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Self-Control and the Development of Work Arrangements

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A significant part of the development experience is the change in the way work is structured. To use a historical example, the Industrial Revolution involved workers moving from agriculture to manufacturing; from working on their own to working with others in factories; and from flexible work-hours to rigid work-days. How are we to understand these changes? Why did they occur? What impacts did they have on labor productivity and possibly growth?

In answering questions such as these, economic theories draw on different assumptions about aggregate production, market failures, and innovation. Yet almost all rely on one of two determinants of labor productivity: human capital and incentives. Human capital theories (broadly construed) emphasize how work arrangements utilize the distribution of human capital and, in learning models, facilitate its development. Incentive theories (again broadly construed) emphasize how workplace arrangements align worker payoffs to minimize moral hazard.

In this paper, we bring together and advance a growing literature on a third feature: worker self-control. Individuals may not be able to work as hard as they would like. Some workplace arrangements may make self-control problems more severe, while others may ameliorate them.[1] Below, we describe evidence from a field experiment broadly supportive of the self-control perspective. We then argue that many work arrangements can be understood differently through this perspective. Specifically, we use self-control considerations to interpret the productivity increases and changes in work organization that accompany the shift from agrarian to industrialized production.

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[1] O'Donoghue and Rabin (2006) present a model of how to incentivize agents with self-control problems. Clark (1994) provides a discussion of how workplace arrangements were structured during the Industrial Revolution to mitigate self-control problems.

I. Self-Control and Work Effort

A large body of theoretical and empirical evidence indicates that self-control problems lead people to fall short of their personal goals (for reviews, see: Frederick et al. 2002; DellaVigna 2009). Economic models of self-control often emphasize time inconsistency in preferences (Thaler and Shefrin 1981; Laibson 1997; Banerjee and Mullainathan 2009) because costs and benefits are weighted differently at different time horizons. The returns to hard work may seem large and the cost may seem small when contemplating work in the future; but the returns may seem small and the costs may seem large when contemplating work today. This generates a self-control problem because different "selves" would like to accomplish different goals. From the perspective of the $t-1$ self, effort e^* at time t equates marginal effort costs and payoffs. But at time t the costs of effort loom large and an $e' < e^*$ will seem optimal.

This generates a problem for firms. Note this problem is distinct from moral hazard. In principal-agent theories, the worker exerts effort valuing the external benefits to the firm. Here the immediate self exerts effort without fully valuing the external benefits to future *selves*. This also generates an opportunity for firms. By helping to mitigate the self-control problem, firms can increase labor productivity and the welfare of their workers (or at least their workers' future-oriented selves).

One way firms can do this is to affect the immediate costs and benefits of hard work. Self-control issues arise because production often involves a long lag between effort and payoffs: cutting the pattern for a dress or running regressions for a paper happen well before the final dress is sold or the paper is presented. The lag between when effort is exerted and when it pays

off is a primary reason for self-control problems. The firm, however, can use regular compensation to reduce these lags and hence self-control problems. In effect, it can make the returns to effort more immediate.

Firms can also create disproportionate penalties for certain types of low efforts—penalties that exceed their marginal impact on output—so as to create sharp self-control incentives. Firms may impose work targets like production minimums or artificial deadlines and penalize workers disproportionately heavily for failing to meet them. Similarly, they may levy large penalties for small deviations in behavior such as minor tardiness. These sharp consequences magnify the costs of shirking and make it a less attractive momentary temptation. By doing this, firms are effectively providing commitment devices (O'Donoghue and Rabin 2006). Indeed, if workers are sophisticated enough to recognize they have time inconsistent preferences, they will demand such commitment devices to bind themselves to work harder in the future (Ariely and Wertenbroch 2002).

Firms can also make it easier for workers to exert self-control. Several models conceptualize the self-control problem as a tension between a myopic short-run self and a long-run self that can constrain the short-run self's behavior at a cost (Thaler and Shefrin 1981; Fudenberg and Levine 2006). The structure of work could plausibly affect this cost. For example, evidence from psychology indicates that more automatic behaviors demand less self-control than active choices (Baumeister et al. 1998). Some tasks require more active choices. Consider work pace. If workers set their own pace, they must constantly decide whether to slow down or take a break, thereby exerting self-control costs. Conforming to an externally set pace, however, can decrease these self-control costs. An interesting example comes from farm labor. Workers planting rice-fields often find it helpful to synchronize movements to music or to beats. In industrial production, the assembly line may serve a similar purpose.[2]

Firms can also use the social arrangement of work to affect self-control. For example, an intrinsic competitive drive may make the momentary self exert more effort when surrounded by hard-working coworkers. Gneezy and Rustichini (2004) provide interesting evidence of this: young boys run races faster when running alongside another boy than when running alone. Alternatively, peers could have a demovitational impact if socializing with coworkers proves to be a tempting distraction.[3] What's interesting for us is that peers may reduce the self-control problem. To do this, peers effects would need to not just affect effort, but to affect the gap between desired effort (by the long-run self) and realized effort. This can happen if peer effects operate through channels—intrinsic competitive drive in the moment, reduction in temptations—that especially affect the momentary self.

