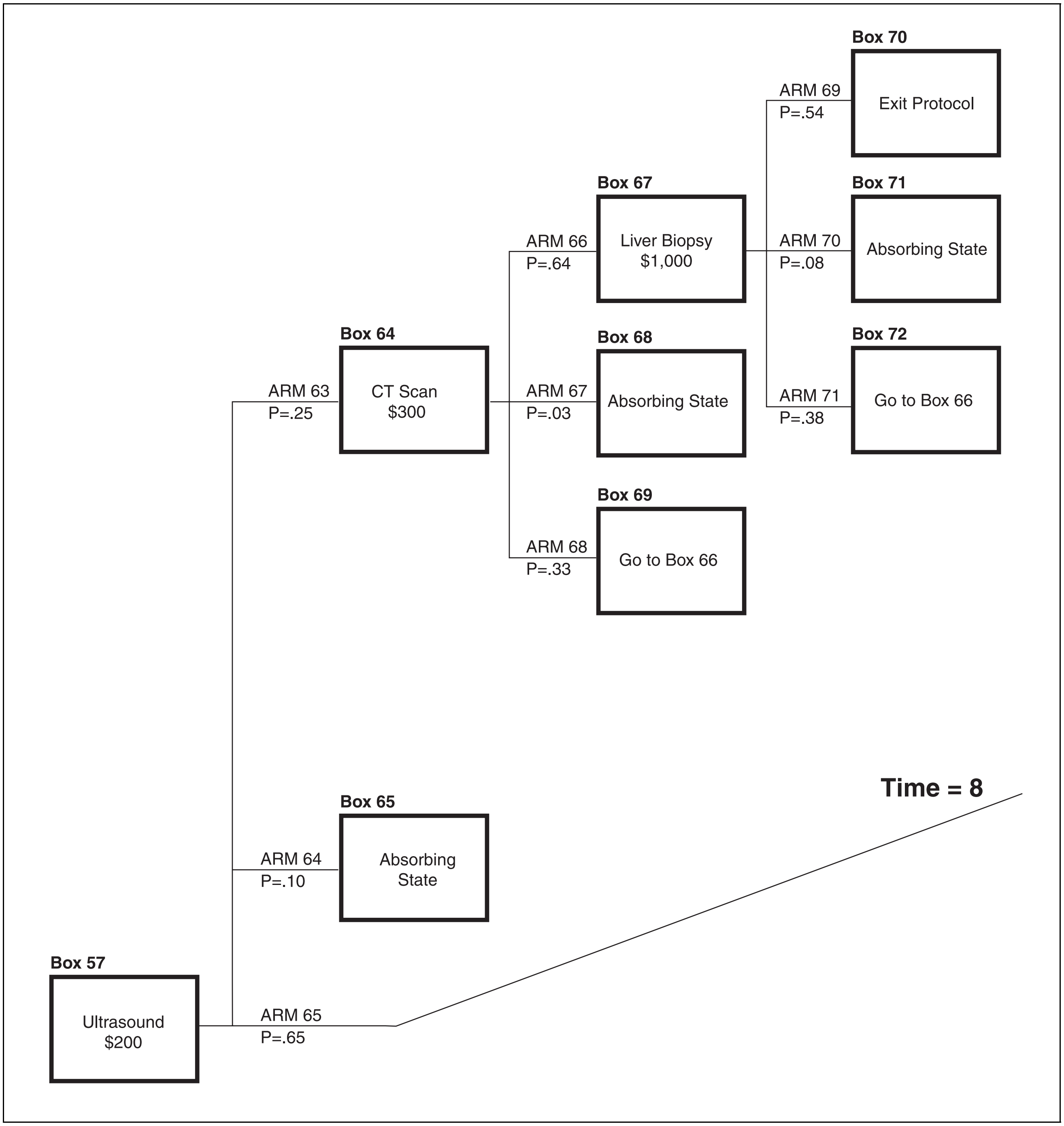
Table 2. Enlargement of Portion of Medical Monitoring Protocol Beginning with Box 1



While Court guidelines can differ, a need for treatment automatically moves one out of the monitoring regime and into a separate world of law and of economic damages. It is shown that eight percent of this cohort leave the protocol, for whatever reasons. Based upon medical foundation, assume 38 percent have a negative biopsy and move to the Box 6 AFP test in Year 2.

This same process continues for 10 years, although tests and probabilities can certainly change. It should be noted that the monitoring protocol moves to an every other year format beginning in year 4. Indeed, we find that in the sample case no testing procedures exist in years 5, 7, and 9. Table 3 enlarges the Appendix I protocol, beginning with Box 57 in Year 8. The period from possible exposure has lengthened. Probabilities of problematic test results have lessened, probabilities that persons drop out have increased, and the AFP test has ended for persons with good results after four years of testing. Medical opinion is that the incremental probability that an AFP test will predict liver cancer, after four years of negative tests, is low. Now, each monitoring year begins with

Table 3. Enlargement of Portion of Medical Monitoring Protocol Beginning with Box 57



an Ultrasound. According to medical experts, 25 percent of those persons tested will move to a CT Scan, 10 percent will be absorbed for whatever reasons, and 65 percent will have good results and simply move to an ultrasound in year 10. Of the 64 percent who move to a liver biopsy, the same probabilities are assumed to apply as in Year 1. Thus, 54 percent will exit the protocol for treatment, 8 percent will be absorbed for whatever reasons, and 38 percent will move to another ultrasound in year 10. Of course, all monitoring ends after 10 years.

The Issues that are the Same or Similar to Life Care Plan Costing

An experienced, forensic economist will approach a medical monitoring case from his or her established, conceptual framework for costing the reports of life care planners. Indeed, some problems and issues are the same or similar. Much time and effort, for example, deal with inter-relationships with foundation experts leading to the work of the forensic economist. This is still true in medical monitoring but, as will be seen, the relationship with medical specialists is more direct and important, while life-care-planners have a smaller but important role in helping to develop the protocol results.

The problem (Slesnick, 1990) of how much an economist versus medical specialists can do in costing medical protocols still exists but is cast differently. A monitoring protocol tends to be much more complex than a life care plan, and much more is needed from medically trained persons -- as in probabilities of results from various tests. Yet, as will be seen, some probabilities may be a mix of medical, economic, and common sense probabilities.

Since monitoring costs extend beyond the trial date into the future, the forensic economist must still balance Medical Cost Price Inflation (MCPI) growth versus discounting to present value. We recommend that monitoring costs, like life care plan costs, be disaggregated by relevant medical and care cost categories and then discounted by a trend rate of discount rates for the same period. This is generally more important in life care plans, because much of the plan may involve non-medical-related services. Monitoring protocol items, by definition, fall into such U.S. government categories as hospital related services and total medical care. The same issues exist in life care plans versus these protocols on the "reasonableness" of future costs, and the economist here looks at foundation experts. In costing each box of a medical monitoring protocol, the quality and standard of care may be issues. They could be cast as another probability/arm subdivision and super-imposed as another dimension of the analysis. Sensitivity analyses and simulations may also be used here.

The issue of "incremental care costs" similarly has common ground with costing life care plans and monitoring. As pointed out by Brookshire and Smith (1990) and Slesnick (1990), one uses good economic (and common sense), subject to the legal guidelines in the particular jurisdiction. Thus, a modified home or van would be an incremental loss, with the costs of a "typical" home and/or car deducted. If medical costs are based upon a "replacement" theory, only incremental costs resulting from the relevant event should be estimated as a loss. In medical monitoring, we now deal with medical testing and its results. We would consider probabilities that persons would have had some of these medical tests, anyway. This could be shown as a "leakage" from the model and/or as an absorbing state.

The issue of income tax effects has traditionally related to FELA, Jones Act, and cases in the few states that instruct the economist to make an "after tax" estimate. There is much literature on the topic in legal and forensic economic journals. While there is a down (wage) effect versus an up (discount rate) effect in lost earning capacity estimates, there is only an up (an after-tax discount rate) effect in any medical-related case: monitoring or otherwise. In other words, class members must be given a larger award so that they can pay income tax on the interest on the award and still have enough left to pay all monitoring costs. A complication is that some or all of these costs may be tax deductible to the individual. These tax complexities have seldom been raised in either life care plan cases or medical monitoring cases.

Probabilities have long been discussed in regard to issues of damages, and an important example for labor/forensic economists is the set of work-life probabilities: life, participation, employment, etc. In medical cases, the life (L) reduction can be handled for one person. With a cohort "class" going into and through a medical monitoring protocol, the death rate by age would certainly be a factor to be considered. This may be the most obvious leakage from any box of the protocol, and/or end (absorbing state) of the protocol, but it usually has a small effect on the present value estimates of loss. Other leakages become an issue when turning to the costing of medical monitoring protocols.

Old Issues That May Be Irrelevant to Medical Monitoring

Any issues relating to treatments of any type, and their costs, are defined as irrelevant under a true monitoring protocol. The moment treatment is indicated, monitoring for the individual has generally been viewed to cease. Issues such as RN versus LPN versus Assistance Care cost alternatives, or institutional care double counts with earning capacity, for example, would simply not appear. It is conceivable, however, that a medical monitoring protocol could be approved, in which certain persons might undergo some treatments while monitoring also continues.

At the level of a trier of fact, jurors may find it difficult to comprehend the large present value losses for only one person moving through a life care plan. Since monitoring protocols do not involve treatment costs, the present value cost of one person moving through a monitoring protocol is not large. It is the multiplication of this one-person number by a large number of persons that may result in substantial, present value dollars. Interestingly, this means a different set of strategy for plaintiff and defense attorneys. In examples and demonstrative evidence on damages, what cohort flow should become the illustrative focus—one person, ten persons, 1,000 persons, 10,000 persons, etc?

The New Issues and Challenges of Medical Monitoring

Much of economic expert time in damages cases involves the collection of appropriate and necessary data for calculations, and this often means inter-relationships with other experts on damages. This work with related experts is different, and more complicated, in medical monitoring cases. The forensic economist may still rely upon life care planners for the cost information in some or all of the boxes in the protocol. It is now more likely, however, that many boxes will involve medical doctors, other medical researchers, or even natural scientists as the foundation source for the economist. This is true in the costs within boxes, and it is certainly true with regard to arms and probabilities. Life care planners have the experience and incentive to provide data (in an appropriate format) that the economist needs. The "new" foundation experts generally have less experience in dealing with economists and may not view this as a high priority activity. The process can be difficult and time-consuming.

The compounding problem is that the forensic economist requires a substantial amount of specific information and scientific opinions. Arms flowing from a box must make common sense and allow probabilities which add to 1.0. A simple example is that any "test" in a box must have at least two arms—for "normal" and "abnormal" results. Otherwise, why was a monitoring/testing event included? And test results may be differentiated with many arms, and flows therefrom. Depending on the class definition and/or calculation guidelines, other arms for possible leakages or add-backs may need to be included. Furthermore, foundation experts may need to help in deciding the types of facilities necessary for certain tests and/or how the nature and availability of proximate facilities affect the flow of a cohort moving through the protocol; this is relevant, in the least, to timing issues with which the economist must deal. Even in a relatively straightforward protocol, collection of the necessary data, while working with foundation experts, is a difficult and detailed task. Extending the above, the economist may have the problem of integrating the opinions of more than one doctor/scientist, perhaps with leakage or probability data from other sources, in one set of arms with probabilities adding to 100 percent. (Or probability ranges adjustable to 100 percent.) The economist may be the expert source for death rates, migration patterns, etc., and several experts might opine on various leakages, or movements out of the model.

The items from life care planners have traditionally been given with a 100 percent probability, or listed "as needed" or "contingent." The economist either costs each item in full, ignores it, or footnotes it. This is despite an early article (Slesnick, 1990), where it was suggested that medical or economic experts might provide a probability between zero and 100 percent: thereby moving toward expected value models and more precise estimates. The costing of medical monitoring protocols means that the forensic economist <u>must</u> be given, generate, and/or deal with probabilities that are between 0 and 1.0.

Unless dictated by a class definition or calculation guideline, the economist will likely be a driving force for timing decisions in the path of a cohort through a protocol. Obviously, the year of a monitoring/testing event is important for discounting to present value. More fundamentally, the assumed speed of movement through a protocol may affect the number of times a given test may be costed. If the Court, for example, has imposed a 10-year period of monitoring, the size of the cohort, mixed with geographical access to appropriate testing facilities, etc., affect movement through the protocol. Depending on advice from other experts, the economist could show slow/medium/fast values or use other simulation techniques to demonstrate the impact of timing assumptions.

One or more arms (and probabilities) can be a leakage of persons from the decision-tree path and lead to what has been called an ending, or absorbing, state. The possibility should be noted that add-ins or add-backs may need to be inserted into the model at various points in time. New in-migrations might be an annual example, or persons might return from (successful) treatment to monitoring. The class definition and Court guidelines are obviously controlling. Similarly, Court parameters affecting the case control add-on damages. Are persons paid for transportation costs or lost wages due to monitoring time?

Simple vs. Complex

The Expected Value (Decision Tree) approach has been the most widely discussed methodology used by economists in costing medical monitoring protocols. The reason for the popularity of the expected value method is its relative simplicity and ability to be portrayed graphically. Such graphics, in decision-tree formats, allow the reader to literally follow the path of individuals through the proposed monitoring protocol from beginning to end. In addition, expected value methodologies tend to be understandable by laypersons because their processes and results make common sense. Distributions of outcomes are not obtained, however, even though sensitivity analyses can certainly be performed and explained.

Economists appearing in court as experts have always faced the simple-versus-complex trade-off when calculating damages. Cases involving medical monitoring claims are no different. In these cases, it is possible for the economist to utilize several approaches to calculate economic damages. In addition to the (relatively simplistic) expected value model, more complex models are available to the economist in costing the monitoring protocol. Two of these are Markov and Monte Carlo analyses.

Markov chains are commonly used to model random processes which evolve over repeated trials. These models, being stochastic in nature, are particularly well suited to modeling economic evaluations due to their ability to concurrently manage both costs and outcomes while maintaining a time component (Briggs and Sculpher, 1998). In the context of medical monitoring protocols, cohorts of individuals are moved through the protocol over the relevant time period. Markov analysis is the same as decision tree analysis, in that it is not a simulation and the probabilities remain fixed. Monte Carlo analysis is a simulation where the probabilities are randomly generated from a range of possibilities.

The clear disadvantage of Markov analyses and/or Monte Carlo simulations is their complexity. Whether in direct or cross examination, answers by economists or statisticians may substantially reduce the credibility and usefulness of the cost conclusion(s). From our experience, both plaintiff and defense attorneys have a special horror that their expert might use the term "Monte Carlo" in a courtroom. Certainly, however, either model can serve as a "check" on the conclusions of the simpler, expected value analysis, and in specific cases, the use of Markov/Monte Carlo analyses can either bolster expected value conclusions or serve as a basis for criticizing expected value conclusions.

