

Employer-provided benefits: employer cost versus employee value

Cash-equivalent value is one approach to measuring employees' value of noncash benefits; more data and research are needed, however, to resolve complex methodological issues regarding this approach

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Employers compensate their employees not only with cash, but also with noncash payments. The latter, sometimes called “in-kind” or “fringe” benefits, include some that are legally required, such as Social Security, workers’ compensation, and unemployment insurance, and some that are not, such as paid leave, health and life insurance, and pensions. This article discusses the effort of economists to measure the value individuals place on noncash payments.¹

Economists have developed the concept of “cash-equivalent value” to measure the value of noncash benefits to an individual.² A person’s cash-equivalent value is the least amount of money he or she would be willing to accept in exchange for not receiving particular noncash goods. When applied to an employer-provided benefit, the cash-equivalent value is the minimum amount of additional cash compensation the worker will accept in lieu of receiving the benefit. Although some estimates of cash-equivalent value for Government-provided in-kind benefits such as food stamps, public and subsidized housing, medicaid, and medicare exist, little has been done to quantify employer-provided benefits, primarily because of a lack of data. Moreover, even if data were available, a variety of problems have made it difficult to implement the cash-equivalent value approach.³

Information on the employer’s cost of providing the benefit is readily available through the Bureau of Labor Statistics’ Employment Cost Index (ECI) program. To what extent does employer cost approximate employee value? We believe that there are various biases associated with using employer cost as the measure of the employee’s value of employer-provided benefits. These biases can result in misleading conclusions.

This article (1) outlines the cash-equivalent value approach to measuring value and points out the relationship of employer cost to cash-equivalent value, (2) describes the three most commonly utilized techniques to estimate cash-equivalent value and examines the data requirements and limitations of each technique, and (3) discusses both the types of studies where the biases do not appear to distort conclusions and studies where we feel the use of employer cost as a measure of employee value would result in highly misleading conclusions. While some of this material is quite technical, we have endeavored to keep the discussion as general as possible.⁴

Employee value

Perhaps the simplest approach to estimating value is that which holds value to be the employer’s cost of a given benefit. A more sophis-

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ticated view is the *funds-released* approach, which maintains that value can be measured as the amount of money an individual would have spent to acquire a certain good in the absence of being provided the benefit associated with that good. In contrast to this is the *market-value* approach, in which value is the amount the individual would have paid for the benefit if he or she had purchased the *specific* amount the employer provided (as opposed to the amount the individual would have chosen at the existing market price). Finally, there is the *cash-equivalent* approach, wherein value is the least amount of money an individual would be willing to accept in exchange for not receiving a certain benefit. This last approach is the way most economists define value.⁵

Description of the theory. If an individual is given some noncash benefit by his or her employer, such as free or subsidized meals, pensions, or health insurance, and nothing else changes, plainly the individual will be better off than before the receipt of the noncash good. But *how much* better off? The cash-equivalent value approach to determining the change in individual well-being is fairly straightforward: we ask, "What is the minimum amount of additional cash compensation an individual would require to become just as well off as that individual would be if he or she received the noncash good?"⁶ The cash-equivalent value is then the amount of cash compensation which makes the individual indifferent between getting the benefit and no cash and getting the cash and no benefit.

Sources of difference between employer cost and employee value. In many ways, it would seem that the relationship between employer cost and employee value is fairly straightforward. Any employer-provided benefits other than legally required ones result from employer-employee contracting, directly for unionized, and less directly for nonunionized, workers. Except for legally mandated benefits, employers can compensate employees with either wages or noncash benefits, and because both cost the employer the same amount, in general the employer has no incentive to prefer one form of compensation over the other.⁷ Thus, in a perfectly competitive situation, in the absence of government intervention, taxes, and other institutional restrictions, the marginal worker (the last worker convinced by the total compensation package to accept the job) would be expected to value the last dollar of each benefit type equal to another dollar of money wages, or he or she could be made better off at no cost to the employer.

Consequently, in such a situation, the cost of the benefit provided is a measure of its value.

Despite this apparent consonance, there are a number of reasons why employer cost can diverge from employee value. Employer cost for a noncash benefit that is not legally required can diverge from employee value because (1) the benefit is not subject to personal income taxes, (2) the benefit is provided uniformly to large groups of employees in a firm, and (3) the employer's cost of providing the benefit may be lower than the market price of the benefit to the employee. Let us consider each of these in turn. (Several graphical representations of the disparity that may arise between employer cost and employee value are presented in the appendix.)

