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Compensating differentials in experimental labor markets☆

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ABSTRACT

The theory of compensating differentials has proven difficult to test with observational data: the consequences of selection, unobserved firm and worker characteristics, and the broader macroeconomic environment complicate most analyses. Instead, we construct experimental, real-effort labor markets and offer an evaluation of the theory in a controlled setting. We study both the wage differentials that evolve between firms with varying degrees of disamenity and how these differentials are affected by worker mobility and therefore selection. Consistent with the theory, we find that riskier firms must pay significantly higher wages to attract workers. Further, when workers are mobile, they sort into firms according to their attitudes towards risk and, as a result, the compensating differential shrinks. Last, we are also able to mimic the biases associated with observational studies.

> *The whole of the advantages and disadvantages of the different employments of labour and stock must, in the same neighborhood, be either perfectly equal or continually tending to equality.* (Smith, 1976 [1776], Book I, ch. X, p. 111)

1. Introduction

Almost two and a half centuries after Smith (1976) first described the basic logic behind compensating differentials, perhaps "*the* fundamental (long-run) market equilibrium construct in labor economics" (Rosen, 1986), considerable doubt remains about the size, and sometimes even the existence, of differentials for even the most salient of disamenities, including death.[1] In principle, calculation of an equalizing difference, the compensation needed to make the marginal worker indifferent between positions with and without disamenities, should be straightforward. In practice, however, credible estimates have proven elusive, for at least two sets of reasons.

The first reason reflects the limitations of observational datasets. Data at both the firm- and job-level is often scarce, which means that important distinctions are either unobserved or measured at inappropriate levels of aggregation. It is often the case, for example, that disamenities are measured at the sectoral, and not firm, level, which can cause researchers to overestimate differentials (Dorman and Hagstrom, 1998). More often than not, researchers also lack sufficient individual-level data to control for firm- and sector-level selection, which makes it difficult to evaluate competing explanations of small wage differentials, including "market failure" or efficient selection (Goddeeris, 1988; Garen, 1988; Kostiuk, 1990; Hwang et al., 1992; Lavetti, 2014).

The second set of challenges is rooted in various labor market complications, and would muddle estimation even with more complete datasets. For example, the standard rationale for the emergence of compensating differentials presumes vigorous and well-informed job search in a world where labor market frictions and incomplete information are absent (Hwang et al., 1998; Bonhomme and Jolivet, 2009). Without evidence on motivation, it can also be difficult to distinguish between voluntary and involuntary job changes (Taber and Vejlin, 2011). Furthermore, if work at firms with disamenities is also harder to observe, or write contracts on,

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[1] For example, Kniesner et al. (2012) use panel data to report estimates of the value of a statistical life between $6 and $26 million, in which the confidence interval for the former includes zero. Worse, perhaps, Dorman and Hagstrom (1998) find that, for non-union workers, the mean differential is in fact negative.

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wage differentials will also include a rent (Ho, 2013). Macroeconomic conditions – in particular, the jobless rate – can also influence firm-level differentials (Dorman, 1998).

Despite these challenges, labor economists have attempted to measure, and evaluate, compensating differentials in the field. There are many papers on compensation for health risks, from the existence of a wage premium for oil workers at sea and on the permafrost, to military bonuses for combat troops, or even higher rates for sex workers who do not insist on condom use (Rao et al., 2003). There are likewise numerous studies of income risk, the disamenity that we study in this paper. In some cases, this risk assumes the form of a small likelihood of a large payoff, as in the arts, sports or entertainment (Hartog and Vijverberg, 2007). In other cases, the income risk comes from an increased likelihood of job loss, including the chance that accidents can lead to long unemployment spells (Hamermesh and Wolfe, 1990). Citing concerns similar to those discussed above, Mas and Pallais (2016) focus on workers' preferences, rather than on the emerging differential. In a recent large scale field experiment, they measure workers' willingness to pay for flexible or predictable work hours and the ability to work from home by asking job applications to make a binary choice between two alternate work arrangements with different wages.

Our paper makes two substantial contributions to the literature. First and foremost, we are, to our knowledge, the first to use experimental labor markets to construct "clean" estimates of compensating differentials in the face of well-defined risks, both with and without worker sorting. Second, because our data also allow us to mimic what a researcher with incomplete observational data would see, we can reproduce, but also better understand, the biases embodied in conventional estimates, a novel application of experimental methods. We believe that this exercise illustrates an important but under-appreciated application of economic experiments.