Whatever the calculation model chosen, presentation issues are also more difficult and complex than in explaining the costing of life care plans. Whether on the plaintiff or the defense, damages experts must give a consistent and common sense picture to the jury of what happens to people who move through the protocol, why, and how it is costed. Effective, demonstrative evidence, from charts to videos of flow processes, may be used. One large chart of one set of arms and probabilities, carefully explained, makes a picture of all the sets put together significantly less threatening.

Ancillary Issues

While forensic economists are not allowed much credibility on issues of law *per se*, medical monitoring protocols do not fit neatly into either the categories of "compensatory" or "punitive" damages. Some proposed protocols have added large dollars for medical research into a monitoring protocol, as an adjunct to the monitoring process and its costs. Defense attorneys will obviously argue that a monitoring protocol becomes an issue of punitive damages and any costs awarded represent, in whole or part, punitive damages.

Two sides may obviously go to trial with their own economist, and each economist may have a different opinion about the present value cost of a monitoring protocol. Differences may exist about boxes, costs, arms, probabilities, timing, discount rates, etc. It is possible that an award or settlement could be a "formula" payout, especially in our sample case with a "likely cost" standard. A formula avoids the uncertainty about the probabilities associated with the arms from boxes that extend 10 years into the future. It may avoid certain leakage and add-back problems. Those who receive the test or procedure are reimbursed, and a cost formula tied to Usual, Customary, and Reasonable (UCR) cost levels can minimize another uncertainty. There are administrative costs forthcoming from this possibility, and it does not eliminate the need for charting and costing a protocol.

Administrative panels have also been proposed to adjudicate and formulate policies regarding the reimbursement of costs. This also can lessen forecast errors about probabilities but such issues as cash bonuses for taking tests, barring persons who don't take tests in the first year or so, and adjusting for the likelihood that other factors may be the true cause of a person's cancer, remain (Lee, 1994). These alternatives need to be further explored but are beyond the scope of this paper.

Summary and Conclusion

The major tasks and issues confronting forensic economists, in costing a medical monitoring protocol, have been identified and discussed. A sample case has been utilized to focus upon the path of a costing model as it would lead to an expected value estimate by the economist. The nature and quality of foundation data to the economist are very important, as are the class definition and other guidelines from the Court. This paper raises many questions to be further pursued. One is how expected value conclusions differ from Markov and Monte Carlo conclusions, for example, and under what circumstances do the differences become significant. Another is how dollar outcomes are best administered toward the objective of the medical monitoring protocol.

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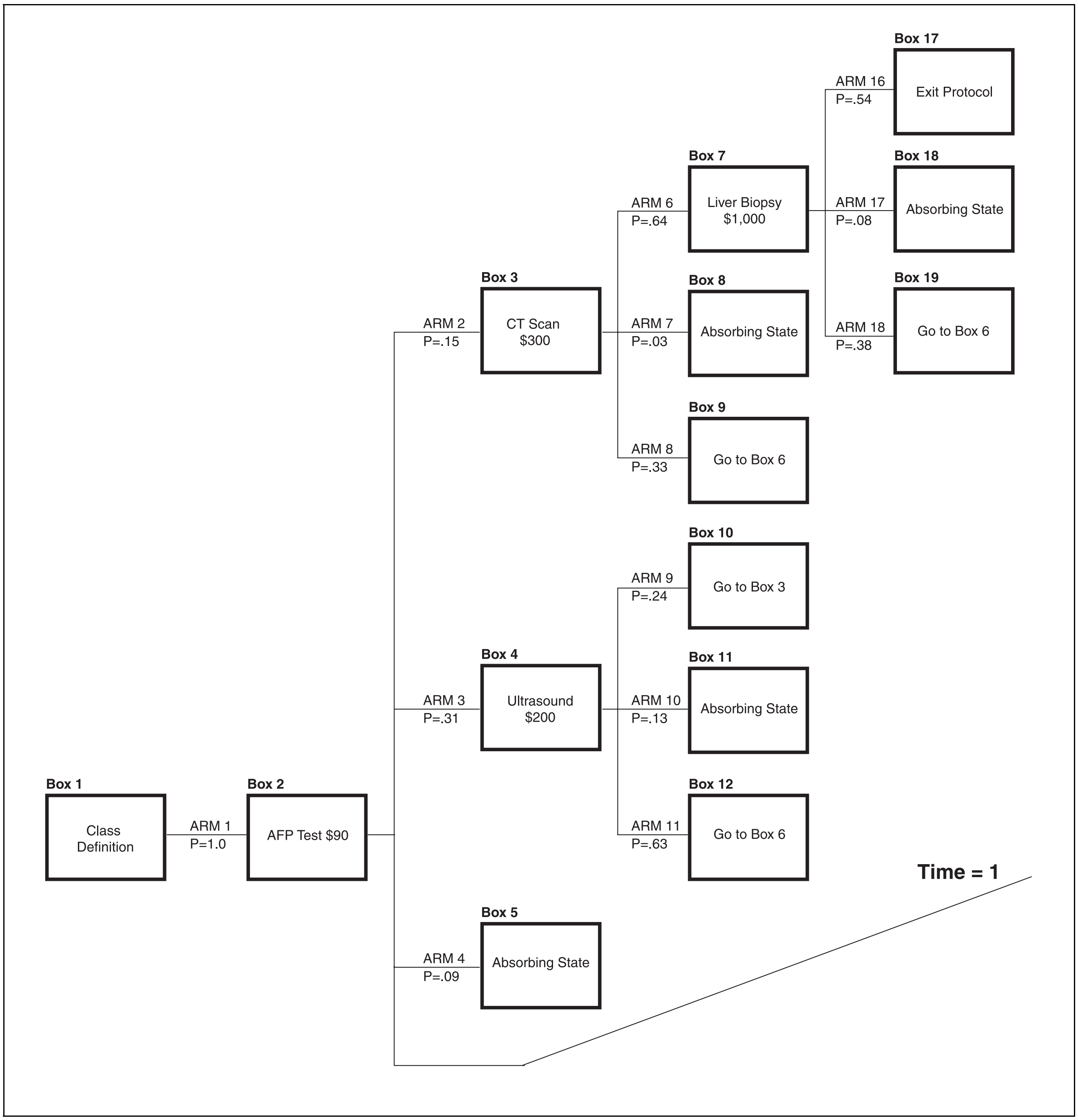
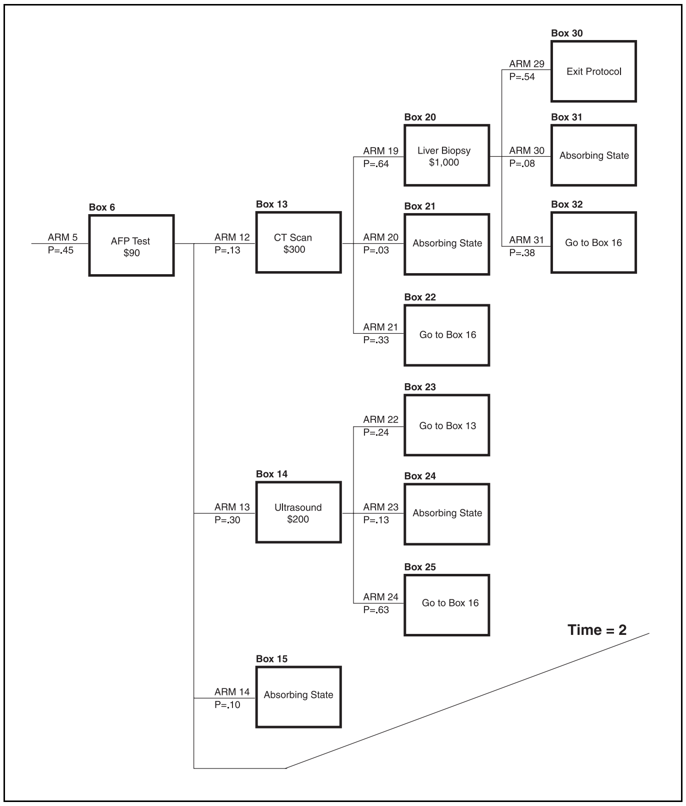
Appendix I: Slide 1. Sample 10-year Monitoring Protocol for Hepatocellular Carcinoma for Persons Age 30 Years or Over Beginning in Year 2002.



Appendix I, continued: Slide 2



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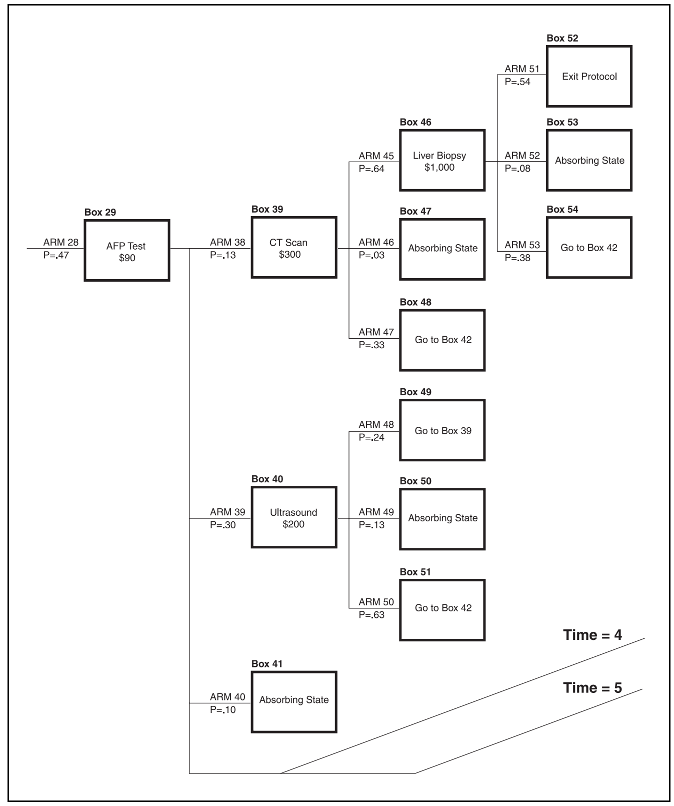

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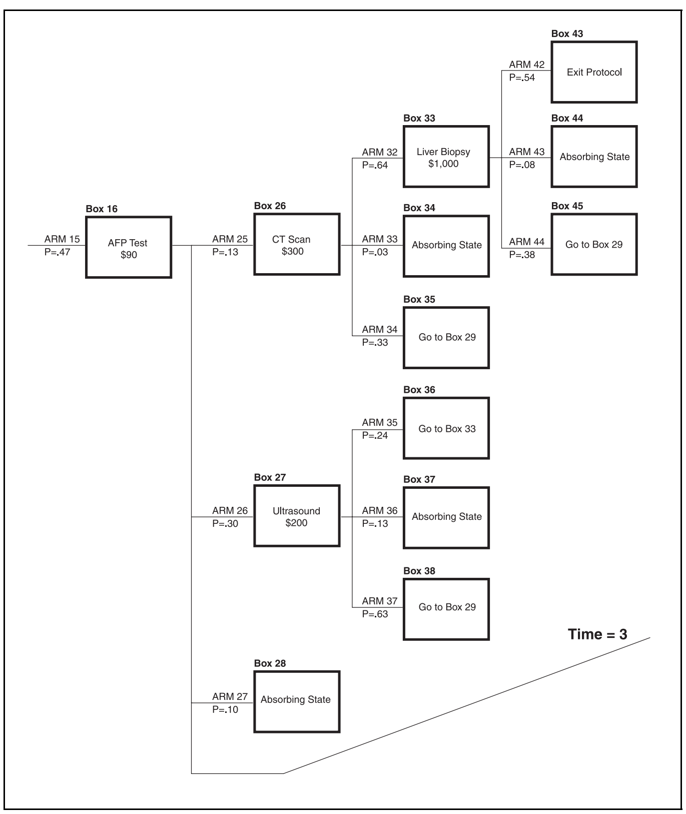

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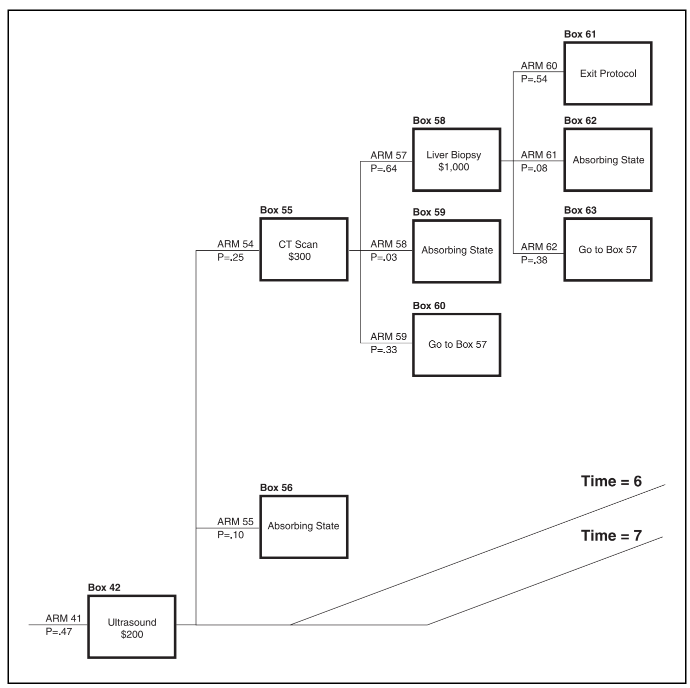

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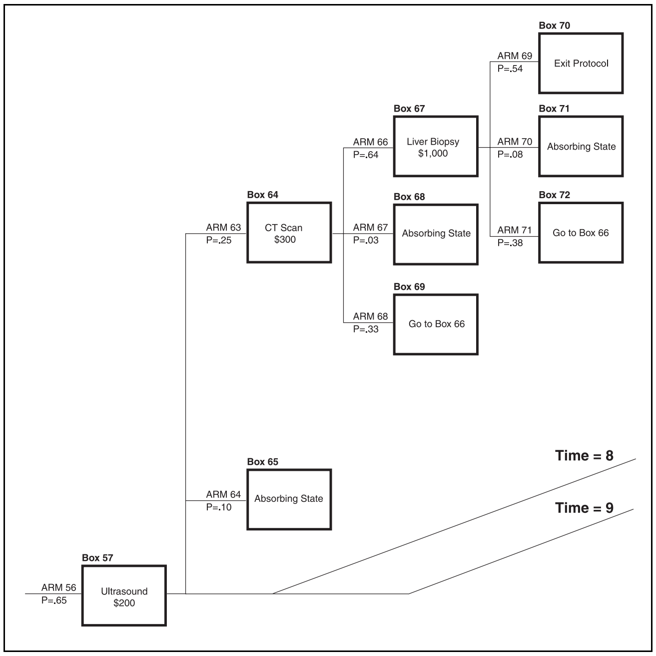
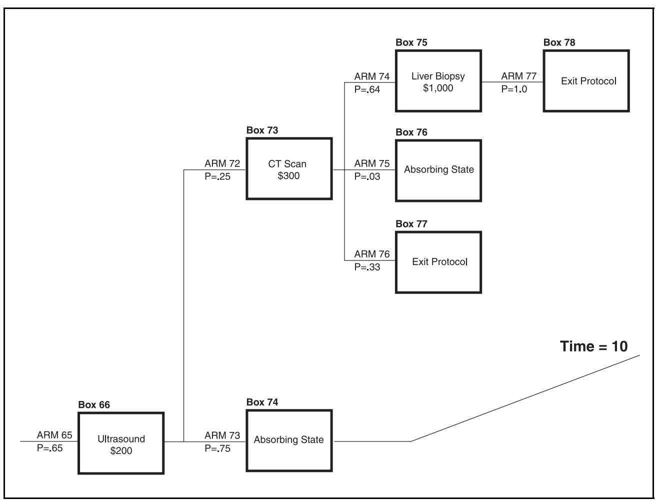