1. When the benefit is not subject to income taxes, the equality of employer cost and employee value breaks down even for the marginal worker. Specifically, in a world with taxes, the marginal worker would be expected to consume noncash benefits up to the point where the marginal value of another dollar of benefits equals the after-tax value of another dollar of money wages. That is, the marginal worker, whose marginal tax rate is, say, t , would need to receive $1/(1-t)$ dollars of pre-tax income in order to get a dollar of after-tax income. (The amount $t/(1-t)$ is paid in taxes, leaving $[1/(1-t)] - [t/(1-t)] =$ one dollar.) More of the benefit will be consumed than if this differential tax treatment did not exist, and as a result, employer cost will overstate the cash-equivalent value of the benefit. (One common explanation for the growth of employee benefits has been the increasing tax rates faced by typical workers.) An implication of the differential tax treatment is that higher income workers will place a higher value on noncash benefits than will lower income workers, because the tax rate of the former exceeds that of the latter.

2. Historically, firms have typically provided benefits to their work forces as a whole, instead of tailoring them to the preferences of individual employees.⁸ In addition, laws mandating that personal income tax advantages be available only for benefits which do not favor higher paid workers provide incentives for a more uniform provision of benefits to all employees in a firm. If there are costs associated with changing jobs and if employees are not perfect substitutes for one another in production, then uniform provision of benefits drives a wedge between employer cost and employee value for at least some individuals.⁹ Under these conditions, the employer would be expected to provide benefits in accordance with the preferences of the "median" worker.¹⁰

Various biases associated with using employer cost as the measure of employee value can result in misleading conclusions.

When a benefit is not subject to income taxes, the equality of employer cost and employee value breaks down.

Even in the absence of differential tax rates, higher income workers would be expected to demand more of any "normal" good (a good which people want more of as their income increases) than would lower income workers. In support of this proposition, Steven A. Woodbury estimated an income elasticity for noncash benefits which is greater than one; that is, a 1-percent increase in income leads to a greater-than-1-percent increase in the demand for non-cash benefits.¹¹ Consider the class of benefits whose provision does not typically vary with employee income (for example, health insurance, child care, Christmas bonuses, and parking). Because employer cost will be the same regardless of employee income, the benefit ratio, that is, the ratio of employee value to employer cost, would be expected to be higher for higher income workers than for lower income workers in a firm. By contrast, for benefits which are provided in amounts proportional to income, such as life insurance and pensions, less of a difference in benefit ratios among workers would be expected.

In general, benefit ratios are also expected to vary by some demographic factors, particularly family status. For instance, two-earner families that receive largely duplicative health insurance policies would place a relatively low value on one of them, single individuals may place a low value on life insurance policies, and so on. Thus, assuming that employee benefits are valued equally by all households—even at a given income level—may severely distort comparisons of well-being among households.¹²

As of 1978, cafeteria plans—that is, plans whereby workers choose among a "menu" of benefit options—could qualify for tax-exempt status. Depending upon the particular choices the employees have, these plans allow the provision of benefits to vary among the workers of a firm. That individuals do choose differently when given a choice is additional evidence that uniformity is a factor in driving a wedge between employer cost and employee value. We may assume that, as more options are given, the amount of the benefit the employer provides approaches the amount the employee would choose. Anecdotal evidence that employees do choose differently when given a choice is presented in the article "Flexible benefit plans: employees who have a choice," by Joseph Meisenheimer II and William Wiatrowski, elsewhere in this issue.

3. Ignoring taxes and issues relating to the uniform provision of benefits, an employee's marginal value of a noncash benefit will be set equal to the employer's marginal cost of providing the benefit, everything else being equal. If

the employer's marginal cost is lower than the employee's market price, then the benefit will be "overprovided" relative to the amount the employee would choose at the market price. Thus, employer cost will provide a lower bound on employee value, and the amount provided by the employer times the price the employee would pay in the market will provide an upper bound.

The cost to the employer may be less than the purchase price to the employee for three reasons.¹³ First, employers are often able to take advantage of discounts sellers offer for bulk purchases. Second, sellers are willing to provide benefits to groups of people at a cheaper rate than to individuals when there are adverse selection problems. Adverse selection occurs when, for example, the workers in the poorest health are the ones who want to purchase the most health insurance. By selling benefits to a group of workers, sellers can mitigate adverse selection. Finally, employers may prefer providing more of a given type of benefit than is demanded in order to reduce turnover, maintain a healthier and more productive work force, or attain another, similar objective. Here, a more inclusive measure of employer cost—one which "nets out" the gain accruing to the firm in providing the benefit—would result in an employer cost that is less than the market price.

