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Anomalies
Interindustry Wage Differentials

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Economics can be distinguished from other social sciences by the belief that most (all?) behavior can be explained by assuming that agents have stable, well-defined preferences and make rational choices consistent with those preferences in markets that (eventually) clear. An empirical result qualifies as an anomaly if it is difficult to "rationalize," or if implausible assumptions are necessary to explain it within the paradigm. This column will present a series of such anomalies. Readers are invited to suggest topics for future columns by sending a note with some references to (or better yet copies of) the relevant research. Comments on anomalies printed here are also welcome. The address is: Richard Thaler, c/o *Journal of Economic Perspectives*, Johnson Graduate School of Management, Malott Hall, Cornell University, Ithaca, NY 14853.

Introduction

A few years ago we hired a new secretary in my department. She was smart and efficient and we were pleased to have her. Much to our dismay, after just a few months she was offered and accepted a job from an IBM facility in a nearby city. She told me that she had been on a waiting list there for a year or so, and would be a fool to turn IBM down since they paid so much more than any of the other local employers. I wondered at the time whether her marginal product typing IBM interoffice memos could be that much higher than it would be typing manuscripts and referee reports, and/or why IBM should find it profitable to pay much more than the going wage.

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A glance at the employment classified ads in the newspaper, or the listings at an employment agency will confirm that the story of this secretary is not unusual. Firms advertise widely varying wages for jobs that appear to be very similar, such as secretary, data entry clerk, or "tele-marketing representative." Students who graduate from Cornell's MBA program often receive offers from several firms in the same city with substantially different salaries. In fact, one recent graduate received two offers for similar finance jobs in New York City that differed in annual salary by $45,000! These observations seem to violate the law of one price, a fundamental component of the theory of competitive markets.[1] Furthermore, the impression created by these casual bits of data is confirmed by more careful investigations. Some industries appear to pay higher wages than others, even when (measurable) labor quality is held constant. These interindustry wage differentials apply across occupations (if one occupation in an industry is high paid, then all other occupations tend to be) and over time. Why?

The Facts

There is a simple way to demonstrate the existence and measure the importance of interindustry wage differentials. Take a large data set with decent information about worker characteristics and income such as the Current Population Survey (CPS). First run a regression with the (log of the) wage rate for each individual on the left hand side and a host of individual characteristics on the right hand side such as age, education, occupation, gender, race, union status, marital status, region, and so on. Now, add industry dummy variables to this regression and see what happens.

This exercise has been conducted using the CPS by Krueger and Summers (1988) and Dickens and Katz (1987a). Both teams find large industry effects, most of which are highly significant. For example, Krueger and Summers find the following proportional industry effects for 1984: mining, +24 percent; autos, +24 percent; leather, −8 percent; petroleum, +38 percent; educational services, −19 percent (ouch!). The weighted (by number of employed) standard deviation of the differentials is 15 percent. Similar results are obtained by Dickens and Katz, with little difference between a sample of union workers and nonunion workers. Remember, these effects are observed after controlling for individual characteristics.

These interindustry differentials are neither a recent nor transitory phenomenon. Slichter's (1950) study found stable industry patterns between 1923 and 1946. Over this period he found the rank correlation of industry wages was .73. Krueger and Summers (1987, p. 22) have updated this analysis by comparing the 1923 pattern with their 1984 data. They find "that relatively high-wage industries in 1923 such as auto manufacturing continued to be high-wage industries in 1984, and low-wage industries such as boot and shoe manufacturing continued to be low-wage industries in 1984. The correlation of industry wages in 1984 and 1923 is .56. Since this correlation is

[1]The law of one price may not hold in product markets either. See Pratt, Wise, and Zeckhauser (1979).

probably an underestimate due to changes in industry definitions and sampling error, we consider this evidence that the wage structure has remained relatively stable for a very long time."

The industry wage pattern is also internationally pervasive. Krueger and Summers (1987) report a correlation matrix for manufacturing industry wages in 1982 across 14 countries. The correlations are remarkably high, especially among the developed, capitalist countries. For example, the correlations between the industry wages in the U.S. and those of Canada, France, Japan, Germany, Korea, Sweden, and the UK all exceed .80. The correlations between U.S. wages and Poland and Yugoslavia are .70 and .79 respectively.