Appendix I, continued: Slide 7



Appendix II-1
Guide to Understanding the Boxes

Box 1 The population of the class as defined by the Court.
Box 2 An alpha-feta protein (afp) test is administered.
Box 3 A CT Scan is administered.
Box 4 An ultrasound is administered.
Box 5 The participant is absorbed, no longer to participate in the protocol.
Box 6 An afp test is administered.
Box 7 A liver biopsy is administered.
Box 8 The participant is absorbed, no longer to participate in the protocol.
Box 9 The participant goes to box 6 in year 2 for an afp test.
Box 10 The participant goes to box 3, for a CT Scan.
Box 11 The participant is absorbed, no longer to participate in the protocol.
Box 12 The participant goes to box 6, in year 2, for an afp test.
Box 13 A CT Scan is administered.
Box 14 An ultrasound is administered.
Box 15 The participant is absorbed, no longer to participate in the protocol.
Box 16 An afp test is administered.
Box 17 The participant exits the protocol and receives treatment.
Box 18 The participant is absorbed, no longer to participate in the protocol.
Box 19 The participant goes to box 6, in year 2, for an afp test.
Box 20 A liver biopsy is administered.
Box 21 The participant is absorbed, no longer to participate in the protocol.
Box 22 The participant goes to box 16, in year 3, for an afp test.
Box 23 The participant goes to box 13, for a CT Scan.
Box 24 The participant is absorbed, no longer to participate in the protocol.
Box 25 The participant goes to box 16, in year 3, for an afp test.
Box 26 A CT Scan is administered.
Box 27 An ultrasound is administered.
Box 28 The participant is absorbed, no longer to participate in the protocol.
Box 29 An afp test is administered.
Box 30 The participant exits the protocol and receives treatment.
Box 31 The participant is absorbed, no longer to participate in the protocol.
Box 32 The participant goes to box 16, in year 3, for an afp test.
Box 33 A liver biopsy is administered.
Box 34 The participant is absorbed, no longer to participate in the protocol.
Box 35 The participant goes to box 29, in year 4, for an afp test.
Box 36 The participant goes to box 33, for a CT Scan.
Box 37 The participant is absorbed, no longer to participate in the protocol.
Box 38 The participant goes to box 29, in year 4, for an afp test.
Box 39 A CT Scan is administered.
Box 40 An ultrasound is administered.
Box 41 The participant is absorbed, no longer to participate in the protocol.
Box 42 An afp test is administered.
Box 43 The participant exits the protocol and receives treatment.
Box 44 The participant is absorbed, no longer to participate in the protocol.
Box 45 The participant goes to box 29, in year 4, for an afp test.
Box 46 A liver biopsy is administered.
Box 47 The participant is absorbed, no longer to participate in the protocol.
Box 48 The participant goes to box 42, in year 6, for an ultrasound.
Box 49 The participant goes to box 39, for a CT Scan.
Box 50 The participant is absorbed, no longer to participate in the protocol.
Box 51 The participant goes to box 42, in year 6, for an ultrasound.
Box 52 The participant exits the protocol and receives treatment.
Box 53 The participant is absorbed, no longer to participate in the protocol.
Box 54 The participant goes to box 42, in year 6, for an ultrasound.
Box 55 A CT Scan is administered.
Box 56 The participant is absorbed, no longer to participate in the protocol.
Box 57 An ultrasound is administered.
Box 58 A liver biopsy is administered.
Box 59 The participant is absorbed, no longer to participate in the protocol.
Box 60 The participant goes to box 57, in year 8, for an ultrasound.
Box 61 The participant exits the protocol and receives treatment.
Box 62 The participant is absorbed, no longer to participate in the protocol.
Box 63 The participant goes to box 57, in year 8, for an ultrasound.
Box 64 A CT Scan is administered.
Box 65 The participant is absorbed, no longer to participate in the protocol.
Box 66 An ultrasound is administered.
Box 67 A liver biopsy is administered.

Box 68 The participant is absorbed, no longer to participate in the protocol.
Box 69 The participant goes to box 66, in year 10, for an ultrasound.
Box 70 The participant exits the protocol and receives treatment.
Box 71 The participant is absorbed, no longer to participate in the protocol.
Box 72 The participant goes to box 66, in year 10, for an ultrasound.
Box 73 A CT Scan is administered.
Box 74 The protocol ends.
Box 75 A liver biopsy is administered.
Box 76 The participant is absorbed, no longer to participate in the protocol.
Box 77 The protocol ends.
Box 78 The protocol ends.

Appendix III - 2
Guide to Understanding the Arms

Arm 1 The participant meets all of the requirements of the class definition and begins the first test.
Arm 2 The participant has an alpha-feta protein level of greater than 70.
Arm 3 The participant has an alpha-feta protein level between 20 and 70.
Arm 4 The participant is leaked from the protocol.
Arm 5 The participant has an alpha-feta protein level below 20.
Arm 6 The CT Scan shows the existence of a liver tumor.
Arm 7 The participant is leaked from the protocol.
Arm 8 The CT Scan shows no tumor.
Arm 9 The ultrasound shows the possible existence of a tumor.
Arm 10 The participant is leaked from the protocol.
Arm 11 The ultrasound shows no sign of a tumor.
Arm 12 The participant has an alpha-feta protein level greater than 70.
Arm 13 The participant has an alpha-feta protein level between 20 and 70.
Arm 14 The participant is leaked from the protocol.
Arm 15 The participant has an alpha-feta protein level below 20.
Arm 16 The result of the liver biopsy is positive.
Arm 17 The participant is leaked from the protocol.
Arm 18 The result of the liver biopsy is negative.
Arm 19 The CT Scan shows the existence of a liver tumor.
Arm 20 The participant is leaked from the protocol.
Arm 21 The CT Scan shows no tumor.
Arm 22 The ultrasound shows the possible existence of a tumor.
Arm 23 The participant is leaked from the protocol.
Arm 24 The ultrasound shows no sign of a tumor.
Arm 25 The participant has an alpha-feta protein level greater than 70.
Arm 26 The participant has an alpha-feta protein level between 20 and 70.
Arm 27 The participant is leaked from the protocol.
Arm 28 The participant has an alpha-feta protein level below 20.
Arm 29 The result of the liver biopsy is positive.
Arm 30 The participant is leaked from the protocol.
Arm 31 The result of the liver biopsy is negative.
Arm 32 The CT Scan shows the existence of a liver tumor.
Arm 33 The participant is leaked from the protocol.
Arm 34 The CT Scan shows no tumor.
Arm 35 The ultrasound shows the possible existence of a tumor.
Arm 36 The participant is leaked from the protocol.
Arm 37 The ultrasound shows no sign of a tumor.
Arm 38 The participant has an alpha-feta protein level greater than 70.
Arm 39 The participant has an alpha-feta protein level between 20 and 70.
Arm 40 The participant is leaked from the protocol.
Arm 41 The participant has an alpha-feta protein level below 20.
Arm 42 The result of the liver biopsy is positive.
Arm 43 The participant is leaked from the protocol.
Arm 44 The result of the liver biopsy is negative.
Arm 45 The CT Scan shows the existence of a liver tumor.
Arm 46 The participant is leaked from the protocol.
Arm 47 The CT Scan shows no tumor.
Arm 48 The ultrasound shows the possible existence of a tumor.
Arm 49 The participant is leaked from the protocol.
Arm 50 The ultrasound shows no sign of a tumor.
Arm 51 The result of the liver biopsy is positive.
Arm 52 The participant is leaked from the protocol.
Arm 53 The result of the liver biopsy is negative.
Arm 54 The ultrasound shows the possible existence of a tumor.
Arm 55 The participant is leaked from the protocol.
Arm 56 The ultrasound shows no sign of a tumor.
Arm 57 The CT Scan shows the existence of a liver tumor.
Arm 58 The participant is leaked from the protocol.
Arm 59 The CT Scan shows no tumor.
Arm 60 The result of the liver biopsy is positive.
Arm 61 The participant is leaked from the protocol.
Arm 62 The result of the liver biopsy is negative.
Arm 63 The ultrasound shows the possible existence of a tumor.
Arm 64 The participant is leaked from the protocol.
Arm 65 The ultrasound shows no sign of a tumor.
Arm 66 The CT Scan shows the existence of a liver tumor.
Arm 67 The participant is leaked from the protocol.
Arm 68 The CT Scan shows no tumor.
Arm 69 The result of the liver biopsy is positive.
Arm 70 The participant is leaked from the protocol.
Arm 71 The result of the liver biopsy is negative.
Arm 72 The ultrasound shows the possible existence of a tumor.
Arm 73 The ultrasound shows no sign of a tumor.
Arm 74 The CT Scan shows the existence of a tumor.
Arm 75 The participant is leaked from the protocol.
Arm 76 The CT Scan shows no tumor.
Arm 77 The result of the liver biopsy is either positive or negative.

Litigation Economics Review
Volume 5, Number 2: 27-31

Time-Series Properties of Capitalization Rates

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Abstract

Applying the discounted cash flow method in valuing a business requires a capitalization rate which, approximately, is the difference between a discount rate and a growth rate in net cash flows. Capitalization rates are analogous to the net discount rate concept familiar to most forensic economists. This paper tests the reasonableness of using historical mean capitalization rates as forecasts of future rates by evaluating the time series properties of various capitalization rates constructed from both micro- and macroeconomic data. Based on this analysis, it is concluded that, in general, capitalization rates are covariance stationary. Therefore, historical long-run mean capitalization rates may provide reasonable estimates of future rates.

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The forensic economics literature is replete with applications of time-series analysis to variables that are part of valuation formulas. This research includes Palaez (1991, 1996); Bonham and La Croix (1992); Gamber and Sorensen (1993, 1994); and Payne, Ewing, and Piette (1998, 1999). At issue in all of these studies is the efficacy of using an historical net discount rate, defined approximately as the difference between a nominal discount rate and rate of wage inflation, in calculating the present value of future lost wages. The point of this research is that if a particular time-series is covariance stationary, it can be argued that the historical mean of the series may be appropriate for present value calculations. Conversely, if the time-series is noncovariance stationary (i.e., has a unit root), the historical long-run mean probably has little predictive power. This paper is an application of these concepts and techniques to business valuations. Specifically, we evaluate the time-series properties of the capitalization rate.

To provide context for the time-series analysis, the paper begins by developing the capitalization of earnings formula and the capitalization rate. Next, the relevant concepts of stationarity are discussed and tests for stationarity are applied. The final section provides a summary.

The Capitalization of Earnings Formula

The most theoretically sound approach to valuing a business is the discounted cash flow (DCF) method. Here, the value of a business, V, is the present value of future net cash flows, i.e.,

(1) $$V = \sum_{t=0}^{T-1} (1+r)^{-t} (C_t)(1-k_t)$$

where r = after tax discount rate, C_t = before tax net cash flow or net earnings,[1] and k_t = the tax rate on net cash flows.

If it is assumed that

(a) C_t changes at a constant rate, g,
(b) k is constant (i.e., it is not a function of C or t),
(c) $r > g$, and
(d) there is an infinite time horizon, equation (1) can be written as

(2) $$V = \frac{C_0(1-k)}{(r-g)/(1+r)}$$

Proof

Let

(3) $$C_t = (1+g)^t C_0, \quad \text{for } t = 1, 2 \ldots T$$

and

(4) $$k_t = k \quad \forall_t .$$

Substituting (3) and (4) into (1) yields

(5) $$V = \sum_{t=0}^{T-1} (1+r)^{-t} (1+g)^t \; C_0(1-k)$$

which can be written

(6) $$V = C_0(1-k)\left[\frac{1-\frac{1}{(1+R)^{T-1}}}{R} + 1\right],$$

where $R = \frac{r-g}{1+g}$.

If $r > g$, as T goes to infinity,

(7) $$V = C_0(1-k)\left[\frac{1+R}{R}\right]$$

or

(8) $$V = \frac{C_0(1-k)}{(r-g)/(1+r)}.$$

Q.E.D.[2]

Equation (2) or (8) mathematically reflects the capitalization of earnings approach and is based on assumptions (a) through (d) above. The denominator in equation (8) is referred to as the capitalization rate.

[1]We recognize the importance of matching the correct capitalization rate with the benefit stream being capitalized (i.e., cash flow vs. net earnings); however, to focus on the stability of the capitalization rate, we have avoided further discussion on cash flow capitalization rates versus net earnings capitalization rates. The interested reader is referred to Fishman et al. (1999) §501.

[2]We would like to thank an anonymous reviewer for pointing out that this particular formula is unique to assuming beginning-of-year cash flows.

While there is general agreement that equation (8) reflects an appropriate concept for valuing a firm,[3] there often is controversy about the values used for each of the parameters k, r, and g. A common approach is to use some sort of historic average for the capitalization rate based on the implicit assumption that the series has a long-run constant mean. For this to be true, the historic capitalization rate must be covariance stationary (i.e., it must exhibit random fluctuations around a constant long-term mean).

Specifically, this paper tests the reasonableness of using an historical mean capitalization rate, $(r - g)/(1 + r)$, in applying equation (8); that is, the capitalization rate is tested to determine whether it is covariance stationary. A subsequent paper will test for the hypothesis that k is independent of C and t, a necessary assumption for the derivation and application of equation (8), the capitalization of earnings approach.

The following section discusses the concept of stationarity. Following that, tests of stationarity are applied to capitalization rates based on both growth rates in corporate profits at the macroeconomic level and for a random sample of individual companies.

Stationary Time Series

Generally in economics, an observed time-series, $y_t, t = 1, \ldots, T$ (e.g., capitalization rates) is the result of some complex, stochastic time-series process denoted Y_t. Y_t is stochastic in the sense that if we were able to go back in time and observe another observation for each t, the "new" observations of the process Y_t would likely be different than y_t for all t. In modeling or forecasting a stochastic time series,[4] it is important to determine if the time series is covariance stationary.