The case of legally required employer-provided benefits is different from that of nonrequired benefits. The difference between the two is that employers and employees can negotiate about which nonrequired benefits will be provided in what amounts, whereas quantities of legally required benefits may be arbitrarily set with regard to employee values. Even given that employees as a group vote for legislators who will enact desired changes in the provision of mandated benefits, some voters who pay taxes are neither workers nor participants in the labor market, so median voter results may not apply.¹⁴ In addition, the aforementioned problem concerning the uniform provision of benefits is exacerbated in the case of legally required benefits. Legally required benefits are provided uniformly to the work force as a whole and not just to groups of workers within a firm. Further, because unemployment insurance and workers' compensation are not fully experience rated, workers in some industries or firms will place a relatively higher value on them than will other workers.¹⁵ As a result, while there may be some cases in which it is reasonable to use employer cost as a measure of the typical employee's value for benefits that are not legally required, it seems quite unrealistic to assume that employer cost of legally mandated benefits is a reasonable approximation of employee value.

Estimating cash-equivalent value

Given the many discrepancies between the employer's cost and the employee's value of a certain benefit, just how difficult is it to get a measure of the cash-equivalent value of the benefit?¹⁶ The discussion that follows shows that estimation of cash-equivalent values is in general quite difficult, both because the data requirements are so extensive and because of the complex issues involved in the actual estimation, even if the data were available. Certainly, if more high-quality data existed, more research would be done on the methodological issues. Three approaches are currently the most frequently utilized:¹⁷

1. *Utility-Based Estimates.* Researchers have estimated recipient values by assuming some functional form for utility.¹⁸ This sets a particular functional form for the demands for goods. Theoretically, because we can observe quantity demanded and price, and economic theory suggests which variables affect the demand for goods (although demand is also affected by factors influencing utility functions across individuals—something about which economic theory has nothing to say), demands for goods can be estimated. After estimating a particular demand system, researchers use the parameter estimates to compare the costs of achieving levels of utility with and without a given noncash benefit. This permits the calculation of the cash-equivalent value of the benefit. Ideally, the data needed to support such a technique include information on prices, wages, amounts of leisure and goods consumed, and characteristics of the benefit package. Although to our knowledge, there are no data sets with all the desired data, there are some studies that employ the utility-based technique to examine recipient values of Government transfer programs.¹⁹

There are a number of methodological problems with utility-based estimates of cash-equivalent value. Probably the foremost is that it is computationally difficult to estimate a demand system (much less, get all the data) for all the goods people demand. Somewhat questionable assumptions must be made in order for the estimates to be valid, for example, that (1) today's consumption is unrelated to both past and future consumption, (2) a reasonable functional form for utility has been chosen, and (3) utility functions among individuals are the same, at least within demographic subgroups.

2. *Survey Approach.* This technique involves asking employees directly about their

willingness to pay for various noncash benefits. Questions like "What is the maximum amount you would be willing to pay to receive this benefit?" are posed to individuals who do not have the benefit in question. Support for this approach in regard to valuing public goods such as environmental quality exists in the literature,²⁰ because study results are both replicable and logically consistent with the predictions of demand theory. In addition, evidence that the survey approach yields the predicted magnitudes relative to hedonic wage equation results (see next) is also in the literature.²¹

The two chief problems with the survey approach are that (1) estimates of value are based upon hypothetical as opposed to actual choices and (2) empirically, there appears to be a significant downward bias in people's stated values—estimates of 50–67 percent exist in the literature.²²

3. *The Hedonic Approach.* The theory behind the hedonic approach, which was popularized by Sherwin Rosen in 1974, is that variation in the observed mix of benefits and cash compensation offered by employers competing for workers having the same productivity is the result of the different tastes for benefits of those workers and the differential ability of employers to provide those benefits. In theory, ignoring institutional features discussed earlier, the amount of wages given up to obtain a specified amount of a noncash benefit is a measure of both the marginal value of the benefit to a worker who accepted the wage-benefit compensation package and the marginal cost to the firm in providing the benefit.²³ The simplest application of the hedonic approach would estimate a regression equation relating the wage to the amount of a particular benefit offered, all else being equal.²⁴ However, movements along the function given thereby reflect both differences in worker tastes for benefits and the firm's ability to provide the benefits. As a result, such movements do not, in general, provide a measure of the change in employee value for significant changes in the amount of the benefit provided.²⁵

The hedonic wage equation tells one very little about either the demand for or supply of benefits; rather, it provides an estimate of a single point on compensated demand and supply functions. However, identifying the underlying compensated demands could provide an estimate of the cash-equivalent value of the benefits. Rosen has suggested a second stage to the hedonic method which would enable a researcher to identify the said cash-equivalent values.²⁶

Under certain conditions, uniform provision of benefits drives a wedge between employer cost and employee value.