Perhaps the most remarkable fact regarding the interindustry wage pattern is its stability across occupations. Katz and Summers (forthcoming) calculate industry wage differentials for secretaries, janitors, and managers. They find significant industry differentials of roughly the same magnitude as for all workers. For example, secretaries in the mining industry are paid 23 percent above the mean while those in the leather industry are paid 15 percent below the mean. Explaining this occupational uniformity in wages is a key task for any theory of industry wage structure.

Possible Alibis

Before the interindustry wage differentials can be considered a legitimate anomaly, two simple explanations must be ruled out. First, it is possible that the high wages are simply compensating differences for some unmeasured undesirable aspects of the working conditions in the high wage industries. Surely the high wages in the mining industry, for example, are explained in part by the unpleasant and unsafe working environment in the mines. Second, the high wage industries might be hiring better workers. The data on worker quality in the CPS are, after all, rather sparse. Before turning to the detailed analyses of these issues, it should be pointed out that the uniformity of wage differentials across occupations works against both hypotheses. While it is plausible that an industry might want to hire high quality workers in some occupations because of the nature of the technology, why should that be true for all occupations? Similarly, while working conditions might be harsh for some occupations in high wage industries, why should secretaries and managers be highly paid in these industries?

While compensating differences are undoubtedly an important determinant of industry wages (Rosen, 1986) this hypothesis clearly cannot explain the pattern of differentials described above. To test the importance of such factors, Krueger and Summers (1988) try adding a set of ten job characteristic variables to a wage equation using the 1977 Quality of Employment Survey. These characteristics included weekly hours, job shift, whether the job was hazardous, the nature of the working conditions. Adding these variables does not substantially alter the measured interindustry wage differentials.

A more telling argument against the compensating wage hypothesis comes from data on quit rates. If the high wage industries are simply compensating workers for unsavory conditions, then there is no reason to expect that such workers are earning rents. In this view, there would not be any expectation of a correlation between industry wage rates and quit rates. However, high wage industries tend to have low quit rates (Katz and Summers, forthcoming; Akerlof, Rose, and Yellen, forthcoming), suggesting that workers in such industries feel they are being paid wages in excess of their opportunity costs.

The unobserved quality explanation is more difficult to evaluate. Krueger and Summers (1988) use two methods to investigate this issue. First they compare the wage regressions with and without labor quality controls. They argue that unmeasured labor quality is probably correlated with measured quality. If this premise is accepted, and industry wage differentials are due to differences in unmeasured labor quality, then adding labor quality variables to a wage regression should substantially reduce the industry wage effects. However, when they add education, tenure, and age (crude measures of human capital) to the wage regression, the standard deviation of industry wage differentials falls by only one percentage point. They conclude (p. 13), "Unless one believes that variation in unmeasured labor quality is vastly more important than variation in age, tenure, and schooling, this evidence makes it difficult to attribute interindustry wage differences to differences in labor quality." Proponents of the unobserved ability model such as Murphy and Topel (1987) take seriously precisely the view scoffed at in the preceding quote. They argue that wage equations explain a very small proportion of the variance, and presumably most of the unexplained variance is due to unobserved ability. To buttress their case they point out that industry wage differentials *are* positively correlated with observed ability measures, and in all likelihood, unobserved quality is positively correlated with observed quality.

Another way to approach the unobserved quality issue is to look at workers who change jobs (since quality is held constant). This task is more difficult to carry out than it might seem. There are complex issues raised by measurement error and selectivity bias. The measurement errors come into play because some of the workers who appear to have switched industries may have instead been incorrectly assigned by the interviewer to the wrong industry for one (or both!) of the two jobs. Krueger and Summers use some direct data from other sources to try to correct for the misclassification problem. The selectivity bias is present because the workers who go from a low paying industry to a high paying industry might be the better workers. The selectivity bias presumably imparts a positive bias to the estimated differentials (relative to the true, quality-adjusted values) because the observed switchers probably have unmeasured quality differences that are positively correlated with the industry differentials.[2]

With the potential problems in full view, Krueger and Summers take a stab at measuring the longitudinal wage differentials using a 1984 CPS survey of displaced

[2]However, one factor that works in the opposite direction is that a worker in a low wage industry might be willing to accept a reduction in seniority to gain entry to the high wage industry. For these movers, the industry differential would be understated.

