



**ESSAYS IN APPLIED MICROECONOMICS**

by

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## **Abstract**

This dissertation uses highly detailed data from the trucking industry to analyze how contracts and networks affect performance and profitability. In the first essay, I analyze the use of training contracts, where firms pay for general training, but then fine employees for quitting. I show that these contracts substantially increase the profitability and that the profitability of these contracts is further enhanced by employee belief biases. In the second essay, I examine the determinants of employee beliefs and biases. In the third essay, I analyze networks among employees and connect these to employee performance.

## Executive Summary

Human capital can be extremely valuable for almost any organization. Training by firms is a central means by which workers accumulate human capital, and investing in human capital has the potential to be quite profitable.

However, since at least Pigou (1912), economists have recognized that the provision of general training is subject to a “hold-up” problem. If workers cannot credibly commit to stay with firms after receiving training, firms will under-invest in training. The canonical solution developed by Becker (1964) is for workers to pay for training themselves, but this may not be feasible, for example, if workers are credit-constrained. Indeed, growing evidence shows that a significant portion of training is paid for by firms.<sup>1</sup> Hold-up may have important implications for the overall level of training in the economy. High worker turnover in the United States may make firms reluctant to train, thereby contributing to lower levels of training than in countries with lower turnover (e.g. Blinder and Krueger, 1996). Understanding what makes training profitable for firms may thus be important for optimal human capital policy.

To discourage workers from quitting after receiving training, firms often use training contracts. In these contracts, the firm pays for training, and in exchange workers must agree to stay with the firm for some period of time. If workers leave early, they must pay penalties. Training contracts of this form are used for many workers, including truckers, policemen, firefighters, nurses, pilots, securities brokers, and federal employees, to name a few, but have received limited attention from economists.<sup>2</sup> How do training contracts affect worker turnover, worker selection, and firm training? How do training contracts affect profits and welfare? While training contracts are legally permissible within some guidelines, some have argued that training contracts are exploitative and tantamount

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<sup>1</sup>See e.g. Barron et al. (1999), Acemoglu and Pischke (1999), and Cappelli (2004) for evidence that firms often pay for training, both nominally and in terms of incidence. U.S. firms appear to spend less on training than firms in other countries (Lynch, 1993; Brunello and Medio, 2001), but training expenditures are still substantial. For example, on tuition reimbursement alone, it is estimated that U.S. firms spent \$10 billion in 2003 (Manchester, 2009). There are many reasons besides credit constraints that firms will pay for training, including labor market frictions, information asymmetries, and screening benefits (Acemoglu and Pischke, 1999).

<sup>2</sup>See the law articles by Kraus (1993, 2008) for these examples, as well as a review of legal issues surrounding training contracts. Other workers with training contracts include metalworkers, mechanics, salesmen, paramedics, electricians, accountants, teachers, flight attendants, bank workers, repairmen, firm-sponsored MBAs, and social workers. In economics, there is a small related literature on firms providing tuition reimbursement. In most of these studies, tuition reimbursement is provided as a benefit and not as part of a contract where the worker is obligated to stay for a length of time.

to a mild form of indentured servitude, and there have been recent legal challenges.<sup>3</sup> How should training contracts be regulated?

To address these questions, I use a very large and detailed dataset from the trucking industry where training contracts are widely used. The main data in the essay are from a leading trucking firm, referred to as Firm A, at which there is plausibly exogenous contractual variation. At Firm A, training was initially provided free of charge with no contractual obligations. In the early 2000s, a newly promoted manager suggested the idea of using a training contract, arguing it could improve retention, as well as help recover training costs. A training contract was created that required trained workers to stay 12 months or pay a penalty if they left early. The contract was phased into different training schools at different times, depending on how fast the contract was approved for use in different states. Around five years later, the company unrolled an 18-month contract with a higher initial quit penalty that decreased with tenure. I exploit the staggered timing of these two contract changes to estimate the impact of training contracts. The 12-month and 18-month contracts reduced quitting by 18 and 11 percent, respectively, relative to a situation with no training contract. The effects appear to be primarily driven by incentives instead of selection.