There are difficulties, however, even in the first-stage estimation—that is, estimating the wage differential associated with the differential provision of benefits.²⁷ First, because the level of benefits provided is often based upon the amount of wages paid to the individual, statistical complexities arise.²⁸ Second, researchers must assume that individuals were able to obtain the desired amount of the particular benefit being studied, rather than having had to choose among a limited number of packages of wages and benefits.²⁹ Finally, because no particular shape of the hedonic wage function is specified by theory, researchers need to allow for variety in their empirical estimates.

In the second-stage estimation, identification of the underlying compensated supply and demand parameters has proven to be far more complex than originally anticipated by Rosen.³⁰ Data requirements are significant for the proper implementation of the proposed technique, and to our knowledge, no empirical estimates of cash-equivalent values for employee benefits exist in the economics literature. By contrast, estimates of compensated demands for clean air, housing amenities, neighborhood characteristics, and noise from hedonic price equations do exist in the literature.³¹

Conclusions

In examining the issues that arise in obtaining employee values of employer-provided benefits, we conclude that employer cost is limited as a measure of employee value. For some purposes, however, using employer cost to proxy the median worker's value of non-legally required benefits seems to be a reasonable approximation to employee value. For example, use of this approximation along with an estimate of after-tax wages to compare the "typical" employee after-tax value of compensation in two industries would appear reasonable. If there are differences in median after-tax wages and non-cash benefits between industries, interesting research could be done to determine what the source of the differences is—for example, different median characteristics of the work forces in those industries, differences in median job amenities, or some other disparity. Employer

cost as a proxy for how the median employee's value of benefits has changed over time also seems reasonable.³²

In contrast, the use of employer cost as an approximation in distributional analyses could be highly misleading. Such studies typically focus on the well-being (proxied by some measure of income) of people at varying income levels or family structures. But as we have argued, income and family structure are themselves associated with variations in employee values, and these variations may be considerable. Further, and perhaps more important, the available employer cost measures refer to the "typical" worker in broadly defined industries (nine) and occupations (three). But employers often actually pay more for benefits provided to some types of workers than for others. For example, they may make higher pension contributions for more highly compensated workers or pay a higher cost for family health insurance policies than for single coverage. Thus, imputing these average employer costs to individual observations in a household file to do distributional studies would clearly yield misleading results. There is no theoretical basis for concluding that such comparisons using after-tax cash wages plus the average employer cost for benefits would provide a better proxy for the value of compensation than would use of after-tax cash wages only.³³ Empirical evidence of the extent of the bias involved would, of course, be useful.

More research on employee values is needed. In particular, empirical estimates of the difference between employee value and employer cost for workers of different demographic characteristics would provide evidence for whether the possible discrepancies are significant enough to preclude the use of employer cost as a measure of employee value in distributional studies. Empirical estimates of whether, and how much, employer per-unit cost differs from market price for the median worker in different industries, occupations, areas, and so forth, would provide evidence as to whether cross-sectional analyses using employer cost as the measure of employee value are reasonable. For these purposes, additional data and methodological research are essential. □

Footnotes

¹ The focus is on the employee value of employer-provided noncash benefits, as opposed to job characteristics, such as safety, security, and cleanliness. For the purposes of this article, the chief distinction between the two is that there exists an explicit market for noncash benefits. As a result, while many measurement issues are conceptually the same for both job dimensions, in analyses involving

benefits, one must always take into account the fact that the employee could have purchased the benefit on his or her own.

² A detailed discussion of the notion of cash-equivalent value and its relation to measurement issues in the case of Government-provided transfers is given in Timothy M. Smeeding, "Alternative Methods for Valuing Selected In-

Kind Benefits and Measuring Their Effect on Poverty," Technical Paper No. 50 (Bureau of the Census, March 1982); see also Bureau of the Census, *Proceedings, Conference on the Measurement of Noncash Benefits*, vol. 1, December 12-14, 1985. Considerations that arise in the context of employer-provided benefits are treated in Jack E. Triplett, "An Essay on Labor Cost," in J.E. Triplett, ed., *The Measurement of Labor Cost*, NBER Studies in Income and Wealth, vol. 48 (Chicago, University of Chicago Press, 1983), pp. 1-60.

³ See, for instance, Smeeding, "Alternative Methods"; Triplett, "Essay on Labor Costs"; Bureau of the Census, *Proceedings*; and Marilyn E. Manser, "Cash-Equivalent Values from In-Kind Benefits: Estimates from a Complete Demand System Using Household Data," Working Paper No. 173 (Bureau of Labor Statistics, December 1987); as well as studies cited in these references.

⁴ Most of the concepts we discuss can be found in any second-course college economics text, for example, Jack Hirshleifer, *Price Theory and Applications*, 2nd ed. (Englewood Cliffs, NJ, Prentice-Hall, 1980).