workers. Krueger and Summers use only the workers who were involuntarily displaced from their jobs, so selectivity bias is reduced, and correct for industry misclassifications as best they can. They find strong industry effects of roughly the same size as those found in the simple cross sectional regression. They conclude that interindustry wage differentials are unlikely to be explained by unmeasured labor quality. Similar results are obtained by Gibbons and Katz (1987) and Blackburn and Neumark (1988). However, using a different CPS sample, and a different procedure to correct for possible misclassifications, Murphy and Topel estimate that workers who switch industries gain only about one-third of the difference between the industry wage rates. They cite these results to support their view that industry effects are primarily due to unobserved quality.

These conflicting studies make it difficult to evaluate the unobserved quality hypothesis. If the wage pattern does reflect unobserved ability, however, then it seems reasonable to think that the industry wage differentials would be positively correlated with other measures of ability such as intelligence. Blackburn and Neumark (1988) investigate this using the National Longitudinal Study Young Men's Cohort which reports an IQ test score for many of its respondents. They find that after controlling for the usual observed quality measures including education there is a negative relationship between an industry's wages and the average IQ score of its workers. Of course, it is possible that high wage industries are buying quality that is uncorrelated with IQ (reliability?), but if the results of this study are taken at face value then the ability hypothesis seems to have suffered a serious blow.

Which Industries Pay High Wages?

To begin to unravel the mystery of these industry wage patterns, researchers on this topic have identified four industry characteristics that appear to be associated with the level of compensation: firm size, profits and monopoly power, capital intensity, and union density.

An empirical phenomenon as strong and perhaps as anomalous as interindustry wage differentials is the fact that large firms pay more than small firms. Brown and Medoff (forthcoming) find that both plant size and firm size have important positive influences on wage rates, even after controlling for the characteristics of the workers and the working conditions of the jobs. Therefore, it is not surprising that industries with large average plant sizes tend to be high wage industries. However, firm size seems more powerful in explaining within industry wage differentials than across industry patterns.[3] Indeed, firm size seems to reinforce the industry effects.

A second factor that some investigators have found correlated with industry pay levels is "ability to pay" as measured either by the market power or profitability of the firms. One indicator of market power is the four-firm concentration ratio (the

[3]Groshen (1988) also finds significant within industry effects by establishment. Indeed, establishment effects appear to be roughly equal in magnitude to industry effects.

percentage of sales in an industry by the largest four firms). Researchers examining the relationship between concentration and pay have found mixed results. Some have found that concentration increases wages, but others have found that the relationship becomes insignificant once controls for labor quality are included.

A more direct measure of ability to pay is profitability. However, this variable is not without drawbacks. Since economic profits are not reported, one must instead use accounting profits. Also, the profit rate obviously is negatively related to wages since, ceteris paribus, an extra dollar of wages necessarily reduces profits. Nevertheless, the profit rate has been found to be a more reliable predictor of industry wages than concentration ratios, especially for nonunion workers.

The relationship between capital intensity and wages was first investigated by Slichter (1950). He examined the association between wages and labor's share of costs in an industry. This turned out to be negative, even though higher wages must contribute to a higher labor share. Similarly, Lawrence and Lawrence (1985) and Dickens and Katz (1987a) find that industries with high capital labor ratios tend to pay higher wages. As usual, one must be careful in interpreting causality. Is there something about the technology of highly capital intensive firms that induces them to pay more to their labor, or do firms that must pay high wages substitute capital for labor?

The final factor that has been shown to be correlated with industry wage rates is union density (the percentage of the workers in an industry who belong to a union). Most studies find that the unionization rate increases wages for both union members and nonunion members in an industry (though Freeman and Medoff (1984) find no effect on nonunion members). Once again interpretation is difficult. Do unions raise wages, or are unions attracted to high wage industries? More on this later.

Theoretical Explanations

The puzzle posed by the observed interindustry wage differentials is that some industries seem to be paying more per unit of labor quality than others. Why? As Krueger and Summers (1987) point out, there are only two classes of theoretical explanations that can logically be considered consistent with the alleged facts. Either firms are choosing not to maximize profits, or, for some reason, high wage firms find that lowering wages would decrease profits. Models based on the first premise need to explain why managers choose to pay higher than profit maximizing wages. The models in which wages above opportunity costs are consistent with profit maximization either assume that higher wages can increase output ("efficiency wage" models) or be a rational response to the threat of collective action.