For a time-series process to be covariance stationary, the following conditions are necessary:

$E(Y_t) = \mu$ and

$Var(Y_t) = \sigma^2$.

Thus, the mean and variance of a covariance stationary time-series are time invariant. The stochastic process generating the observed values does not change over time. It follows that for a covariance stationary time series, shocks or deviations from the mean have no persistent effect. Therefore the historic mean of such a series may be a reasonable estimate of its future values.

An essential characteristic of a series which is not a covariance stationary series is the presence of a unit root. Many economic time-series appear to be generated by a unit root process (see Nelson and Plosser 1982). As Gamber and Sorensen (1993, p. 70) note, ". . . a unit root process will wander through time with no tendency to revert back to a particular mean or trend." Hence, the historic mean of such a time series has little predictive power.

[3]See Fishman et al. (1999), Chapter 5, for a discussion of the capitalization of earnings approach for business valuation.

[4]While technically not equivalent, we use the terms "process" and "time series" interchangeably.

A unit root process has the form[5]

(9) $Y_t = \alpha + \beta t + Y_{t-1} + \varepsilon_t$.

If **α** and **β** are both zero from equation (9), successive substitution yields,

$$Y_t = Y_0 + \sum_{i=0}^{T-1} \varepsilon_{t-i} ,$$

where Y_0 = the initial realization of the time series. Such a time series is called a pure random walk process and has the following mean and variance,

$E(Y_t) = Y_0$

$V(Y_t) = t\sigma^2$,

where

$\sigma^2 = V(\varepsilon_t)$.

Intuitively, such a series is nonstationary in the sense that a shock to the series has a permanent effect; technically, the series has a stochastic trend.

Allowing for a drift term (i.e., the case of $\alpha \neq 0$) in equation (9) but retaining the assumption that **β = 0**, changes the mean to $E(Y_t) = Y_0 + \alpha t$.

Hence, the drift term introduces another element of nonstationarity—a deterministic trend. Similarly, in the case of $\alpha \neq 0$ and $\beta \neq 0$, the process has both a stochastic and a deterministic trend.

Subtracting Y_{t-1} from both sides of equation (9) yields

(10) $\Delta Y_t = \alpha + \beta t + \varepsilon_t$,

where **Δ** = the first difference operator. A general test of the unit root hypothesis is based on estimating a version of the following model:

(11) $$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{\rho} \delta_i \Delta Y_{t-i} + \varepsilon_t .$$

Under the null hypothesis of a unit root, **γ = 0**. Dickey and Fuller (1979) provide three sets of critical values depending on whether the drift, the trend, or both are included in equation (3).

Stability of Capitalization Rate

Initially, the following two time series are used to construct a capitalization rate: ***g*** = quarter over quarter percentage change in corporate after tax profits;[6] and ***r*** = quarterly total return to S & P 500 composite index.[7]

The capitalization rate, the denominator in equation (8), is calculated as:

(12) $CAPRATE = (r_t - g_t) / (1 + r_t)$.

Table 1 provides descriptive statistics for these three variables.

Table 2 provides a summary of the augmented Dickey-Fuller tests applied to each time-series noted above using three different variants of equation (11). The three test statistics, **τ**, **τ**$_\mu$, **τ**$_\tau$ correspond to whether the drift and trend term are excluded from equation (11), just the trend term is excluded, or both the drift and trend term are included, respectively. For all tests, the number of lag terms in equation (11) was two.

Table 1. Descriptive Statistics for the Discount Rate (*r*), growth Rate (*g*), and Capitalization Rate: Quarterly Rates

Series	Mean (%)	Std. Error (%)	Min. (%)	Max. (%)
r	3.55	8.20	-25.2	23.0
g	2.45	6.68	-14.4	21.2
CAPRATE	0.53	9.71	-31.8	20.2

Table 2. Summary of Unit Root Tests

	Test Statistics		
	τ	**τ**$_\mu$	**τ**$_\tau$
Capitalization rate	-6.21	-5.92	-5.91
Discount rate	-7.08	-6.82	-5.00
Growth rate	-6.06	-6.04	-4.88
Critical values (5%)	-3.45	-2.89	-1.95

As shown in Table 2, the null hypothesis of a unit root is rejected for all time series. This implies that the capitalization rate defined by equation (12) is stationary; deviations from the long-term, constant mean do not persist.

For further analysis of the capitalization rate, unit root tests are applied to capitalization rates based on five randomly selected companies. Five large companies were randomly selected from a population of companies included in the S&P 500 Index both on October 26, 2000 and in the 1966, 1st quarter edition of Moody's Corporate Stock Handbook.[8]

The discount rate used to construct capitalization rates for the companies was based on returns to large company stocks as reported by Ibbotson Associates (2000). Table 3 reports summary statistics on the time series just described.

Equation (12) was used to construct capitalization rates for the five large companies selected. Five capitalization rates were constructed using revenue growth rates and five using operating income growth rates.[9] Table 4 reports the augmented Dickey Fuller (ADF) unit root tests for the ten large company capitalization rates. Based on this sample of large companies, the evidence indicates that the capitalization rates are covariance stationary time series.

[5]Both the drift term, ***α***, and the parameter on the time trend, ***t***, may be zero.
[6]Source: www.stls.frb.org/fred/data/gdp/cpatax . Quarterly data from 1970:1 through 2000:2.
[7]Source: www.stls.frb.org/fred/data/business/trsp500 . Quarterly data from 1970:1 through 2000:2.

[8]We tried also to select a random sample of small companies form the S&P Small Cap 600 Index. However, small companies in 2000 tended not to exist in 1966 and small companies in 1966 were no longer small companies in 2000.
[9]It is our opinion that revenue measurement probably is less affected by accounting methods (e.g., choice of depreciation methods) than operating income. Consequently, the historical growth rate in revenue may be a better measure of the future growth rate in the economic income stream being capitalized (e.g., net cash flow or net earnings).

Table 3. Descriptive Statistics: Returns to Owning Large Company Stocks and Company Growth Rates: Selected Companies (Annual Rates 1955-1999)

Sources	Mean (%)	St. Error (%)	Minimum (%)	Maximum (%)
Large company stocks				
Total return	14.54	16.92	-26.47	51.42
Operating income growth rates:				
Hercules	9.75	32.04	-54.91	105.87
TRW	23.64	87.36	-85.75	540.68
Honeywell	14.72	40.73	-76.37	224.07
Mead	15.68	50.42	51.23	154.74
Cummings Engine	86.68	308.88	-95.87	1641.86
Revenue growth rates:				
Hercules	7.20	12.29	-15.13	51.42
TRW	10.18	11.24	-7.60	42.91
Honeywell	12.26	20.25	-18.81	114.94
Mead	9.00	13.64	-25.71	41.78
Cummings Engine	11.93	14.13	-19.11	44.94

Table 4. Summary of Augmented Dickey-Fuller Unit Root Tests on Large Company Capitalization Rates

Capitalization Rate/Company	Test Statistics		
	τ_τ	τ_μ	τ
Capitalization rates based on earnings growth rates:			
Hercules	-3.61*	-3.39*	-3.43**
TRW	-3.99*	-3.92**	-3.71**
Honeywell	-4.18*	-4.23**	-4.17**
Mead	-3.69*	-3.68**	-3.67**
Cummings Engine	-4.29**	-4.02**	-3.42**
Capitalization rates based on revenue growth rates:			
Hercules	-3.90*	-3.29*	-3.19**
TRW	-3.74*	-3.36*	-3.39**
Honeywell	-4.90**	-4.77**	-4.79**
Mead	-3.96*	-2.65	-2.63**
Cummings Engine	-3.78*	-3.20*	-3.28**

*Significant at 5% level.
**Significant at 1% level.

Summary and Conclusions

The net discount rate is an important element in many forensic economic assignments. In business valuation engagements, the capitalization rate is analogous to the net discount rate concept familiar to economists in personal injury litigation. While the literature on the time-series properties of net discount rates applicable to personal injury litigation is voluminous, little has been written about the time-series properties of the capitalization rate.

This paper has evaluated the time-series properties of specific capitalization rates. Based on capitalization rates calculated from macroeconomic data (i.e., economy-wide rates of return and growth rates in corporate profits) and five randomly selected companies from the S&P 500 Index, the hypothesis that these capitalization rates contain unit roots generally is rejected. These capitalization rates appear to be covariance stationary time-series. Therefore, our initial, tentative conclusion is that historical long-run mean capitalization rates may provide reasonable estimates of future capitalization rates. Further research using small company growth rates and costs of capital is necessary to either support or discredit this initial conclusion.

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Litigation Economics Review
Volume 5, Number 2: 32-37

The Literature Corner: Recent Publications of Interest to Forensic Economists

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Abstract

The reader response to this new feature in the *Litigation Economics Review* has been nothing short of overwhelming. Both letters that we received were effusive in their praise for "The Literature Corner." For example, one forensic economist told us that he "wastes no time reading the new recent publications section." The other reader wrote that he "couldn't say enough good things about the 'Literature Corner'."

All joking aside, in this new feature of the *Litigation Economics Review*, we provide an annotated listing of recent publications likely to be of considerable interest to forensic economists in their work and in their research. To compile such a list, we scour the regular *non-forensic* economics literature, a literature that because of time constraints or narrow sub-disciplinary interests is not likely to be visited as frequently as many of us would wish. Although some of the publications that we note may be periodically brought to the attention of NAFE members via the LISTSERV, we feel that a regular feature such as this has several advantages. First, not all NAFE members subscribe to or read the LISTSERV. Secondly, information about recent publications provided on the LISTSERV is presented in a random, non-systematic way, one that is dependent on the time and goodwill of those providing the information. Finally, in a regular feature such as this, we are able to summarize, categorize, and link the publications in ways that are not always possible with the LISTSERV.

We welcome any suggestions from the NAFE readership about items to include, coverage, etc. Readers are cautioned that the article descriptions appearing below are necessarily brief and cannot convey all the richness of detail, qualifications, and caveats appearing in the articles themselves. Also, it should be noted that most of the works we highlight will generally have appeared in the last year or two. However, we have elected to follow no strict statute of limitations.

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In this issue, we highlight articles of interest in the areas of crime, disability and health, discrimination, earnings, self employment, older workers, worker displacement and young workers. As a result, articles have been arranged by topical area.

Disability and Health

Thomas DeLeire, "Changes in Wage Discrimination against People with Disabilities," *Journal of Human Resources*, Vol. 36, No. 1, Winter 2001, pp. 145-58.

Some persons with a disability may earn less because the disability they have reduces their labor market productivity. Other persons with a disability may earn less because they are subjected to employer discrimination even though their disability does not hinder their labor market productivity. Some persons with a disability may earn less for both these reasons, and still others may not experience any wage reduction because they are neither less productive nor subject to discrimination. DeLeire attempts to sort out some of these distinctions. He does so by using SIPP (Survey of Income and Program Participation) data on the earnings of a sample of men with disabilities who claim to have no work limitation and compares them with the earnings of (a) another group with disabilities that do cause a work limitation and (b) the non-disabled. For 1984 he finds that about 86% of the predicted gap in log earnings between the nondisabled and the disabled are due to poor health, whereas about 5% is attributable to discrimination and about 9% to differences in other observable characteristics. For 1993 he finds that about 78% is due to poor health, whereas about 8% is due to discrimination and 14% to other observable characteristics. Hence, wage discrimination does not appear to have been reduced as of 1993 by the Americans with Disabilities Act (ADA). In addition, the negative effects of disability on productivity appear to have diminished between 1984 and 1993. This could be due, DeLeire argues, to improvements in technology and perhaps also to the ADA because of its requirements that firms accommodate disabled workers.

DeLeire, Thomas "The Wage and Employment Effects of the Americans with Disabilities Act," *Journal of Human Resources*, Vol. 35, No. 4, Fall, 2000, pp. 693-715.

Using SIPP data this paper analyzes the impact of the Americans with Disabilities Act of 1990 on the wages and employment of men with disabilities. According to the author, "The analysis of wages and employment in this study reveals that the ADA failed to achieve its goal of increasing labor market opportunities for people with disabilities. Following passage of the ADA in 1990, the employment of disabled men fell 7.2 percentage points compared with the employment of nondisabled men. Moreover, relative employment rates fell immediately in 1990 and continued to fall through 1995, the end of the observed sample. The relative wages of these men, however, changed little over this period. Larger employment declines are observed for disabled men in manufacturing industries and managerial and blue-collar occupations. Men who become disabled through work-related injury were not affected by the regulation, nor were disabled men with 'other' disabilities (which include heart disease, asthma, diabetes, high blood pressure and other impairments). Disabled men who worked in the government sector were also unaffected by the ADA." (pp. 694-95)

Acemoglu, Daron and Joshua D. Angrist, "Consequences of Employment Protection? The Case of the Americans with Disabilities Act," *Journal of Political Economy*, Vol. 109, No. 5, October, 2001, pp. 915-57.

This paper covers the same topic as the previous one by DeLeire in investigating the employment and wage effects of the ADA, but uses the March Current Population Survey (CPS) which also has data on the number of employees of the firms in which workers were employed. Additional data from the Equal Employment Opportunity Commission (EEOC) on discrimination charges were also used. The paper's main results are as follows: "The CPS data show a post-ADA decline in the relative employment of disabled men and women aged 21-39, with no change in relative wages. The deterioration in the relative employment position of disabled workers began in 1993 for men and in 1992 for women, the first two years the ADA was in effect. These results are unchanged by controlling for pre-ADA trends in employment of the disabled or for the increase in the fraction of people receiving disability insurance and supplemental security income (SSI). Together, these findings lead us to conclude that the ADA reduced employment for disabled workers aged 21-39. The results for those aged 40-58 are more mixed. There is a post-ADA decline in the employment of disabled men aged 40-58, but no clear evidence of an effect on women aged 40-58. Additional results suggest that employment of the disabled declined more in medium-sized firms, possibly because small firms are exempt from the ADA and large firms can more easily absorb ADA-related costs.... We find no evidence that the ADA had a negative impact on nondisabled workers. This suggests that the adverse consequences of the ADA had been limited to the protected group." (p. 917)

The authors proceed to argue that the lack of an impact of the ADA on older women may be explained by the existing protection for older workers via the Age Discrimination in Employment Act (ADEA) and Title VII of the Civil Rights Act preventing discrimination on the basis of sex.

Hale, Thomas W. "The Lack of a Disability Measure in Today's Current Population Survey," *Monthly Labor Review*, Vol. 124, No. 6, June 2001, pp. 38-40.