⁵ For an examination of the similarities and differences between these alternative approaches, as well as a discussion of the relative merits of each, see G. Cooper and A. Katz, *The Cash Equivalent of In-Kind Income* (Stamford, CT, Cooper and Co., 1977); Smeeding, "Alternative Methods"; and Bureau of the Census, *Proceedings*.

⁶ This phrasing is after a measure called the *Hick's equivalent variation*. An alternative measure is the *Hick's compensating variation*, which asks, for an individual who already has the employer-provided benefit, "What minimum amount of cash compensation would have to be taken away from the individual to return the individual to the level of satisfaction he or she could achieve without the benefit?" While the two questions will in general have different answers, one is not more correct to ask than the other. However, the former seems a more natural way to approach the issue of employee value, so we shall appeal to it for the rest of our analysis. Chapter 4 of Richard W. Tresch's *Public Finance: A Normative Theory* (Plano, TX, Business Publications, Inc., 1981) offers a further discussion of the two approaches; see also Cooper and Katz, *The Cash Equivalent*, pp. 73-81.

⁷ This statement is not universally true, because when benefits are excluded from Social Security tax, the employer and employee split the tax savings. (See Richard A. White, "Employee Preferences for Nontaxable Compensations Offered in a Cafeteria Compensation Plan: An Empirical Study," *The Accounting Review*, July 1983, pp. 539-61, esp. p. 541.) Also, employers sometimes provide benefits to increase worker productivity, as when health insurance is provided to improve health care, which then results in more productive workers. Yet again, employers may prefer the provision of benefits over wages in the case of employees working overtime if the employees are compensated at more than the hourly wage for overtime hours. In any of these cases, the employer would not be indifferent to the provision of cash as against benefits.

For simplicity, we shall ignore these exceptions in our analysis.

⁸ Avoidance of adverse selection (see shortly) is one explanation for the uniform provision of benefits. The high cost of tailoring benefits to the preferences of each employee may be another.

⁹ If there were no costs to switching jobs, and if any worker were equally as good as another in any particular job, one would expect to see a segmented labor market—that is, those with similar tastes, family structures, nonlabor income, and so on would "sort" into the same firms. Then

there would be no disparity between employer cost and employee value as a result of the uniform provision of benefits. Some evidence that, as benefits have increased as a proportion of total compensation, the labor market has become more segmented is provided in Frank A. Scott, Mark C. Berger, and Dan A. Black, "Effects of the Tax Treatment of Fringe Benefits on Labor Market Segmentation," *Industrial and Labor Relations Review*, January 1989, pp. 216-29.

¹⁰ For any employee who could resell the benefit at the market price, no divergence would arise.

¹¹ See Steven A. Woodbury, "Substitution between Wage and Nonwage Benefits," *American Economic Review*, March 1983, pp. 166-82.

¹² This bias would arise even if employer cost were measured for each employee separately. Another bias would be introduced if the ECI measure were used for distributional studies, because the ECI measures employer costs for the work force as a whole, whereas employer costs for some employee benefits vary among workers in a firm (for example, life insurance costs may be higher for higher income than for lower income workers, and employers often pay more for health insurance coverage for married workers than for single workers). Using the ECI as the measure of employee value entails assuming that average costs provide a measure of employee values for all workers in an industry and/or occupation, which is not appropriate.

¹³ It is possible for the employer's cost to be higher than the employee's market price if administrative costs are high enough. This would appear more likely in the case of certain Government transfers in which monitoring costs are high, such as housing subsidy programs or the food stamp program. Because these are not examined here, only the situation in which provider cost is less than market price is analyzed in the text.

¹⁴ For a discussion of the notion of a median voter, see Anthony Downs, *An Economic Theory of Democracy* (New York, Harper and Brothers, 1956).

¹⁵ See the discussion in Smeeding, "Alternative Methods."

¹⁶ When the benefit is provided to the individual in amounts less than or equal to the amounts the employee would purchase at existing market prices, estimation of employee values is, in principle, straightforward. The employee value would be the market price times the amount the employer provided. Estimation of employee value would thus involve ascertaining (1) the appropriate market price and (2) how much the individual would purchase at that price. The latter is straightforward if the person can be observed to purchase more of the good than the employer provides. For instance, an individual who receives employer-provided life insurance and purchases additional life insurance can be assumed to desire at least as much of the benefit as is provided by the employer. If the employer provides more than the employee would choose at existing market prices, then the cash-equivalent value of the benefit must be determined.

¹⁷ For a description of a variety of other alternatives, see Cooper and Katz, *The Cash Equivalent*; and Smeeding, "Alternative Methods."

¹⁸ A utility function mathematically describes an individual's preferences for various bundles of goods.