The suggestion that firms do not maximize profits was once considered heresy, equivalent to a belief in upward sloping demand curves. In recent years, however, the old fashioned notion of "managerial discretion" has been given the respectable term "agency theory," and the suggestion that managers might not maximize the wealth of the shareholders is no longer considered immediate grounds for excommunication.

Still, there does seem to be a preference in the profession for agency theories in which managers sacrifice stockholder wealth in order to enrich *themselves*. The idea that managers would reduce profits to enrich their employees, especially the blue collar workers far removed from the manager's milieu, is an enigma. Perhaps for this reason, I know of no formal attempt to explain interindustry wage differentials with an agency model in which managers have a taste for both profits and highly paid employees. Nevertheless, the facts described above do suggest that this hypothesis is plausible. As Krueger and Summers stress, high wages are observed in industries with high profits and low labor shares, precisely the industries in which one might expect such behavior to be manifested.

Much more attention has been given to the "efficiency wage models" in which higher than competitive wages can be profitable.[4] Yellen (1984) offers a simple generic efficiency wage model. Assume that each identical, competitive firm in an economy has a production function of the form $Q = F(e(w)N)$ where N is the number of employees, e is effort per employee, and w is the wage rate. Assume that $e' > 0$, $e(0) \leq 0$, and the elasticity of $e(w)$ with respect to w is declining in w. Suppose that the firm can hire all the labor it wants at any reasonable wage. Then the profit maximizing solution is to set the wage $= w^*$ (the efficiency wage) such that the elasticity of effort with respect to the wage is unity, and hire labor at that wage until the marginal product equals w^*. The key to the model, of course, is the assumption that effort per worker is increasing in the wage rate. Several different versions of this generic efficiency wage model have been proposed, with the variation coming from presumed source of the positive effort-wage relationship. The models can be categorized in four types.

1. *Shirking models.* In most jobs, workers have some discretion in how hard they work. Piece rates are often impractical because of the difficulty in counting the "pieces," and monitoring is costly. In the shirking efficiency wage model (one version that comes with the *JEP* seal of approval is Shapiro and Stiglitz, 1984) firms pay above market wages, engage in some monitoring, and fire those workers caught shirking. By paying above market wages, firms decrease the incentive to shirk, since detection then entails loss of rents. According to the shirking model, high wage industries should be those with high monitoring costs and/or industries which bear a relatively high cost of employee shirking.

2. *Turnover models.* Firms may also wish to pay above market clearing wages to reduce turnover. Models based on this premise (e.g., Salop, 1979; Stiglitz, 1974) are similar to (indeed, formally identical to) the shirking model. Here the idea is to pay high wages to reduce quits. The turnover model predicts that the high wage industries are those in which turnover costs are highest.

3. *Adverse selection models.* In these models, (Stiglitz, 1976; Weiss, 1980) employers cannot costlessly learn the ability of workers, either as applicants or on the job. It is

[4]A brief introduction to this literature is contained in Janet Yellen (1984). For a more comprehensive review, with particular attention to interindustry wage differentials, see Katz (1986). Stiglitz (1987) provides another survey with a theoretical emphasis.

assumed that the average quality of the applicant pool increases with the wage rate. These models imply that industries which are more sensitive to quality differences or have higher costs of measuring quality will offer high wages.

4. *Fair wage models.* The premise of the fair wage models (Akerlof, 1982, 1984; Akerlof and Yellen, 1988; Solow, 1979) is that workers will exert more effort if they think they are being paid fairly. This premise gives firms an incentive to pay wages above competitive levels whenever their workers' perceived fair wage exceeds the competitive wage. If workers believe that fairness requires a firm to share rents with employees (for supporting evidence see Kahneman, Knetsch and Thaler, 1986) then fair wage models predict that industries with high profits will be those which pay high wages. The model also predicts high wages in industries where teamwork and worker cooperation are particularly important.