The challenges faced by researchers measuring differentials using observational data suggest the usefulness of using a controlled laboratory experiment to contribute a clean test of the theory. The lab provides three main advantages. First, we can ensure that jobs differ only in a well-defined disamenity that we induce. We construct experimental labor markets that allow us to control the basic determinants of wages – the production process, output prices, labor demand – as we introduce cross-firm variation in the riskiness of compensation. The disamenity in our design is consistent with the presence of either income and/or employment risk, an example that Smith (1976) discussed at length, and which we choose due to its canonical stature in the literature. Since there are no other differences in the managerial decision problem, any wage differentials that arise should reflect the firms' response to the revealed preferences of workers for the disamenity. Second, because the "workers" are experimental participants, we are able to elicit measures of each worker's risk preferences in order to assess their tolerance for the disamenity. Finally, our experimental design allows us to vary worker mobility so that we can cleanly assess the effect of worker sorting on the differential.

Our design, with its emphasis on the effects of commuting costs on compensating differentials, is unique.[2] Firm managers compete on piece rates to attract workers to their firms, where they exert real effort. The firms are identical, except that in one firm we introduce a disamenity: in each period, there is a 25% chance that a worker's effort, and thus earnings, will be lost. To measure worker tolerance for the disamenity, we collect incentivized risk attitudes from all of our participants.

To evaluate the effects of selection, we include two mobility treatments. Workers are randomly assigned to the catchment area of one of the two firms, but can commute to the other firm at a cost. By varying the commuting cost, we control the extent to which endogenous sorting can occur, and thus can measure the effect of sorting on the differential. In one treatment, it is costly for workers to commute from one firm to another, and, as expected, relatively few do. Since workers also have a self-employment option, the resulting wage difference in this treatment can be understood as the "full" or "pre-sorting" differential. In the second, high mobility, treatment, it is much cheaper for workers to migrate, which allows us to evaluate how much the matching of workers and firms reduces the full differential – a result with important theoretical and empirical implications.

The design allows us to avoid the two main challenges described above. First, we can study the evolution of compensating differentials in the absence of competing labor market complications; and, second, we can directly observe both firm characteristics (which we control) and worker characteristics (which we measure).

In this setting, we find considerable support for the Smithian model of compensating differentials. In almost all sessions, a significant differential, in both substantive and statistical senses, soon emerges and persists. Unless the marginal worker is risk-loving, however, the differential isn't sufficient to compensate workers for their assignment to the risky firm. In this sense, even in our "stripped down" environment, markets fail. We further find that the differential does shrink when workers are mobile and, consistent with the basic theoretical model, that workers sort on the basis of their risk preferences. We find that the effect of selection, or worker-firm matching, is equivalent to between one quarter and one third of the full differential.

Last, to link our work to previous studies that examine naturally occurring data, we show that a researcher who had access to all of our data except for worker characteristics, a common deficit, would underestimate the differential almost 25%, while a researcher forced to use sectoral, rather than firm, characteristics would vastly overestimate it. We view our results as both a robustness check and confirmation of longstanding concerns about potential biases in conventional studies.

The paper proceeds as follows. Section 2 provides a conceptual framework and describes the experimental design and measurement of worker tolerance for the disamenity. Section 3 reports our results and is organized around the three main questions our experiment was designed to address: (1) Do differentials arise to compensate workers for a risky disamenity? (2) Do workers sort according to their tolerance for the disamenity? and (3) Do differentials shrink when mobile workers are able to sort according to their preferences? As hinted at above, Section 4 concludes with a discussion of how our experimental data – which includes complete information on worker preferences, commuting costs, and job-level disamenity – can be used, not only to address these questions, but to assess how the measurement of our differentials would be affected if we had access to less complete information on worker or job characteristics.

2. Experimental design

2.1. Conceptual framework

The intuition for our predictions is rooted in Rosen's (1986) canonical treatment: labor markets produce better matches between firms and workers when the latter are mobile. If it is easier, for example, for firms with uncertain compensation schemes

[2] The closest experiments to ours are Fehr et al. (1996a, 1996b) in that these authors are also interested in wage setting dynamics, but the focus of these papers (on gift exchange and the evolution of non-compensating differentials) is very different.