¹⁹ Among recent studies are Manser, "Cash-Equivalent Values," on medicaid and food stamps; Christine K. Ranney and John E. Kushman, "Cash Equivalence, Welfare Stigma, and Food Stamps," *Southern Economic Journal*, vol. 54, no. 4, 1987, pp. 1011-27; and Alan S. Caniglia, "The Economic Evaluation of Food Stamps: An Intertemporal Analysis with Nonlinear Budget Constraints," *Public Fi-*

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nance Quarterly, January 1988, pp. 3-29. Earlier studies include those cited in Cooper and Katz, *The Cash Equivalent*; and in Smeeding, "Alternative Methods."

²⁰ See studies cited in Davis S. Brookshire, Mark A. Thayer, William D. Schulze, and Ralph C. d'Arge, "Valuing Public Goods: A Comparison of Survey and Hedonic Approaches," *American Economic Review*, March 1982, pp. 165-77.

²¹ See Brookshire and others, "Valuing Public Goods."

²² The estimates of downward bias were based upon a study (see Brookshire and others, pp. 174-75) which asked for willingness to pay for goose hunting permits. Willingness to pay was then compared to actual repurchases.

²³ See Sherwin Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy*, vol. 82, 1974, pp. 34-55. The theory is that if everything else about the workers and the job is equal, the workers will be compensated the same. If there are two identical workers working identical jobs, and one is given more health insurance than the other, the worker with more health insurance will have lower wages. Measuring this difference in wages is the goal of the hedonic wage equation.

²⁴ Estimates of the wage differential associated with the differential provision of employer-provided benefits have primarily been for pensions (see Robert S. Smith and Ronald G. Ehrenberg, "Estimating Wage-Fringe Trade-offs: Some Data Problems," in Triplett, *The Measurement of Labor Cost*), but some also have been made for paid sick leave (Arleen Leibowitz, "Fringe Benefits in Employee Compensation," in Triplett, *The Measurement of Labor Cost*; and Smith and Ehrenberg, "Estimating Wage-Fringe Trade-offs") and for health insurance (Leibowitz, "Fringe Benefits"). The technique has been applied extensively to the evaluation of workplace amenities such as job safety, repetitive work, and employment stability. (See Robert S. Smith, "Compensating Wage Differentials and Public Policy: A Review," *Industrial and Labor Relations Review*, April 1979, pp. 339-52.)

²⁵ See Myrick A. Freeman, III, "Hedonic Prices, Property Values and Measuring Environmental Benefits: A Survey of the Issues," *Scandinavian Journal of Economics*, 1979, pp. 154-73, esp. p. 158; and Smith, "Compensating Wage Differentials," p. 349.

²⁶ Rosen, "Hedonic Prices." According to Rosen, first we estimate the hedonic wage equation. Then we take the first derivative of the wage equation with respect to the benefit of interest and evaluate it at the amounts of the benefit provided to the employees in the sample. This represents the implicit marginal price of the benefit. Finally, we use the resulting implicit price variable as the dependent variable in the estimation of compensated supply and demand equations (that is, supply and demand equations in which utility is held constant—see Tresch, *Public Finance*, pp. 63-64) for the benefit. The area under the compensated demand curve,

between different amounts of benefits, is an estimate of cash-equivalent value.

²⁷ See, for example, Smith and Ehrenberg, "Estimating Wage-Fringe Trade-offs."

²⁸ The difficulty is one of "simultaneous equation bias," which arises because a variable (here, benefit provision) not only affects, but is affected by, the dependent variable (here, wages). The instrumental variables method is one standard econometric technique used to solve this estimation problem. (See J. Johnston, *Econometric Methods*, 3rd ed. (New York, McGraw-Hill, 1984).)

²⁹ If benefits are provided "lumpily" (and if there are mobility costs, and if labor is not perfectly substitutable), then the researcher cannot assume that empirical estimates are tracing out true wage-benefit tradeoffs. See Freeman, "Hedonic Prices," pp. 161-63, for a discussion of this point with respect to the tradeoff between housing prices and air quality.

³⁰ For discussions of the problems involved in identifying structural equations using the hedonic method, see especially Dennis Epple, "Hedonic Prices and Implicit Markets: Estimating Demand and Supply Functions for Differentiated Products," *Journal of Political Economy*, vol. 95, no. 1, 1987, pp. 59-80; and Timothy J. Bartik, "The Estimation of Demand Parameters in Hedonic Price Models," *Journal of Political Economy*, vol. 95, no. 1, 1987, pp. 81-88; but also James N. Brown, "Structural Estimation in Implicit Markets," in Triplett, *The Measurement of Labor Cost*, pp. 123-51; James N. Brown and Harvey S. Rosen, "On the Estimation of Structural Hedonic Price Models," *Econometrica*, May 1982, pp. 765-68; and Freeman, "Hedonic Prices." In brief, the problem of identification centers around the fact that the hedonic wage equation need not be linear. As a result, both prices and quantities of benefits are choice variables. Extreme care in the modeling of the errors in the hedonic wage equation and the demand equation for the benefit is necessary to determine appropriate instruments for prices and quantities of the benefit.