In Jovanovic’s (1979) seminal theory of turnover, workers gradually learn about their productivity or job match, using their updated beliefs in deciding whether to quit. Thus, a big advantage of the Firm A data is that weekly panel data on worker subjective productivity forecasts are available for a large subset of drivers. Drivers are paid almost exclusively per mile driven (a piece rate), so beliefs about miles are highly consequential for how much drivers think they will earn. I analyze the belief data so as to better understand worker turnover in the presence of training contracts. Workers’ beliefs about future productivity significantly predict quitting and future productivity. In addition, the data show that workers are substantially overconfident about their productivity, though there is significant heterogeneity. On average, workers’ initial productivity beliefs exceed their productivity by roughly 25%. Overconfidence decreases over time, but persists throughout

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<sup>3</sup>Arguments that training contracts are exploitative have been made, for example, in the context of police officers. As of 2006, the City of Los Angeles used a training contract requiring new officers to stay five years after receiving training. McGreevy (2006) quotes a non-L.A. police official arguing that the contracts constitute indentured servitude. The City of Oakland also requires police officers to stay five years after receiving training. In November 2010, an Oakland police officer sued to challenge her contract, with the case decided by the 9th Circuit of the U.S. Court of Appeals. See *Gordon v. Oakland*. In *Heder v. City of Two Rivers*, a firefighter argued his training contract constituted “involuntary servitude.”

the two year panel.

Overconfidence raises important considerations for the efficacy and welfare consequences of training contracts. If workers are overconfident about their future earnings at the current job relative to the outside option, they will be more likely to sign up for training contracts and more likely to stay after training. This makes training more profitable for firms. Overconfidence may also be important for understanding whether training contracts are exploitative. Specifically, workers may overestimate how successful they will be at the job and end up owing penalties for training they would not have undertaken had they not been overconfident.<sup>4</sup>

To better understand observed behavior and to quantify these considerations, I develop a dynamic model of turnover and belief formation. In many empirical models of turnover, workers are assumed to know their future productivity at the firm. However, in my model, productivity is initially unknown and is instead gradually learned about over time as in Jovanovic (1979). Using weekly productivity realizations, workers form expectations of their future productivity and earnings, and use this to decide whether to quit. Although workers update their beliefs in response to new information, they may hold biased priors and/or update faster or slower than a Bayesian would, thereby nesting (a simplified version of) the Jovanovic model as a special case. The estimated structural model replicates several key features of the data including the quit-tenure curve, the productivity-tenure curve, and the belief-tenure curve. Both overconfidence and learning are key. Without overconfidence, the model predicts too much early quitting and fails to rationalize the subjective belief data. Additionally, without learning, the model does not generate the inverted U-shaped quit hazard observed in the data, nor does it predict that observed overconfidence will decrease over time. Estimating the model using workers with the 12-month contract, I show that the model can predict reasonably well out of sample, helping rationalize behavior under the no contract and 18-month contract regimes.

I use the estimates for counterfactual simulations. First, I show that the firm increased profits through its contractual changes, but decreased worker welfare. Second, I consider the counterfactual of reducing worker overconfidence. Eliminating the observed amount of overconfidence would

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<sup>4</sup>The argument that contracts can be exploitative or unfair due to behavioral biases has been made in the legal literature, e.g. Kronman (1983), Eisenberg (1995), and Jolls and Sunstein (2006). Eisenberg (1995) argues that behavioral limitations constitute one of the major rationales for restricting the contracts people should be allowed to sign.

moderately increase worker welfare, but would substantially decrease firm profits and worker retention. Profits would decrease by over \$7,000 per truck in the baseline case. Third, I analyze a government ban on training contracts. Firms are assumed to maximize profits subjects to workers' participation constraint. Because they believe it is unlikely they will want to quit, overconfident workers are willing to accept a large quit penalty in return for a small wage increase. Banning training contracts has the potential to improve welfare for overconfident workers and I find that a ban increases worker welfare by 4%. I also study optimal training contracts for firms, showing that as worker overconfidence is reduced, the optimal training contract becomes smaller.

While the results in my essay are specific to a particular industry, there are several reasons why long-haul trucking provides an interesting setting for studying the effects of training contracts. First, training contracts are a common mechanism by which general training is provided for truckdrivers, a large occupation employing 3.2 million Americans. Second, and more importantly, trucking provides a natural setting for examining training contracts in the context of Jovanovic's (1979) model of turnover where workers gradually learn about their productivity. Unlike in many other industries, productivity in trucking (miles driven per week) is easily measurable, and is accurately recorded by firms given that it is used for determining worker payment. There is considerable variation in productivity across workers, but such differences are unlikely to be known *ex ante*. Third, trucking is an industry with high turnover, allowing for high-frequency retention analysis.