It should be noted that this taxonomy of efficiency wage models should not be interpreted as suggesting that the models are mutually exclusive. Firms might well pay above competitive wages to reduce shirking and quits, attract high quality applicants, and improve worker morale. All of these ideas make sense and probably have some validity. What is at issue here is the extent to which any of these models can explain the interindustry wage pattern. The key fact to explain is the uniformity of the industry wages across occupations. The models based on shirking, turnover, and adverse selection seem to offer few insights into why the high wage industries should offer above the market salaries for secretaries and janitors. The fair wage models do better on this score. If an industry has to pay some of its workers high wages for exogenous reasons (such as compensating differences to miners) then it may pay other workers high wages for "internal equity" reasons. The fair wage models are also consistent with the correlation of industry wages and profits (since sharing rents is fair) and with the persistence of the wage differentials over time (high wages become a norm). However, fairness seems to have little to offer to explain the strong international correlations, especially those for Eastern bloc countries.

The other logical explanation for a firm paying higher than competitive wages is based on the threat of collective action. In Dickens (1986), nonunion workers can benefit from the threat of unionization if employers raise wages to prevent collective action. The model predicts that industries will have high wages where the threat of union action is highest: where workers are predisposed toward unions, where laws favor union formation, and where firms have rents to share.

Some of the evidence regarding industry wage differentials is consistent with the union threat model. High wages in the U.S. are correlated with union density and with industry profits, as the model predicts. However, Krueger and Summers (1987, p. 36) offer a plausible alternative view:

> Historical evidence suggests that high-wage industries already paid relatively high wages before the advent of wide-scale unionization in manufacturing. For instance, the Big Three automobile manufacturers in the U.S. were wage leaders prior to successful union organization of General Motors and Chrysler in 1937 and Ford in 1941. Furthermore, unions have tended to concentrate their

organizing efforts in industries which have a greater ability to pay high wages, and these industries appear to share their rents with unorganized workers anyway. Lastly, international evidence shows that the industry wage structure is similar in countries where there is not a threat of unions and in countries where there is widespread collective bargaining. All this suggests that union density is a correlate of industry wage differentials, but probably not an underlying determinant of the industry wage structure.

Commentary

How surprising are the empirical findings described above? Several readers of the first draft of this column constructed an example within the academic labor market in which "industry" wage differentials would not be considered anomalous. Suppose we divide colleges and universities into two broad "industries": research universities and teaching colleges. Note that most of the faculty in both industries will have Ph.D's, and thus will be indistinguishable based on the sort of data usually available on research tapes. Now run a wage regression for all faculty members and include an "industry" dummy variable. Will anyone be surprised if the dummy variable explains a significant portion of the variance? Surely not. So why should the significance of other industry dummy variables be considered evidence against a competitive labor market?

I do not find this analogy compelling. First, note that this division of the academic labor market into "industries" is hardly arbitrary. We have good reason to expect that this market does sort workers in part by ability (at least on the research dimension—teaching might well be a different story). There is no similar presumption that automobile workers should have more ability than leather workers. Also, the analogy doesn't address the uniformity of wage differentials across occupations. Would we expect janitors at research universities to be paid more? If so, do we think they are better janitors? Finally, there are what I think are more telling analogies to industry wage pattern within the academic labor market. Consider the salaries of economists in economics departments, business schools, and law schools. Business and law schools appear to pay a substantial quality-adjusted premium, one that seems to have increased in recent years. While it is possible to argue that this is a compensating differential, few economists in business or law schools request transfers to the economics department. Rather, I think that the high salaries are explained by internal equity considerations. It seems unfair to pay a full professor of economics less than a new assistant professor of accounting! Of course, the high salaries will tend to attract good people, so over time the average quality of the economists in the professional schools will improve. But the point is that the high wages came first, for fairness reasons. There is, as far as I know, no technological reason why business schools and law schools should want (or in fact get) higher quality economists than departments of economics.

The debate as to whether the industry wage pattern can be explained by variations in ability strikes me as a debate over whether the pattern is an anomaly or a puzzle. If it is true that the high wage industries get higher quality janitors and secretaries, then the competitive theory of labor markets is intact, but we are left with a puzzle as to why it is profit maximizing for automobile industry managers to have cleaner offices and better typists than their colleagues in the leather industry.