³¹ See Epple, "Hedonic Prices," for references.

³² For this purpose, analysts would have to be willing to assert either that the overconsumption of benefits induced by the taxation of wages has not changed significantly over time, or that this distortion is small enough that ignoring it will not introduce a significant bias.

³³ Other issues may also arise in income-distributional studies. For instance, we have not discussed what should be included as benefits in a more comprehensive measure of income. David T. Ellwood and Lawrence H. Summers ("Measuring Income: What Kind Should Be In?" in Bureau of the Census, *Proceedings, Conference on the Measurement of Noncash Benefits*, pp. 8-27) argue against including employers' contributions toward pensions in analyzing income, on the grounds that to do so entails double-counting if, as is the present practice, pension benefits are treated as income when received by retirees.

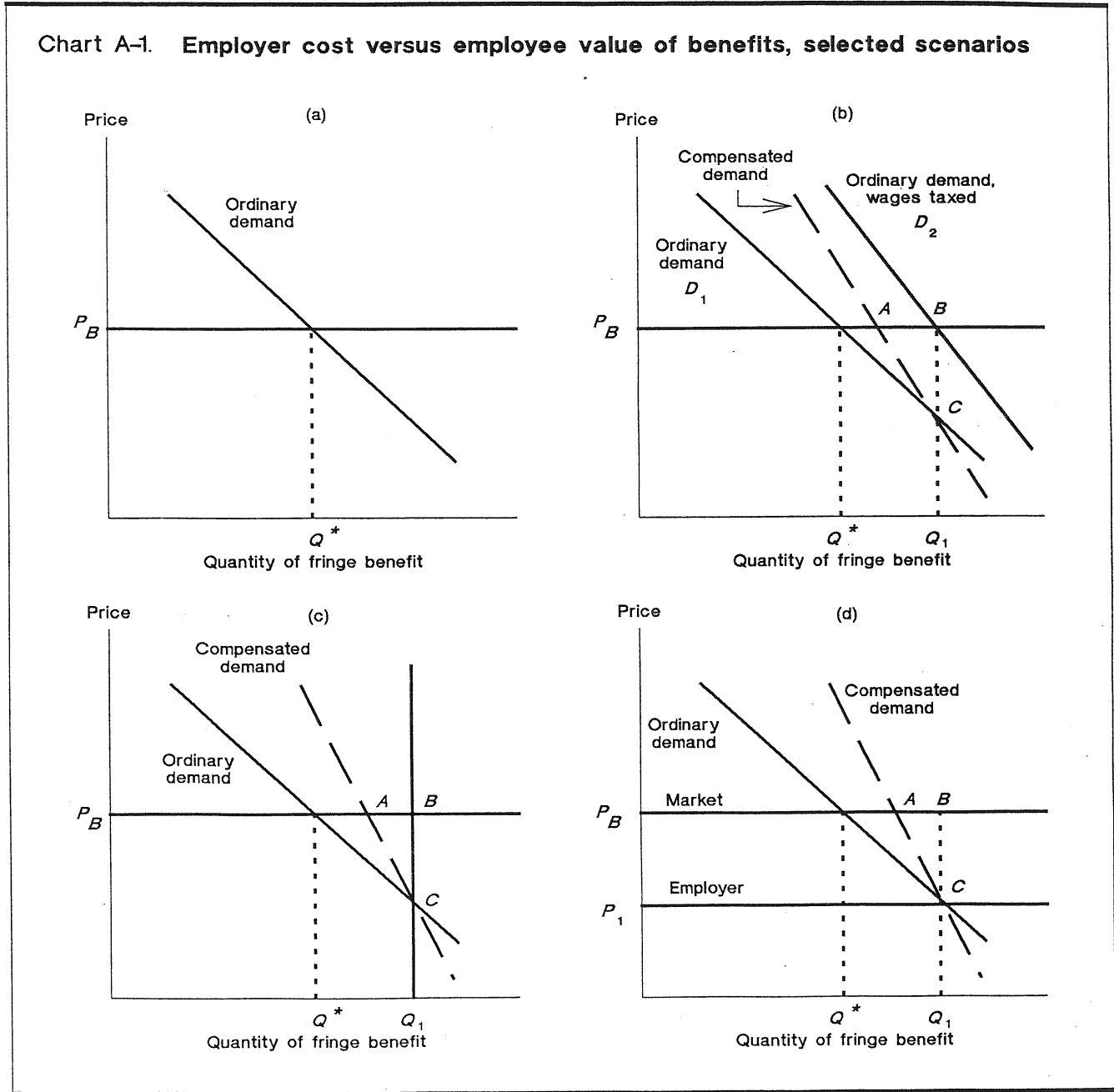
APPENDIX: Graphical analysis of the relationship between employer cost and employee value in various situations

Employer cost equals employee value

Assume that employer per-unit cost of the benefit is constant and equals the price P_B the employee would have to pay in the market to obtain the benefit.