My study makes three contributions to the literature. First, I show that training contracts significantly reduce worker turnover, estimating the effects using plausibly exogenous intra-firm contractual variation. As discussed in the literature reviews by Prendergast (1999) and Chiappori and Salanie (2003), theory has often preceded measurement in economists' study of contracts. Firms' contractual choices are often difficult to observe, and contracts are unlikely to be randomly assigned across or within firms even when they are observable.<sup>5</sup> While Chiappori and Salanie (2003) argue that natural experiments may help researchers circumvent such endogeneity problems in studying contracts, relatively few such studies exist. Second, I provide long-term high-frequency

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<sup>5</sup>For example, it may be imagined that firms with more serious retention problems may be more likely to adopt training contracts. A regression predicting retention may incorrectly show that training contracts have zero or even a negative effect on retention. Alternatively, it may be that only the most successful firms or firms providing the best training think to adopt training contracts, in which case a regression predicting retention will overstate the effect of training contracts. By looking at multiple plausibly exogenous contract changes *within different segments of a single firm over time*, I provide credible estimates of causal effects.

field evidence on overconfidence, the longest I am aware of in the literature, and quantify its welfare impacts for workers.<sup>6</sup> To do so, I develop a structural learning model augmented with heterogeneous and potentially biased beliefs. I contribute to a small, but growing literature incorporating behavioral biases into structural models.<sup>7</sup> Third, I demonstrate that worker overconfidence benefits firms by increasing the profitability of training. Counterfactual simulations suggest that biased beliefs are quantitatively important in facilitating training; even when firms use training contracts, training would not be profitable for firms unless workers are also overconfident. Just as firms may benefit from consumers having time-inconsistent preferences or biased beliefs,<sup>8</sup> so too may firms benefit from their workers having biased beliefs.<sup>9</sup>

Whether it would be possible to reduce worker overconfidence is a separate question from its would be. I explore the feasibility of reducing overconfidence in the second chapter of the dissertation. A field experiment with a large trucking firm shows that workers tend to systematically overpredict their productivity and that their overconfidence is unaffected by whether workers receive financial incentives of different sizes for accurate guessing. Randomly informing workers about other workers' overconfidence reduces overconfidence in the short-run, but the effect fades within two weeks. Neither the incentives or information treatments have any effect on worker satisfaction or search behavior. Using long-term survey data from a second firm, I show that experience reduces overconfidence, but only quite slowly. Although workers at both firms exhibit aspects of Bayesian updating, overconfidence appears to be sticky and difficult to change.

The third essay analyzes worker referrals. Many firms use referrals in their recruitment and hiring procedures. Are these practices profitable, and if so, why? A model is developed where referrals may improve selection and reduce moral hazard. The model is tested using extremely detailed personnel and survey data from a leading firm in the trucking industry. Referred workers are similar to non-referred workers across a large number of background characteristics and lab experimentally-measured dimensions of preferences. Referred workers are between 10-25% less

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<sup>6</sup>For other longer term evidence of overconfidence, see Massey et al. (2011) who study overconfidence in football fans over the four months of the NFL football season.

<sup>7</sup>See also Laibson et al. (2007), Conlin et al. (2007), Paserman (2008), Fang and Silverman (2009), Acland and Levy (2011), Bellemare and Shearer (2011), Crawford and Meng (2011), DellaVigna et al. (2012), and Grubb and Osborne (2011).

<sup>8</sup>See e.g. DellaVigna and Malmendier (2004, 2006), Eliaz and Spiegel (2006), Grubb (2009), and Ericson (2010).

<sup>9</sup>The point that firms may benefit from worker biases is also made in the recent experiment by Larkin and Leider (2011).



likely to quit; the effects are strong across all groups of drivers, including new workers for whom the firm invests in expensive firm-sponsored general training. However, referred workers attain similar initial productivity and productivity growth as non-referred workers, and are no more likely to engage in various forms of moral hazard. The accumulation of friends *after* the starting work does not positively affect retention, productivity, or moral hazard. On net, the evidence is consistent with the idea that referrals benefit firms by selecting workers with a better fit for the job, as opposed to selecting workers with higher overall quality, by affecting worker behavior, or by changing job amenities.

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