Question 59a of the CPS March Supplement asks: Do you/does anyone in this household have a health problem or disability which prevents you/them from working or which limits the kind or amount of work you/they can do? According to Hale, "Neither the work limitation nor the income questions were designed to identify the population with disabilities, nor were they tested to determine if they do so." (p. 39) Moreover, he claims that there are a number of elements of uncertainty with respect to the question about work disability. First, does the health dimension to this question mean that we are identifying as disabled those with *temporary* conditions such as the flu or a broken leg? Second, is it plausible that many people who work and also have a disability (according to the ADA definition) would not consider themselves limited in the type or amount of work they can do? After all, the CPS question asks them to identify some failing about themselves; but why should they – after all, they are working. (p. 40) Third, given the "mind-body split assumption" in most western populations, a mental condition is not likely to be considered a "health condition" or a "disability" by many. (p. 40) Fourth, the work limitation question in the CPS March Supplement does not differentiate between work as a means of obtaining a living and work as a meaningful use of time. Hence, when the Supplement asks about a work limitation, a respondent who does volunteer work might assume that volunteer work is included. For all these reasons, Hale concludes that "there are no questions in the Current Population Survey that identify persons with disabilities." (p. 38).[1]

[1]Judging from the DeLeire and Acemoglu papers, apparently the finding that the ADA reduces employment rates of the disabled does not depend on whether one uses a good measure (from the SIPP) or a poor measure (from the CPS) of disability!

Discrimination

Allegretto, Sylvia, and Michelle Arthur. "An Empirical Analysis of Homosexual/Heterosexual Male Earnings Differentials: Unmarried and Unequal?" *Industrial and Labor Relations Review*. Vol. 54, No. 3, April 2001, pp. 631-46.

The authors use 1990 census data for what they claim is the "first large-scale study of wage differentials between heterosexual and homosexual men." (p. 631) The homosexual sample consists of gay men in unmarried partnership relationships. Overall, the authors estimate that gay men in such relationships earn 15.6% less than similarly qualified married heterosexual men and 2.4% less than similarly qualified unmarried partnered heterosexual men. The authors interpret this range as the upper and lower limits of the earnings differential between homosexual and heterosexual men. The explanation for most of the wage differential between partnered homosexuals and married heterosexuals appears to be a variant of the "marriage premium." The marriage premium is a well-established observation that married men, *ceteris paribus*, earn more than single men. Although various explanations have been offered for the existence of the marriage premium in heterosexual households, one explanation is based on the observation that the sexual division of labor results in men being more productive in the labor market since wives perform the lion's share of housework. In the homosexual households that they studied, the authors found that partners of gay men worked longer hours in the labor force than wives of married men or females in unmarried partnerships. As a consequence, the sexual division of labor tends to be less marked in male homosexual households, thus equalizing the market productivity of both partners. The authors conclude by stressing that there is still little empirical research in the area of sexual orientation and its effect on human capital accumulation, occupational choice, and labor market discrimination.

Mason, Patrick L. "Annual Income and Identity Formation among Persons of Mexican Descent," *American Economic Review*, Vol. 91, No. 2, May 2001, pp. 178-83.

In the author's own words, "This paper examines the impact of assimilation, acculturation, and discrimination on income inequality among persons of Mexican descent [PMD]. By assimilation, I refer to the extent and empirical impact of a common set of variables that are usually hypothesized to explain interpersonal differences in income, such as nativity, English fluency, education, experience, region, marital status and gender. By acculturation, I mean Spanish fluency, color self-identity, and racial/ethnic self-identity. The empirical analysis suggests that assimilation raises the annual earnings of persons with Mexican descent. Certain dimensions of acculturation, that is, abandoning a unique social-group identification, also raise the income of persons of Mexican descent. Finally, there is discrimination against darker and more Indian-featured PMD." (p. 179)

The data used for the empirical work are from the 1979 Chicano National Survey. For the assimilation variables, some of the results are as follows: an additional year of education raises the annual earnings of an immigrant PMD by $368 (in 1979 dollars), while each year of additional experience raises annual earnings by $204. PMD with limited English proficiency earn 10% less than their English-proficient counterparts. Concerning the effect of acculturation, or lack thereof, self-identification as Chicano lowers annual income by 9% for the average PMD, 10% for women and 20% for immigrants. Identification as Mexican-American has a negative effect on PMD who have dark complexions and Indian phenotype in the amount of $1,548 per year, but a positive effect ($894) for PMD who have light complexions and medium complexion PMD with European features. There is also evidence of discrimination against dark-complexion/Indian PMD, in the form of an 11% earnings penalty relative to light- and medium-complexion PMD with European features.

Earnings

Wiatrowski, William J. "The National Compensation Survey: Compensation Statistics for the 21st Century," *Compensation and Working Conditions*, Vol. 5, No. 4, Winter 2000, pp. 5-14.

This article describes the new compensation data program produced by the U.S. Bureau of Labor Statistics – the National Compensation Survey (NCS). The NCS evolved from several existing programs and measures (such as the Occupational Wage Surveys), which the BLS is now combining into a single comprehensive program detailing wages, benefits, and establishment practices. The design of the new survey is integrated, and as a result users will be able to relate various measures with other measures in ways that were not possible before. For example, do higher-paid workers tend to have more or less generous pension plans? (Careful, here, that's more or less generous, not more-or-less generous. Mind your punctuation, caution grammarians Rodgers and Thornton.) Forensic economists who frequently use Department of Labor compensation data will find this article useful for familiarizing themselves with some of the interrelated features of the new NCS.

Older Workers

Wiatrowski, William. "Changing Retirement Age: Ups and Downs," *Monthly Labor Review*, Vol. 124, No. 4, April 2001, pp. 3-12.

In the past age 65 was considered to be *the* retirement age, and workers generally had few choices or decisions to make as to when to retire and how to fund their retirement years. More recently, though, legislative changes, new types of retirement plans, and increases in life expectancy have led to vast differences in the ages at which people elect to retire and to the proliferation of sources of retirement income. This article summarizes the changes in these areas and will serve as a useful primer for forensic economists desiring to keep abreast of retirement trends, issues, and instruments (such as cash value plans and pension equity plans). Also, Wiatrowski's assertion on p.10 that "a single standard retirement age no longer exists" might serve as a warning to forensic economists who routinely refer to the "standard retirement age of 65" in their reports.

Purcell, Patrick J. "Older Workers: Employment and Retirement Trends," *Monthly Labor Review*, Vol. 123, No. 10, October 2000, pp. 19-30.

As members of the "baby-boom" generation begin to retire, many changes to both public and private retirement systems may occur, including raising the ages of pension eligibility, more flexible pension plans, and "phased retirement." The article describes the aging of the labor force, noting that between 2000 and 2010 about 90% of the increase in the number of people age 25-64 will be accounted for by the increase in the number in the 55-64 age bracket. Furthermore, data for the period 1994-2000 indicate an increase in labor force participation rates for men age 55 and over. This includes all the age subgroups: 55-61, 62-64, 65-69, and 70 and over. These increases may have been due to the strong economy over this period as well as to the increase in the number of persons covered by age-neutral defined contribution plans rather than defined benefit plans with special subsidies for early retirement. Based on the demographic changes that lie ahead, it can be expected that more employers will want to retain their older workers for a longer period of time or encourage phased retirement, whereby workers do not abruptly retire but reduce work schedules over a period of time while beginning to draw retirement benefits. The author also discusses various forms of phased retirement plans that have been used and the restrictions on them because of ERISA and the Internal Revenue Code. In addition, the author argues that the Social Security Act and the Internal Revenue Code may be amended to provide incentives for people to work longer.

Chan, Sewin, and Ann Huff Stevens. "Job Loss and Employment Patterns of Older Workers,"*Journal of Labor Economics*, Vol. 19. No. 2, April 2001, pp. 484-521.

This article uses data from three waves of the Health and Retirement Study (1992, 1994, and 1996) to examine the employment patterns of workers over age 50 who have lost their jobs. Their findings show that job loss results in large and lasting effects on future employment probabilities. For example, two years after a job loss at age 55, just 60% of men and 55% of women are employed, compared with employment rates of more than 80% among non-displaced men and women who were working at age 55. And four years after job losses at age 55, the employment rate of displaced workers remains 20 percentage points below the employment rates of similar non-displaced workers. These long-term employment effects of displacement result from both the rates of return to employment after displacement and rates of exit from post-displacement jobs.

Self-Employment

Georgellis, Yannis, and Howard Wall. "Who Are the Self-Employed?" *Federal Reserve Bank of St. Louis Review.* Vol. 82, No. 6, November/ December 2000, pp. 15-23.

Despite the importance of self-employment (about 8.6% of employed persons are self-employed), there has not been a great deal of data analysis to identify who the self-employed are and what they do. This article uses 1997 data from the Current Population Survey (CPS) to provide a snapshot of self-employment in the U.S., with particular emphasis given to the differences between men and women. Among the findings, the authors report that self-employed men and women tend to be concentrated in a small number of (two-digit) occupations. Both tend to be heavily represented in sales, professional specialty, and executive, administrative, and managerial occupations. In addition, nearly a quarter of self-employed men (but very few women) are in precision production, while large shares of self-employed women (but few men) are in service or administrative support occupations. Differences also exist across racial groups, with whites and Asians having self-employment rates above the national average and blacks and Native Americans having below-average rates. As far as education is concerned, most (57%) of the self-employed do not have post-secondary degrees. Finally, older workers are more likely than younger workers to choose self-employment over paid employment. This snapshot of the self-employed does not attempt to explain the differences among groups, but can be useful to forensic economists who may be asked to create or evaluate worklife scenarios involving self-employment.

Hundley, Greg. "Why Women Earn Less than Men in Self-Employment," *Journal of Labor Research*. Vol. XXII, No. 4, Fall 2001, pp. 816-29.

The author uses data from the 1989 and 1990 waves of the Michigan Panel Study of Income Dynamics (PSID) to evaluate explanations offered for the earnings differential between self-employed men and women. This gender earnings differential is extremely large. According to Robert Aronson's 1991 estimates using CPS data, the annual incomes of self-employed women were only 36.7% of the incomes of self-employed men. (By the way, Robert Aronson's 1991 book, *Self-Employment: A Labor Market Perspective* [Cornell University, ILR Press], probably belongs on the bookshelves of most forensic economists.) Furthermore, this large earnings difference persists within broad occupational groups. Hundley finds that much of the gender differential in earnings can be explained by the types of markets where the self-employed sell their goods and services (such as women's disproportionate representation in the area of personal services), the fact that women devote more time and energy to housework and raising children, and the fact that men devote more hours to their businesses.

Worker Displacement

LaLonde, Robert. "The Returns of Going Back to School for Displaced Workers," *Poverty Research News* (Newsletter of the Northwestern University/ University of Chicago Joint Center for Poverty Research). Vol. 5, No. 4, July/August 2001

Since the 1980s a growing number of community colleges have been providing job retraining under contract with various business, government, and nonprofit organizations. Little is known, however, about the effectiveness of such retraining on the earnings and productivity of displaced workers. LaLonde (along with Louis Jacobson and Daniel Sullivan – LJS) studied the schooling and work experiences of about 21,000 workers in Pennsylvania and Washington State who were displaced between 1990 and 1994 and compared them with a large control group of displaced workers who did not enroll in community colleges after their loss of job. They find that one academic year of community college raised displaced workers' earnings by about 5% over what they would have been without further education. Most workers who enrolled in college, however, did not wind up completing even one year of coursework. LJS also find that the type of coursework taken is strongly associated with future earnings. For those taking one year of technical and applied coursework, the expected return is about 10-15%, while those focusing on a more general curriculum tend to experience a drop in earnings. Overall, though, the authors conclude that on average community college training for displaced workers does not offset a significant portion of their long-term earnings losses.

Helwig, Ryan T. "Worker Displacement in a Strong Labor Market," *Monthly Labor Review*, Vol. 124, No. 6, June 2001, pp. 13-28.

This article uses the biennial surveys of displaced workers (supplements to the Current Population Survey) to analyze the labor market experience of displaced long-tenured workers (displaced workers who lost or left jobs they had held for 3 years or more). The analysis is restricted to long-tenured workers because it is more likely that these workers lost their jobs due to labor market conditions rather than to a "bad match" with their employer. The period studied is 1997-98, when about 1.9 million long-tenured workers (about 2.5% of all such workers) permanently lost their jobs. This comprehensive article is rich in detail, and only a few of the highlights can be recounted here. For example, it furnishes descriptive statistics about the age, sex, race and Hispanic origin of displaced long-tenured workers over the 1981-98 period. The overall displacement rate has exhibited a procyclical pattern, being 3.9% in 1981-82 and 1991-92, and only 2.4% and 2.5%, respectively, in 1987-88 and 1997-98. Displacement rates in 1997-98 for workers 55 and over were considerably higher than for workers aged 25-54, though this pattern is not typical over the entire 1981-98 period, as the rate for those 55 and over was lower in four of the nine observation periods and the same in two others. Somewhat surprisingly, while displacement rates were lower for college graduates, they were higher for workers with some college and no degree than for high school graduates with no college. Goods-producing industries had higher displacement rates than service-producing industries. The median period between jobs for the 1.5 million workers (out of 1.9 million displaced) who found jobs was 5.3 weeks. The article also gives the distribution of time required to find jobs across industries and occupations. Details are provided about employment rates after termination – 78% of those displaced in 1997-98 were employed as of February 2000. About half had switched to a new industry or a new occupation, though the former was more likely than the latter. And finally, about 61% of those who returned to full-time jobs earned as much or more on the new job as the old.

Younger Workers

Painter, Gary, and David Levine. "Family Structure and Youths' Outcomes: Which Correlations Are Causal?" *Journal of Human Resources*, Vol. 35, No. 3, Summer 2000, pp. 525-49.

Persons who grow up in families that lack a biological father are more likely to have lower levels of education and experience higher rates of teen out-of-wedlock fertility. But what is the evidence for causality? This study uses the National Educational Longitudinal Survey of 1988 to examine the extent to which the apparent effects of divorce or remarriage during a youth's high-school years are not causal but instead due to preexisting characteristics affecting the family or the youth. The authors find evidence that the correlations between family structure and youth outcomes are indeed largely causal. Parental characteristics and parenting behaviors were similar in intact families and in families that were about to undergo divorce. Moreover, family and youth characteristics at the time of eighth grade do not predict much of the higher dropout rates observed in youths whose parents divorced during high school. Divorce, in other words, seems to be causally related to poor outcomes for youths.

Lang, Kevin and Jay L. Zagorsky, "Does Growing Up with a Parent Absent Really Hurt?" *Journal of Human Resources*, Vol. 36, No. 2, Spring, 2001, pp. 253-73.

The authors study the impact of a missing parent, *and unlike the findings of the previous paper*, reach the following conclusions: "Once we control for correlated background characteristics, there is little evidence that parental presence affects the economic well-being of children. It does appear that the father's presence matters for the cognitive performance and education of both sons and daughters while the mother's presence influences these outcomes for daughters. While statistically significant, however, these effects are modest.... In general, these findings suggest less basis for concern about the decline of the traditional two-parent family than is suggested by earlier work. There is one result that stands in sharp contrast to this general pattern. A father's death greatly reduces the probability that his son will be married." (pp. 271-72)

Parker Boudett, Katheryn, Richard J. Murnane, and John B. Willett, " 'Second-chance' Strategies for Female High School Dropouts," *Monthly Labor Review*, Vol. 123, No. 12, December 2000, pp. 19-31.