In trying to evaluate the competing theories of interindustry wage differentials, I am struck by the relevance of what might be called "Herbert Simon's Lament." For many years, Herbert Simon has been critical of the economics profession's aversion to direct observation of economic decision making. The absence of such direct observations makes evaluating many economic theories difficult. Consider the shirking model. Do employees work harder when they think they are in danger of losing a highly paid job? More to the point, do they work enough harder to justify the higher wages? Are the firms that pay high wages those who would gain the most from an increase in worker effort? As far as I know, we have virtually no empirical basis for evaluating the shirking model.

The situation is only slightly better for the turnover model. Since data on quit rates are published, it is possible to see whether paying high wages decreases quit rates (it does). But if we wish to know whether the observed pattern of wages and quit rates is consistent with profit maximization, we also must know how turnover costs vary by industry. Are the industries that pay high wages those with the highest turnover costs? Who knows?

While the fair wage model seems to fit the data best, it too has little direct empirical support. Are workers more productive if morale is high? Common sense and social psychological research on "equity theory" both suggest that the sign of the effect is right. But again we are not close to being able to test whether firms have found the true efficiency wage which sets the marginal gains from increased morale equal to marginal costs.[5]

To address any of these issues we need much more in the way of what might be called micro-micro (nano?) economics. Economists would have to get their hands dirty collecting data on the actual operation of organizations. Unless the profession is willing to reward this type of time-consuming research activity, many important questions will remain unresolved.

There is an interesting relationship between the fair-wage models of Akerlof and Yellen and the topics of two of the previous articles in this series. In the column on "Cooperation," (Dawes and Thaler, 1988) the anomaly discussed was the fact that people often cooperate in public goods-prisoner's dilemma type situations in which a selfish action is dominant. (Many people vote, donate to charities and public television, etc.) Furthermore, cooperation is more common in situations where the participants can talk to one another and/or have some sense of group identity. The next

[5]One interesting effort along these lines is Raff and Summers' (1987) evaluation of Ford's decision in 1913 to double wages.

column (Thaler, 1988) presented evidence on the "Ultimatum Game." Remember that in an ultimatum game one player, the allocator, is given a sum of money, say \$10, to divide between himself and another player, the recipient. The allocator makes the recipient an offer, x, which the recipient can either accept or reject. If the recipient accepts the offer then she gets x and the allocator gets $\$10 - x$; if the recipient rejects the offer both players get nothing. The game theoretic solution to the game is for the allocator to offer the recipient a penny which the recipient accepts. Two types of anomalous behavior have been observed in these games. First, allocators make generous offers, often close to a 50-50 split. Second, recipients reject positive offers that are felt to be insultingly small.

What would happen if we combined these two research paradigms? Suppose two subjects first played an ultimatum game and then a one trial prisoner's dilemma. It seems plausible to assume that recipients who received what they considered to be unfair offers in the ultimatum game would subsequently be less likely to cooperate in the prisoner's dilemma game. More generally, it is probably not a good strategy to offer a recipient epsilon in the ultimatum game and then ask her for a favor.

Now consider the case of two large firms with plants located in the same community. The firms have clerical staffs that perform virtually identical services. Firm H is in a high wage industry and pays its clerical staff W_H, while Firm L is in a low wage industry and pays its clerical staff only $W_L < W_H$. Suppose that Firm H decides to save money by cutting the wage of its clerical workers to W_L. Is this action profitable? That depends on the reaction of the clerical workers. If the workers think of their old wage (equal to the wage the firm pays its clerical workers at other facilities) as a fair one (which seems likely) they may resist the wage cut in various ways that can be summarized as saying they become less *cooperative*. The reduction in worker cooperation could easily offset any gains from reducing the wage bill. One model that comes very close to this point of view is presented by Lindbeck and Snower (1988).

To sum up, I find the pattern of industry wages difficult to understand unless we assume that firms pay attention to perceived equity in setting wages, an assumption that only an economist would find controversial.

■ *The topic for this column was suggested by Robert S. Smith. This paper draws heavily on the excellent papers by William Dickens and Lawrence Katz (1986, 1987) and Alan Krueger and Lawrence Summers (1987a, b). For details and complete bibliographies, readers are urged to consult these papers. Helpful comments have been received from all four of these authors plus Daniel Kahneman, Kevin M. Murphy, Walter Oi, Sherwin Rosen, the editors of this journal, and several Cornell colleagues. Needless to say, these people do not agree with one another nor with everything said here. Financial support was provided by Concord Capital Management.*

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