Assume also that there are no institutional or other constraints. Then the employer and employee will contract to have benefits provided until the employee's marginal value of the benefit (as measured along the employee's ordinary demand curve for the

Chart A-1. Employer cost versus employee value of benefits, selected scenarios



benefit) is equal to the market price P_B . Thus, if Q^* is the number of units of the benefit the employer will provide, we have

$$\text{Employer cost} = P_B \cdot Q^* = \text{Employee value}$$

(See chart A-1(a).)

Note that the cash-equivalent value of the benefit provided is equal to price times quantity, and not the area under the demand curve—that is, it does not include consumer surplus. Because it is always possible to purchase Q^* at price P_B , the employee would not be willing (in this hypothetical world without

taxes) to give up more than $P_B \cdot Q^*$ in cash wages to be provided the benefit by the employer.

Employer cost does not equal employee value

If compensation in the form of taxed wages or untaxed fringe benefits is provided. Assume that employer per-unit cost of the benefit is constant and equals the price P_B the employee would have to pay in the market to obtain the benefit. Assume also that the only institutional constraint is that taxes are paid on money wages. Let t be the employee's marginal tax rate. Then the tax on wages acts like a subsidy on fringe benefits, and the vertical distance between the

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ordinary demand curve D_1 presupposing no tax on wages and the ordinary demand curve D_2 given that wages are taxed (see chart A-1(b)) is $P_B[1/(1-t)]$. In that case, the employer and employee would contract to have Q_1 units of the benefit provided. The value of the additional units to the employee ($Q_1 - Q^*$) is given by the area under the compensated demand curve (which holds utility constant—see, for example, Tresch, *Public Finance*, pp. 63-64, cited in text footnote 6) through point C on the graph. Then we have

$$\begin{aligned} \text{Employer cost} &= P_B \cdot Q_1 \\ \text{Employee value} &= P_B \cdot Q_1 \\ &\quad - \text{Area of triangle } ABC \end{aligned}$$

Note that the after-tax value of wages of amount w is then $w(1-t)$, which is less than the employer cost of those wages. Also, employer cost is an upper bound on the employee's value of benefits.

If provision of benefits is uniform to the employees within a firm. Assume that employer per-unit cost of the benefit is constant and equals the price P_B the employee would have to pay in the market to obtain the benefit. Assume also that the only institutional constraint is that benefits are provided uniformly to the employees within the firm. Then, for a given employee, the relationship between employer cost and employee value depends upon whether the benefit is over- or underprovided to the employee. If the amount of the benefit provided is less than or equal to the amount the employee would otherwise have chosen at P_B , then employer cost will equal employee value. If, on the other hand, the amount of the benefit provided is greater than the amount the employee would otherwise have chosen at P_B , then employee

value will be less than employer cost. This is because the additional units of the benefit ($Q_1 - Q^*$) are valued at an amount represented by the area under the compensated demand curve through point C , while the employer's cost of each unit is the constant market price P_B . (See chart A-1(c).) For this case, if Q_1 is the amount of benefit provided, we have

$$\begin{aligned} \text{Employer cost} &= P_B \cdot Q_1 \\ \text{Employee value} &= P_B \cdot Q_1 \\ &\quad - \text{Area of triangle } ABC \end{aligned}$$

If employer cost differs from the price the employee would pay in the market. Assume that there are no taxes or other institutional constraints. Assume, however, that the employer cost P_1 of providing the benefit is less than the price P_B the employee would have to pay in the market to obtain the benefit. Then employee value will exceed employer cost, and for an amount Q_1 of benefit provided, we have

$$\begin{aligned} \text{Employer cost} &= P_1 \cdot Q_1 \\ \text{Employee value} &= P_1 \cdot Q_1 + (P_B - P_1)Q_1 \\ &\quad - \text{Area of triangle } ABC \end{aligned}$$

(See chart A-1(d).)

Employee value is greater than employer cost by an amount $(P_B - P_1)$ because the employee would have to pay P_B , and not P_1 , in the market to acquire the benefit. Employee value is less than $P_B \cdot Q_1$ because the cheaper price to the employer causes "overprovision" of the benefit in relation to what the employee would choose to purchase at P_B . The "overprovided" units ($Q_1 - Q^*$) are valued at an amount represented by the area under the compensated demand curve through point C . \square