After reviewing the literature regarding the effect of the GED on men's and women's earnings, the authors use National Longitudinal Survey of Youth (NLSY) data to study the impact of the GED using a sample of 689 women who dropped out of school before obtaining a high school diploma. They find that women who obtain a GED by the third year after dropping out of high school have earnings 10 years after dropping out that are about 25% higher than those of women who do not obtain the GED. In addition, women who obtain the GED and also undertake a year of off-the-job training (training offered by proprietary schools and government agencies) or college boost their earnings by nearly 50%.

Miscellany

Dunifon, Rachel, Greg J. Duncan, and Jean Brooks-Gunn, "As Ye Sweep, So Shall Ye Reap," *American Economic Review*, Vol. 91, No. 2, May 2001, pp. 150-154. (This paper is part of a three-paper session on "The Benefits of Skill," all of which are worth reading.)

We will let the authors' own words describe this intriguing paper: "The inability of formal skills such as schooling and on-the-job training to account for most of the variation in labor market success has spurred investigations of other factors.... Our focus in this paper is on the role of a different kind of personal characteristic: organization and efficiency, as operationalized in our data set by the housework-hours-adjusted score from five annual interviewer assessments of the cleanliness of the respondent's dwelling at the time of the interview. People whose homes appear "clean" both value order and demonstrate the ability to impose a degree of order at home. It is likely that people who are able to maintain such homes carry over the ability and desire to be organized to other aspects of their lives, such as work and parenting. The ability to maintain a degree of organization may be a skill that would command a reward in the labor market. Additionally, children raised in more organized households may be more successful in school and work. The results presented here indicate that net of socioeconomic-status background, cognitive ability, completed schooling, housework time, and a host of other factors, the cleanliness rating of one's home is predictive of: (i) one's own earnings 25 years later; (ii) children's subsequent completed schooling; and (iii) children's earnings measured 25 years later." (p. 150)

Samuel, Sidney. "When It Comes to Pay, Does Location Matter?" *Compensation and Working Conditions*, Vol. 5, No. 2, Summer 2000, pp. 37-43.

The simple answer to the question raised in the title is (not surprisingly) "Yes, location *does* matter." The National Compensation Survey (NCS) provides data on earnings for 154 areas – 81 of them metropolitan and 73 of them non-metropolitan. Overall, pay in metropolitan areas was higher than pay in non-metropolitan area, with the Middle Atlantic and New England metropolitan areas having the highest pay and the East South Central metropolitan areas the lowest.

Symposium, "OSHA and Ergonomics," *Journal of Labor Research*. Vol. XXII, No.1, Winter 2001.

OSHA's proposed ergonomics program standard, dealing with workplace repetitive stress injuries such as carpal tunnel syndrome, was overturned by President Bush in March 2001. Nevertheless, the issue remains a controversial one with ergonomic proponents in Congress pressing for new rules and a series of national public forums being held on the issue. This symposium consists of 9 papers, and many of them will be of considerable interest to forensic economists and vocational specialists who deal with workplace injuries and disorders. The papers are:

- "OSHA's Ergonomics Program Standard and Musculoskeletal Disorders: An Introduction" (S.E. Dudley and W.B. DeLong)
- "Workplace Transformation and the Rise in Cumulative Trauma Disorders: Is There Connection?" (D. Fairris and M. Brenner)
- "Musculoskeletal Disorders and Productivity" (H. Conway and J. Svenson)
- "OSHA's Ergonomics Litigation Record: Three Strikes and It's Out" (E. Scalia)
- "Where Is the Market Failure? A Review of OSHA's Economic Analysis for It Proposed Ergonomics Standard" (M.P. Berkman and J. David)
- "The Benefits and Costs of OSHA's Proposed Ergonomics Program Standard" (S.E. Dudley)
- The Robustness of OSHA Ergonomics Benefits: A Note" (J. Cochran)
- "Avoiding 'Regulatory Mismatch' in Regulating Workplace Ergonomics: The Case for an Informational Approach" (T.A. Lambert)
- "Do Workers Want OSHA's Ergonomics Regulations? (J.M. Johnson, W.L. Gramm, and W.K. Viscusi)

Litigation Economics Review
Volume 5, Number 2: 38-46

Calculating Labor Force Participation Tables using CPS Microdata

Kurt V. Krueger[A]

Associate Editor's Note

This article is a second in a series of *Litigation Economics Review* articles under the Associate Editorship category of computer software, data sources, and sites on the Internet of interest to litigation economists. This article demonstrates how litigation economists can make specific labor force participation tables by age and other demographic features using the Current Population Survey microdata published on the Internet by the Bureau of Labor Statistics and the U.S. Census Bureau.

In future articles that appear under this *LER* Associate Editorship category, we hope to bring to readers similar articles that take various concepts or methods used in litigation economics and show the reader various data sources or computer software addressing their usage. We encourage anyone with suggestions of relevant computer software, data sources, or Internet sites to send an email with an idea for future topics.

When using the Living-Participating-Employed (LPE) model of expected lifetime earnings (or a variant thereof), data inputs include (1) a mortality table presenting the probability of death by age, gender, and sometimes other demographic categories, and (2) a table of labor force participation and unemployment by age, gender, and relevant demographic and economic categories. Because the Bureau of Labor Statistics (BLS) does not publish a variety of labor force participation tables, in many instances, the litigation economist might need to construct his or her own tables. For example, the economist could be working with a case calling for the labor force participation rates of married, college educated, white males living in California.

In this article, we show economists how to construct their own labor force tables using the Current Population Survey (CPS) microdata published by the BLS and the U.S. Census Bureau (Census). Because we will be working with microdata containing detailed respondent information, we can construct tables for specific population groups regarding work-related status across time. For example, instead of showing the traditional labor force statistics for one year or month, we can compute average labor force participation rates across years. We can also examine the portion of the population not in the labor force and their reasons for not working. Or, we could examine the percentage of the full-time and part-time worker populations across demographic groups. This article provides the basic programming to create a variety of such analyses.

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We begin the article with a discussion of where the CPS microdata are located on the Internet and how to move the data from the Internet to your own computer. We also discuss the electronic data formats available for working with the microdata. Next, we present the CPS variables useful in constructing a variety of labor force participation tables. Finally, we present a quick tabulation method of the micro-data forming the basis for a variety of revealing labor force participation and population status tables.

CPS Documentation

The CPS documentation web server can be found on the Internet at http://www.bls.census.gov/cps/. At this site, you will find an overview and history of the CPS, methodology and documentation, and other related CPS information. On this web page, the link "Data" will take you to a web page containing links to the "Basic Monthly Survey," the "Annual Demographic Survey (March CPS Supplement)," and other CPS special topic surveys. The official BLS labor force participation rates are computed from the Basic Monthly Survey. Clicking on the "Basic Monthly Survey" link will take you to a new page containing links to "Microdata and Table Access via FERRET," a "Glossary of Subject Concepts," and CPS "Variable Descriptions by Topic." We will skip a discussion of the glossary and variable descriptions and proceed directly to the location for microdata access.

The FERRET system, http://ferret.bls.census.gov/cgi-bin/ferret, is an acronym for "Federal Electronic Research and Review Extraction Tool." FERRET is a tool developed and supported by the U.S. Census Bureau in collaboration with the Bureau of Labor Statistics and other statistical agencies. To first access the FERRET system, you will need to enter your email address. Your email address serves two purposes: (1) large data requests are processed in a batch mode that runs overnight and the FERRET system will send you an email when you can download your results, and (2) FERRET periodically sends email to notify users of new data releases.

After entering your email address and pressing the "Continue" button, you will receive a menu of available data sources. The first data source in the menu allows access to the "CPS Public Basic Monthly (Jan 1994-Present)." Make sure the radio button next to this selection is highlighted and then press the "Continue" button at the bottom of the page.[1] At this point, the user can decide if he or she wants to download entire CPS datasets using the FERRET "FTP Page" link, or simply allow FERRET to extract the data for him or her. We will want FERRET to extract our data, so press the "Continue" button at the page. Had we selected the link to the "FTP Page," we would have been presented with a listing of Basic Monthly CPS files by month since January 1998. Each of those files is a compressed, record formatted data file that requires external software to read for manipulation or extraction. Uncompressed, those files are each approximately 80 to 100 megabytes in size and require hefty computer power to process and store when working with multiple months. Historical CPS files are also available for download at the National Bureau of Economic Research Internet site at http://www.nber.org/data/cps_basic.html. Currently, NBER CPS files begin with January 1976 and continue monthly to the present. Also at this link, the NBER provides programs to read CPS Basic Monthly Data with SAS, SPSS, or Stata. The NBER also sells merged extracts of the monthly CPS and merged March Supplement CPS files. Information about these CPS files for sale can be found at http://www.nber.org/data/morg.html.

CPS Data Extraction

After pressing the "Continue" button to bypass the downloading of complete CPS datasets, we now arrive at the heart of the FERRET data extraction system. The first choice to make is the selection of a time frame for data extraction. You are allowed to check multiple months and as many years as are available. However, if you select more than one month of data, your data extraction will run as a batch job overnight and you will receive an email from FERRET describing how to pick up your results via an Internet link once the job completes.

The steps to extract one month of data or sixty months of data are identical with the exception of the overnight batch job processing for multi-month data extraction. For purposes of our illustration, let's download one month of data in order to get results directly to our screen in real time without having to wait overnight. Once you are comfortable with downloading one month of data, you can repeat the FERRET extraction steps to download many months of data and wait overnight for receipt of the data download location.

Under the "Select a time frame" area, select the box next to "Jan" for January data and in the scroll area underneath, select the year 2002. The next box in this first data extraction screen calls for the list of CPS variables you wish to search for and extract from the CPS survey database. To duplicate the examples we present in this report, type in the following CPS variable names: HRMONTH, HRYEAR4, PEMLR, PENLFACT, PESEX, PERACE, PEMARITL, PEEDUCA, PRCIVLF, PRTAGE, PRUNTYPE, PRWKSTAT, PRWNTJOB, PWCMPWGT, and GESTCEN. We will discuss these variables later in the paper. If you do not know the names of the variables you want to extract, before beginning a FERRET session you can consult the Basic Monthly Survey variable definitions found at the Basic Monthly Survey web page (http://www. bls.census.gov/cps/). Next, under the section titled "Choose the option for the type of search you want," in order to prevent extraneous search results, click on the radio button "Short descriptions & variable names." The next section of this data extraction screen presents a series of check boxes titled "To further restrict your variable search, choose one or more of the following variable groupings." Since we know the variable names we wish to extract, leave those check boxes unmarked and click on the "Continue" button to instruct FERRET to extract our variables for January 2002.

At the next FERRET screen, all of the variables you typed in the previous screen should appear with their titles in a scroll box area. If FERRET cannot find a particular variable in the database, most likely due to a typographical error in the

[1] By selecting the next lower radio button, CPS data are available from January 1989 to December 1993.

previous screen, it will notify you of an error in its search. In order to have FERRET extract all of these variables, we need to select the variables using the mouse and the shift key. Scroll up to the top of the box so that you see the first variable in the list. Click once on that variable title to select it. Then scroll down to the last variable in the box. Hold down your shift key and click once on the last variable title. If the entire list becomes highlighted, you now have selected every variable in the list. If all of the variables do not become highlighted, try the selection process again. Then, click on the "Continue" button to move forward to the next screen.

The next FERRET screen is titled "Select Variable Values." At this screen you can limit the observations culled from the CPS databases by selecting certain variable values. For example, to select only males respondents, we could click on "PESEX=1 (Males)" in the description for the demographic PESEX variable. Since we want to make a variety of tables, let's skip these selections and download all observations. At the bottom of this screen is the section titled "Choose the output you want." The options are "Create ASCII file for downloading or printing" and "Create crosstabs, frequencies, or SAS dataset for downloading or printing." If you choose the first option, you will download a simple text data file containing the raw values for each variable selected. The capability of FERRET to create crosstabs and frequencies is limited to four variables. Additionally, if you process more than one month of data, you will have to wait overnight for your results. To construct multi-dimension tables, we will want FERRET to deliver the data we selected in a SAS file for further processing on our own computer. By selecting a SAS file, all titled variables by observation number will be placed in an organized file easily loadable into the popular SAS data system. If you do not have access to SAS, you will have to select the ASCII option and read the data manually from the text file into a database software package for manipulation and tabulation, or you can use a utility to convert the SAS file into another file format compatible with your database or statistical software. If you have access to SAS, but are unfamiliar with its programming language, you can follow the SAS programming steps we show in this article, or you can use SAS to convert the data into another familiar format. After clicking the radio button next to the choice "Create crosstabs, frequencies, or SAS dataset for downloading or printing," click the "Continue" button to move to the next FERRET screen.

The final FERRET screen is titled "Verify your Selections." At this screen you can choose to (1) download the resulting ASCII or SAS file, (2) display data on the screen, or (3) make a cross-tabulation or frequency count using one column, one row, one page, and one chapter variable. As mentioned, the crosstab and frequency options of FERRET are limited and the ASCII format is cumbersome, so we will choose to download the data in the SAS format. For persons working in a PC environment, select the "Download Resulting File" checkbox with the radio button "DOS (PKZIP)" selected. With ZIP compression, the downloaded file will be approximately 10% of its original size facilitating transfer over the Internet. Once the download boxes are selected, move to the bottom of the page and click on the "Get Results" button. The FERRET system now goes to work extracting your requested one month of CPS data. Depending upon the user load of the FERRET system, it could take up to three or four minutes for the next screen to appear. Be patient and do not re-click the "Get Results" button.

Once FERRET extracts your selected data, a new screen will appear in your browser that will say a "SAS Data Set with 141,834 obs was created for your query." Since we did not limit the data extraction by variable value in the second previous screen, the interpretation here is that in January 2002 there were 141,834 respondent observations to the CPS survey. There are two hyperlinks on this final page. Clicking the first titled "Download zipped extraction file(s)" will open a "File Download" dialogue box on your computer asking you to save the file from the Internet to your computer. Click on the "Save" button and direct your operating system to place the file in a location of your choice on your personal computer hard disk. Your computer's dialogue box will inform you when the download is complete. Next, click the link on the FERRET page titled "Download custom code book" in order to save a definition list on your computer of the variables you extracted. When clicking this link, a new window will appear with the variable definitions which you can either save to your computer by clicking "File" on your browser menu then selecting "Save as" to place it in a folder on your own computer's hard disk, or you can simply print the file.

The SAS file that you saved on your computer is in the ZIP file format. You will need to un-ZIP the file before working with the file in SAS. Some PC operating systems have ZIP file extraction utilities built in. If you do not have a ZIP extraction utility, you can find one for free download on the Internet at http://www.winzip.com/ddchomea.htm.

CPS Variables for Labor Force Participation Tables

In this article we present detailed labor force status tables from which labor force participation rates can be computed. The variables we choose to analyze do not represent an exhaustive set of possibilities for labor force status computation and readers are encouraged to experiment with variants of the tables computed in this article by adding or omitting demographic and economic variables.

For ease of tracking the month in which each CPS observation occurred, we asked for the two variables HRMONTH and HRYEAR4. HRMONTH is simply a variable coded 1=January, 2=February, 3=March, …, 12=December. The variable HRYEAR4 is the four digit year of observation.

The demographic variables we selected for FERRET extraction are PESEX (gender), PRTAGE (age), PERACE (race), PEMARITL (marital status), PEEDUCA (highest obtained education), and GESTCEN (resident state). The labor force/population status variables selected are PEMLR (employment status), PENLFACT (reason not in the labor force), PRCIVLF (labor force attachment), PRUNTYPE (reason for unemployment), PRWKSTAT (full/part time work status), and PRWNTJOB (want a job but not in labor force). We will detail the values of these variables later in the paper.

The variable PWCMPWGT is the important respondent's final composited weight that is used to tabulate the BLS's official published labor force statistics. Each respondent to the CPS represents multiple persons in the United States as measured by his or her final composited weight. In order for valid statistics to be computed, matching those published by the BLS, we need to use the PWCMPWGT weight for each observation tabulated. An advantage of using a software package such as SAS is that it has built-in features for handling weighted variables. For more information about how the CPS weights are constructed, see the CPS website at http://www.bls. census.gov/cps/.

SAS Programming Steps

Translate data file from FERRET

The SAS file that FERRET created for our download is in the machine-independent SAS Transport file format. The SAS Transport format allows various types of computers utilizing different operating systems to read the same data files. In order to convert the generic SAS Transport file format to your machine's native SAS file format, you will need to run the SAS Copy procedure as follows:

```
/* comment: translate transport file and put it into the CPS folder in a
SAS data file */
libname trans xport 'C:\location\q29349.trn' ;
libname cps 'C:\location\cps\' ;
proc copy in=trans out=cps ;
run;
```

Comment lines in SAS are written by placing text within the character combinations /* and */. The first two statements are SAS file locater statements (libname). The first "libname" provides SAS the location on your hard disk for the transport (xport) file downloaded from the FERRET system (q29349.trn). The second "libname" provides SAS the location on your hard disk of a permanent data library to store the converted SAS Transport file (CPS). The procedure copy translates and moves the SAS file to the desired permanent location. In each libname, substitute the first part of the file location "C:\location\" statement with your machine's file structure locating the SAS Transport file on your hard disk and the resulting sub-directory where you want the permanent, translated file to reside.

Provide value formats for the demographic CPS variables

The SAS procedure Format can create text labels for each of the numeric coded CPS variables. By establishing value formats, the tables we compute will be clear to the reader without him or her knowing the underlying data values. Before proceeding to analysis variables, it is useful to create value formats for the demographic variables we downloaded. Creating value formats in SAS is straightforward:

```
proc format ;
value prtage /* age of respondent */
16-19='16-19'
20-24='20-24' 25-29='25-29'
30-34='30-34' 35-39='35-39'
40-44='40-44' 45-49='45-49'
50-54='50-54' 55-59='55-59'
60-64='60-64' 65-69='65-69'
70-74='70-74' 75-79='75-79'
80-84='80-84' 85-90='85+'
;
value pesex /* gender of respondent */
1='Males'
2='Females'
;
value perace /* race of respondent */
1='White'
2='Black'
3='American Indian, Aleut, Eskimo'
4='Asian or Pacific Islander'
;
value educ /* education of respondent */
31-38='Less than a high school diploma'
39='High school graduates, no college'
40-42='Less than a bachelors degree'
43-46='College graduates'
;
value married /* marital status */
1-2='Married'
3-5='Widowed, divorced, or separated'
6='Never married'
;
value hrmonth /* month of observation */
1='January' 2='February'
3='March' 4='April'
5='May' 6='June'
7='July' 8='August'
9='September' 10='October'
11='November' 12='December'
;
run ;
```

Create simple labor force participation rates

The data we use in this article are from the January 1998 through the December 2001 Basic Monthly CPS surveys. Using the exact FERRET procedures documented above, we selected these 48 months of data and downloaded the file to a personal computer (q29349.trn). The proc copy procedure created a SAS dataset on our personal computer called q29349. When SAS converted the transport file it noted that q29349 contained 5,990,597 observations. In order to make our dataset smaller to speed repeated processing, we run a simple SAS data step to delete children ages 15 and under. These children are not included in labor force statistics published by the BLS. When creating this reduced observation dataset, we will also add a variable called "counter" which is set to the constant of 1. We will use this constant variable when summing observations in the SAS tabulation procedure. The SAS data step to accomplish this small administrative task is:

```
data cps.years_1998_to_2001 ;
set cps.q29349 ;
if prtage < 16 then delete ;
counter = 1 ;
run ;
```

Our new permanent dataset name is "years_1998_to_2001" which contains persons ages 16 and over, our extracted variables contained in the dataset q29349, and the constant value counter variable. Deleting children under age 16 from the downloaded dataset left 4,579,255 observations. We will use this file throughout the rest of the paper when creating our labor force status tables.

The CPS variable PRCIVLF divides the U.S. non-institutional civilian population into three groups (presented below in the format procedure which you will supply to SAS):

```
proc format ;
value prcivlf
-1='In Universe, Met No Conditions To Assign'
1='In Civilian Labor Force'
2='Not In Civilian Labor Force' ;
run ;
```

The first value format of PRCIVLF is "-1". Children under the age of 16 are "in the universe" of the U.S. population, but they cannot be members of the labor force as defined in the

Current Population Survey, so children under the age of 16 are assigned a “-1” value for appearance in the civilian labor force. Rarely, a person age 16 or over will be assigned a “-1” value if the BLS was unable to ascertain the respondent’s labor force status.

The power of the SAS system is revealed by computing simple labor force participation rate tables using the PRCIVLF CPS variable. Summarizing the steps taken so far, we (1) downloaded 48 months of data, (2) supplied variable labels for the chosen CPS demographic variables, (3) limited the dataset to persons 16 and over and added a constant variable, and (4) supplied variable labels for PRCIVLF. To create labor force participation rate tables with the basic structure of participation rates of males by age, we submit the following code to SAS:

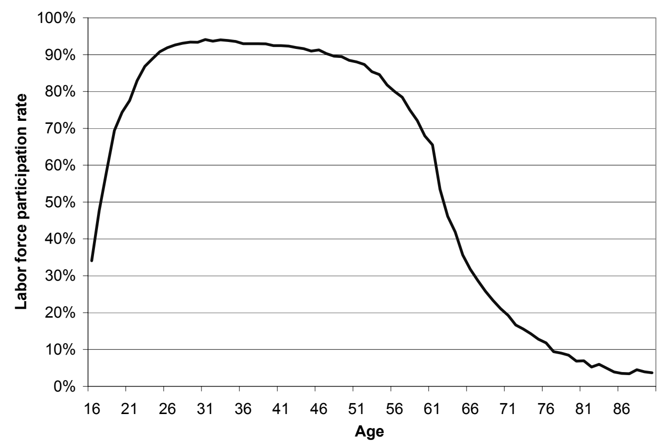
```
proc tabulate data=cps.years_1998_to_2001 ;
where prcivlf <> -1 /* omit missing data */
   & pesex = 1 /* only include males */ ;
class pesex prtage prcivlf ;
var counter ;
table prtage all ,
     prcivlf*counter*rowpctsum=' '*f=8.2 ;
weight PWCMPWGT ;
format prtage prtage.
      pesex pesex.
      prcivlf prcivlf. ;
label prtage='Age group'
     pesex='Gender'
     prcivlf='Labor force status 1998-2001'
     counter='% of population' ;
run ;
```

We show the output of the above SAS tabulate procedure in Table 1. The tabulate procedure begins with a specification of the dataset to be processed, here our dataset created from January 1998 to December 2001 CPS surveys. The “where” statement limits the observations included in the tabulation. In this program, we only include the observations where PRCIVLF is equal to 1 or 2, eliminating the rare missing data where PRCIVLF is equal to “-1” (see above). Using the logical “&” connector, we also limit the data to males by selecting PESEX equal to 1. Class variables determine the categories that PROC TABULATE uses to calculate statistics. In our case, the variables PESEX, PRTAGE, and PRCIVLF provide the “classes” that we use to compute labor force participation as represented by the proportion of the “counter” values in each class of PRCIVLF. The variable “counter” is the “var” or variable value used to compute statistics. The table statement within PROC TABULATE sets up the crosstab in which we are interested. The table statement is divided into two parts: rows and columns. The rows are represented by PRTAGE and the columns by PRCIVLF. Notice that these variables are separated by a comma signifying to SAS the break point between rows and columns. The word “all” next to PRTAGE signals SAS to compute the labor force participation rate for persons of “all”ages. The column variable PRCIVLF has two values, 1=In the Labor Force and 2=Not in the Labor Force. The labor force participation rates are computed using the “rowpctsum” statistic. The SAS procedure tabulate sums the number of observations within the row and column variables and computes the percentage of the total fitting within each row cell as shown in Table 1. We add a blank label to rowpctsum in the printed output by adding the =’ ‘ marks and format the labor force participation rate as eight characters with two decimal places (f=8.2).

Table 1. SAS output all males

Age group	Labor force status 1998-2001	
	In Civilian Labor Force	Not In Civilian Labor Force
	% of population	% of population
16-19	52.38	47.62
20-24	81.97	18.03
25-29	92.40	7.60
30-34	93.80	6.20
35-39	93.08	6.92
40-44	92.17	7.83
45-49	90.34	9.66
50-54	86.90	13.10
55-59	77.77	22.23
60-64	55.39	44.61
65-69	29.20	70.80
70-74	17.51	82.49
75-79	10.44	89.56
80-84	6.11	93.89
85+	3.76	96.24
All	74.65	25.35

Figure 1. Labor force participation rates of all males (1998-2001)



As mentioned before, the important CPS weight variable is included in the SAS procedure in the line “weight PWCMPWGT” which assigns multiple CPS recorded values to each observation to represent the entire U.S. civilian non-institutional population.

The format statement attaches value labels previously defined to the table variables and the label statement provides titles for the output. If the format for PRTAGE were removed, the procedure would compute single age labor force participation rates that we charted in Figure 1.

By changing the “where” limiting statement in the previous SAS program, different labor force participation rate tables can be computed. For example, the following “where” statement, if placed in the previous SAS tabulate procedure, would limit the table to the labor force participation rates of married, college educated, white males living in California.

```
where prcivlf <> -1 /* omit missing data */
   & pesex = 1 /* only include males */
   & perace = 1 /* only include white */
   & 43 <= peeduca <= 46 /* college educated */
   & 1 <= PEMARITL <= 2 /* married */
   & gestcen = 93 /* California residents */;
```

Using the PRCIVLF variable, we computed the proportion of the population "in" and "not in" the civilian labor force. Using a new CPS Basic Monthly Survey variable, PEMLR, we can compute the unemployment rate within the civilian labor force. The variable PEMLR is a monthly labor force recoded variable computed by the BLS post-survey using answers given by the respondent regarding the employment status of persons in the household. The values assigned by the BLS to the variable PEMLR are:

```
proc format ;
value pemlr
1='Employed-At Work'
2='Employed-Absent'
3='Unemployed-On Layoff'
4='Unemployed-Looking'
5='Retired-Not In Labor Force'
6='Disabled-Not In Labor Force'
7='Other-Not In Labor Force' ;
run ;
```

Using the variable PEMLR, we can construct an output table that will present the unemployment rates for the demographic groups we select. The values 1-4 of PEMLR are persons in the civilian labor force and the values 5-7 are persons not in the civilian labor force. To make this new table, we will supply a "where" statement to skip the PEMLR values of 5-7 and rearrange the format of PEMLR as follows:

```
Proc format ;
Value pemlr (multilabel)
1-4='In the labor force'
3-4='Unemployed' ;
run ;
```

The multilabel option in the format statement allows SAS to process the same variable values more than once for table output. In this format statement for PEMLR, the multilabel option allows values 1-4 to be grouped together at the same time as the sub-group values 3-4. The SAS tabulate procedure to generate the unemployment rate table for males with less than a high school education is:

```
proc tabulate data=cps.years_1998_to_2001 ;
where pemlr <> -1 /* omit missing data */
  & pemlr < 5 /* omit not in labor force */
  & pesex = 1 /* only include males */
  & 31 <= peeduca <= 38 /* < high school */ ;
class pesex prtage ;
class pemlr /MLF ; /* MLF=multilabel format */
Var counter ;
Table prtage all ,
    pemlr*counter*rowpctsum=' '*f=8.2 ;
weight PWCMPWGT ;
format prtage prtage. pesex pesex. pemlr pemlr. ;
label prtage='Age group'
    pesex='Gender'
    pemlr='Labor force status'
    counter='% of the labor force' ;
run ;
```

The tabulate procedure above differs from the previous labor force participation rate tabulation by adding a second "class" statement for the variable PEMLR with the MLF option for multilabel format processing. In Table 2, we show the results of running the above tabulate procedure three additional times, once for each of the education levels previously presented for the variable PEEDUCA.

Table 2. Male unemployment rates by age and education completed, 1998-2001

Age group	Less than a high school diploma	High school diploma	Some college but no degree	College graduates
16-19	17.74	12.63	8.26	1.49
20-24	13.40	8.84	5.69	5.30
25-29	7.79	5.31	3.64	2.18
30-34	6.71	4.27	2.79	1.54
35-39	6.39	3.79	2.48	1.47
40-44	6.21	3.41	2.71	1.64
45-49	5.50	3.29	2.66	1.62
50-54	5.52	3.03	2.65	1.95
55-59	4.48	2.79	2.87	1.87
60-64	4.05	3.01	3.08	2.35
65-69	4.09	3.28	2.81	2.99
70-74	4.15	2.90	3.38	1.99
75-79	3.91	3.46	3.84	2.78
80-84	2.57	1.71	2.97	1.45
85+	1.54	1.42	1.46	0.41
All	9.49	4.72	3.40	1.91

Detailed Labor Force Tables

In the previous section, we computed tables regarding the aggregate civilian labor force. Using additional CPS variables, we can refine labor force status. In this section of the paper, we compute labor force participation and unemployment tables by full and part-time workers and reason for unemployment.

The CPS Basic Monthly Survey variable PRWKSTAT provides full and part-time work status.

```
proc format ;
value PRWKSTAT
-1='In Universe, Met No Conditions To Assign
1='Not in Labor Force'
2='FT Hours (35+), Usually FT'
3='PT for Economic Reasons, Usually FT'
4='PT for Non-Economic Reasons, Usually FT'
5='Not At Work, Usually FT'
6='PT Hours, Usually PT for Economic Reasons'
7='PT hrs, Usually PT for Non-Economic Reasons'
8='FT Hours, Usually PT for Economic Reasons'
9='FT hrs, Usually PT for Non-Economic'
10='Not at work, Usually Part-Time'
11='Unemployed FT'
12='Unemployed PT' ;
run ;
```

Using the variable PRWKSTAT, we can construct an output table that will present the proportions of the population working full or part-time for the demographic groups that we select. In order to differentiate a person's normal schedule from their activity during the reference week of the monthly CPS survey, the BLS classifies persons according to their usual full- or part-time status. Full-time workers are those who usually worked 35 hours or more (at all jobs combined). This group will include some individuals who worked less than 35 hours in the reference week for either economic or non-economic reasons and those who are temporarily absent from work. Similarly, part-time workers are those who usually work less than 35 hours per week (at all jobs), regardless of the number of hours worked in the reference week. This may include some individuals who actually worked more than 34 hours in the reference week, as well as those who are temporarily absent from work. The full-time labor force includes all employed persons who usually work full time and unemployed persons who are either looking for full-time work or are on layoff from full-time jobs. The part-time labor force consists of employed persons who usually work part time and unemployed persons who are seeking or are on layoff from part-time jobs. Unemployment rates for full- and part-time workers are calculated using the concepts of the full- and part-time labor force.

Using the variable PRWKSTAT, we can construct an output table that will present the percentage of the labor force by full and part-time work status for the demographic groups we select. The values 2-5 and 11 of PRWKSTAT are persons in the civilian labor force usually working full-time and the values 6-10 and 12 are persons in the civilian labor force usually working part-time. To make this new table, we will supply a "where" statement to skip the PRWKSTAT values of -1 and 1 and rearrange the format of PRWKSTAT as follows:

```
proc format ;
value PRWKSTAT (multilabel)
2-5,11='FT Labor Force'
6-10,12='PT Labor Force'
2-12='Civilian Labor Force' ;
run ;
```

The SAS tabulate procedure to generate the work status table for females in the civilian non-institutional labor force is:

```
proc tabulate data=cps.years_1998_to_2001 ;
where prwkstat <> -1
   & prwkstat <> 1
   & pesex = 2 ;
class pesex prtage ;
class prwkstat /MLF ;
Var counter ;
Table prtage all ,
     prwkstat*counter*rowpctsum=' '*f=8.2 ;
weight PWCMPWGT ;
format prtage prtage. pesex pesex. prwkstat prwkstat. ;
label prtage='Age group' pesex='Gender'
     prwkstat='Labor force status'
     counter='% of the labor force' ;
run ;
```

In Table 3, we show the results of running the above tabulate procedure for the work status of females in the civilian labor force. On average during 1998 and 2001, of the females in the labor force, 74.85 percent usually work full-time and 25.15 percent usually work part-time.

Further rearranging the format for the PRWKSTAT variable and including additional dataset limiting (using the where statement), we can compute the full and part-time unemployment rates by chosen demographic group. The format procedure for creating the full-time unemployment rate is:

```
Proc format ;
Value PRWKSTAT (multilabel)
11='FT Unemployed'
2-5,11='FT Labor Force'
run ;
```

Table 3. SAS output for all females

Age group	Labor Force Status 1998-2001	
	In Full-time Civilian Labor Force	In Part-time Civilian Labor Force
	% of Labor Force	% of Labor Force
16-19	30.83	69.17
20-24	68.91	31.09
25-29	82.54	17.46
30-34	79.86	20.14
35-39	78.75	21.25
40-44	80.20	19.80
45-49	82.36	17.64
50-54	81.82	18.18
55-59	78.70	21.30
60-64	67.27	32.73
65-69	44.01	55.99
70-74	34.61	65.39
75-79	33.79	66.21
80-84	29.77	70.23
85+	46.07	53.93
All	74.85	25.15

Table 4. SAS output for all females

Age group	Labor force status 1998-2001	
	Full-time Civilian Labor Force Unemployment	Part-time Civilian Labor Force Unemployment
	Percent	Percent
16-19	19.95	9.71
20-24	8.63	4.58
25-29	4.98	4.12
30-34	4.59	3.29
35-39	3.99	2.90
40-44	3.44	2.62
45-49	2.88	2.46
50-54	2.53	2.31
55-59	2.57	2.60
60-64	2.40	2.84
65-69	3.15	3.29
70-74	3.31	2.58
75-79	2.86	3.17
80-84	1.62	2.18
85+	1.31	3.35
All	4.49	4.27

The SAS tabulate procedure programming for the full-time unemployment rate is as follows:

```
proc tabulate data=cps.years_1998_to_2001 ;
where (2 <= prwkstat <= 5 or prwkstat = 11)
   & pesex = 2 ;
class pesex prtage ;
class prwkstat /MLF ;
var counter ;
table prtage all ,
     prwkstat*counter*rowpctsum=' '*f=8.2 ;
weight PWCMPWGT ;
format prtage prtage. pesex pesex. prwkstat prwkstat. ;
label prtage='Age group'
     pesex='Gender'
     prwkstat='Labor force status'
     counter='% of the labor force' ;
run ;
```

In Table 4, we show the results of the above tabulate procedure limiting observations to those in the full-time labor force (the where statement only considering PRWKSTAT = 2-5 and 11) for all females. By changing the "where" statement to limit observations to those in the part-time labor force (PRWKSTAT = 6-10 and 12), we also show in Table 4 the part-time labor force unemployment rate for all females.

The CPS Basic Monthly Survey variable PRUNTYPE provides the reason for unemployment. The recorded values of PRUNTYPE are:

```
proc format ;
value PRUNTYPE
-1='In Universe, Met No Conditions to Assign'
1='Job Loser/On Layoff'
2='Other Job Loser'
3='Temporary Job Ended'
4='Job Leaver'
5='Labor Force Re-Entrant'
6='Labor Force New-Entrant' ;
run ;
```

Using the variable PRUNTYPE in conjunction with PRCIVLF to limit the sample to those in the labor force, we can compute a table of unemployment reason. The values of 1-3 of PRUNTYPE are associated with involuntary job losers, so we combine them together. Because we will use PRCIVLF in the where statement to limit the sample to those in the labor force, the value of "-1" for PRUNTYPE will need to be included to account for the employed persons in the labor force. The revised format values for PRUNTYPE are:

```
proc format ;
value PRUNTYPE (multilabel)
-1-6='In the Civilian Labor Force'
1-3='Job Losers'
4='Job Leavers'
5='Labor Force Re-Entrants'
6='Labor Force New-Entrants' ;
run ;
```

The SAS tabulate procedure programming for the unemployment reason rates for all males is as follows:

```
proc tabulate data=cps.years_1998_to_2001 ;
where prcivlf = 1 /* In the labor force */
   & pesex = 1 ;
class pesex prtage ;
class pruntype /MLF ;
var counter ;
table prtage all ,
     pruntype*counter*rowpctsum=' '*f=8.2 ;
weight PWCMPWGT ;
format prtage prtage. pesex pesex. pruntype
pruntype. ;
label prtage='Age group'
     pesex='Gender'
     pruntype='Reason for unemployment'
     counter='% of the labor force' ;
run ;
```

In Table 5, we show the results of the above tabulate procedure limiting observations to males in the labor force (the where statement only considering prcivlf = 1) for all males.

Detailed Population Tables

In the previous section, we computed tables regarding the civilian labor force useful in making calculations for the Living-Participating-Employed (LPE) model of future expected earnings. A variant of the LPE model, directed towards measuring earning capacity, is the Living-Able to Participate-Employed (LAPE) model where "Able to Participate" is defined as one minus involuntary non-labor force participation. Using additional CPS variables in conjunction

Table 5. Male unemployment reason rates (reason for unemployment as a percent of the labor force) by age, 1998-2001

Age group	Job Losers	Job Leavers	Labor Force Re-Entrants	Labor Force New-Entrants
16-19	2.60	1.26	7.17	4.14
20-24	3.43	1.30	2.83	0.47
25-29	2.50	0.64	1.03	0.12
30-34	2.24	0.49	0.60	0.03
35-39	2.15	0.38	0.54	0.02
40-44	2.17	0.34	0.46	0.01
45-49	2.01	0.29	0.44	0.01
50-54	2.08	0.29	0.40	0.01
55-59	1.94	0.27	0.51	0.01
60-64	1.95	0.25	0.78	0.02
65-69	1.60	0.19	1.43	0.01
70-74	1.39	0.19	1.36	0.02
75-79	1.45	0.15	1.83	n/a
80-84	0.68	0.20	1.14	n/a
85+	0.76	n/a	0.38	n/a
All	2.29	0.52	1.20	0.31

with our basic tabulation model, we can present the portions of the civilian non-institutional population reporting involuntary reasons for not participating in the labor force. In this section of the paper, we compute those tables by user-chosen demographic classification.

To compute involuntary non-labor force participation, we will need to focus on three CPS variables. The first variable, PEMLR, has already been discussed in this paper. PEMLR records one involuntary reason for not participating in the labor force, disability, along with the voluntary reason of retirement. The other not in labor force response in PEMLR is "other." A CPS variable providing greater non-labor force participation is PENLFACT. The CPS question and possible answers recorded under the PENLFACT variable are: "What best describes your situation at this time? For example, are you disabled, ill, in school, taking care of house or family, or something else?" The variable formats for PENLFACT are:

```
proc format ;
value PENLFACT
1='Disabled'
2='Ill'
3='In School'
4='Taking Care of House or Family'
5='In Retirement'
6='Something Else/Other' ;
run ;
```

The BLS recognizes that there are some jobless persons not fitting the unemployment definition of actively seeking work in the last four weeks. In order account for the persons not in the labor force, but wanting a job, the BLS adds a CPS question to account for persons not in the labor force who want and are available for a job and who have looked for work sometime in the past 12 months. The CPS variable PRWNTJOB divides the not in the labor force population into those wanting a job and others not in the labor force. The SAS format procedure for PRWNTJOB is:

```
Proc format
Value PRWNTJOB
-1='In Universe, Met No Conditions to Assign'
1='Want A Job'
2='Other Not In Labor Force' ;
run ;
```

In order to compute the detailed population table by voluntary and involuntary labor force participation, we first run a data statement to combine the classifications of the variables PEMLR, PENLFACT, and PRWNTJOB. We also show the further classification of unemployment reason within the SAS data statements. The SAS programming for the population status of males ages 16 and over is as follows:

```
data cps.years_1998_to_2001_ps_males ;
set cps.q29349 ;
where prtage > 15 ; /* ages 16 and over */
where pesex = 1 ; /* males */
counter=1 ;
/* create population status variable PS */
if pemlr <= 2 then  PS = 1 ; /* Employed */
if pemlr = 3 then ps = 2 ; /* Unemployed on Layoff,
                    or Job loser */
if pemlr = 4 then do ; /* Unemployed-Looking for
                 Work */
if pruntype = 2 then ps = 2 ; /* Job loser */
if pruntype = 3 then ps = 2 ; /* Job loser */
if pruntype = 4 then ps = 3 ; /* Job leaver */
if pruntype = 5 then ps = 4 ; /* Re-entrant */
if pruntype = 6 then ps = 5 ; /* New-entrant ;
end ;
if pemlr = 5 then ps = 11 ; /* Retired-NILF */
if penlfact = 5 then ps = 11 ;
if pemlr = 6 then ps = 9 ; /* Disabled-NILF */
if penlfact = 1 then ps = 9 ;
if penlfact = 2 then ps = 9 ; /* Ill-NILF */
if penlfact = 3 then ps = 7 ; * In-School ;
if penlfact = 4 then ps = 8 ; /* Taking Care of
                    House or Family */
if penlfact = 6 then ps = 10 ; /* Something
                    else/other */
if penlfact = -1 and pemlr = 7 then ps = 10 ;
if prwntjob = 1 then ps = 6 ; /* NILF, but wants a
                    job */
run ;
```

The format values for the newly created PS are:

```
proc format ;
value ps
1-5='In the Labor Force'
6='NILF, but want a job'
7='In school'
8='Taking care of house or family'
9='Disabled can not work'
10='Something else or other'
11='Retired' ;
run ;
```

The SAS tabulate procedure programming for the voluntary and involuntary population status rates for all males is as follows:

```
proc tabulate data=cps.years_1998_to_2001_ps_males ;
class pesex prtage ps ;
Var counter ;
Table prtage all ,
    ps*counter*rowpctsum=' '*f=8.2 ;
weight PWCMPWGT ;
format prtage prtage. pesex pesex. ps ps. ;
label prtage='Age group'
    pesex='Gender'
    ps='Population status'
    counter='% of the population' ;
run ;
```

In Table 6, we show the results of the above tabulate procedure using the dataset created to limit the analysis to males.

Summary

In this paper we show the reader how to access the CPS microdata that are located on the Internet and how to move the data from the Internet to your own computer. We also discussed the electronic data formats available for working with the microdata and alternative sources of CPS data. We provided the reader with the basic demographic and labor force CPS variables necessary to construct a variety of labor force participation tables. Finally, we presented a quick tabulation method of the microdata forming the basis for a variety of revealing labor force participation and population status tables. We hope that the information in the paper is useful to readers as they embark on their first attempt to construct their own labor force and population tables useful in a variety of litigation economics cases.

Table 6. Main activity as a percentage of the population, males by age, 1998 to 2001

Age group	In the Labor Force	NILF, but want a job	In school	Taking care of house or family	Disabled can not work	Something else or other	Retired
16-19	52.38	6.89	36.27	0.64	1.26	2.52	0.03
20-24	81.97	3.38	10.38	0.67	1.81	1.69	0.10
25-29	92.40	1.71	2.27	0.57	2.09	0.82	0.15
30-34	93.80	1.18	0.92	0.52	2.80	0.57	0.20
35-39	93.08	1.17	0.49	0.60	3.86	0.59	0.22
40-44	92.17	1.07	0.40	0.61	4.85	0.55	0.35
45-49	90.34	1.03	0.25	0.63	6.50	0.58	0.66
50-54	86.90	1.08	0.16	0.48	7.52	0.47	3.39
55-59	77.77	1.42	0.08	0.44	9.45	0.41	10.44
60-64	55.39	1.80	0.04	0.23	9.32	0.39	32.83
65-69	29.20	2.03	0.01	0.12	4.98	0.21	63.45
70-74	17.51	1.56	0.01	0.10	3.48	0.19	77.15
75-79	10.44	1.16	0.02	0.10	3.46	0.12	84.70
80-84	6.11	0.69	0.01	0.08	3.82	0.13	89.15
85+	3.76	0.44	0.07	0.06	4.59	0.19	90.89
All	74.65	1.93	4.31	0.50	4.50	0.77	13.34