II. Empirical Tests

What is the economic magnitude of these forces? Pilot data from a field experiment we performed provides some quantitative guidance. The experiment involves full-time workers in an Indian data entry firm. Workers use data entry software to type information from scanned images into fields on their computer screen. Output is readily measured as the number of accurate fields entered, where accuracy is determined using dual entry of data (standard practices in the data entry industry). Ease of measuring output and the discrete nature of the task make data entry an ideal job for piece-rate payment. Workers are paid their wages weekly.

We first directly test for self-control problems by testing whether workers demand commitment devices. We offer them two types of incentive contracts. Under the control contract, workers receive a piece rate wage of w for each correct field entered. The commitment contract allows workers to set their own production target T, which can be zero. Under it, they receive

[2] Another way in which workplace structure can ease the self-control problem is through cues. Over time, people come to relate environmental factors with specific behaviors, altering the payoffs from those behaviors in the presence of the associated cues (Laibson 2001). This implies that features like uniforms and the physical work environment can reduce cues that induce the temptation to shirk. For example, one may think it would be efficient for firms to offer workers rooms to watch television during breaks, but firms typically do not do this.

[3] Coworkers can also have a variety of motivational benefits unrelated to self-control. For example, coworkers can teach each other or can generate peer monitoring.

a piece rate of w as before if they meet the target, but only receive $w/2$ if they fall short of it. Since individuals can never make more under the commitment contract (and may make substantially less if they fail to meet their target), time consistent individuals should always pick a target of zero, thereby guaranteeing themselves a wage of w. Time inconsistent workers that recognize their problem (i.e., are sophisticated) may choose the commitment contracts. They know they will end up producing less than they like. By setting a positive production target in advance, they can greatly increase the cost *to the future self* of stopping work before reaching this target, ensuring that the future self works harder. We randomize workers into either receiving only the control contract or being offered a choice of the commitment contract.

When offered the choice of a commitment contract, workers choose positive targets 35 percent of the time, with targets being set at a nontrivial level. In addition, simply being offered the *choice* of a commitment contract increases production and wages by 2.3 percent on average relative to the control contract. Moreover, the lag between the costs and returns to effort matters: workers work harder on paydays. These results illustrate the quantitative magnitude of self-control problems even in this piece rate setting where returns to effort are experienced as soon as the next weekly payday.

We also find that the social structure can play a role in mitigating self-control problems. Because workers are randomly assigned to seats in the data entry firm and seating assignments change periodically, we can directly estimate the impact of peers' productivity on own productivity. To deal with codetermination of output (for example, neighbors may get sick at the same time), for each peer we compute her "fixed effect"—her productivity based on *past performance*. We find strong impacts of (randomly assigned) neighbors' productivity. For example, having a peer with above average productivity increases own productivity by 5 percent. We further find that the effect on productivity appears to operate through increases in work hours rather than productivity per unit of time. Moreover, the contemporaneous effect of peers continues to occur even after production increases from learning have subsided. These findings call into question a learning from peers interpretation of the effects. Since there is no codependence among workers in output or compensation, the effects also cannot be driven by production technology or agency factors.[4]

Perhaps most interestingly, however, is that we find a strong peer effect in the demand for commitment. When workers are offered commitment contracts, they are 5 percentage points less likely to select them if they have above average peers. This highlights how peers do not simply affect productivity: they also mitigate the self-control problem.

III. Development of Workplace Organization

The discussion and results so far highlight the importance of self-control for work effort. We now illustrate how these ideas can help us understand the transformation of work through the development process. We focus on two sets of changes—the sectoral shift away from agriculture to industrial production and the organization of industrial production itself.

The agrarian production process creates difficult self-control problems. First, it involves long time horizons—farmers must tend their land constantly for months before reaping benefits at harvest. These lags can generate suboptimal effort in early stages of production. Financially, farmers may also fail to save enough money out of lumpy harvest payments to make efficient investments during the production cycle, further affecting labor supply returns and output (Duflo et al. 2009). Second, agriculture often involves self-employment or very small firms. As a result, there are rarely firms or large employers to mitigate the self-control problem. Tasks cannot be structured, compensation altered, or work intensity regulated.[5] Finally, agrarian production by nature is also geographically dispersed, which makes colocation of workers difficult. Together, these factors can potentially cause large distortions in effort provision and

[4] Mas and Moretti (2008) find strong peer effects as well but attribute it to peer monitoring since, unlike here, in their case workers have a joint production function. Bandiera et al. (2009) find evidence that workers' productivity is influenced by the relative productivity of their friends whereas the results we describe are for randomly assigned peers—friends or otherwise.

[5] Of course these are general features. Even in developing countries, some forms of agriculture (such as plantations) do permit some large employers who can do exactly this.

productivity. This can help explain the observation that work hours appear to be low in modern-day subsistence agriculture (Fafchamps 1993). It also implies productivity gains as production shifts to other sectors that are more amenable to enhancing productivity from a self-control perspective.[6]

Consistent with this view, the transition to industrial production also leads to substantial changes in the way production is organized. Some of these changes can be interpreted as responses to self-control problems. Clark (1994) makes this argument persuasively for the rise of the factory during the Industrial Revolution. He classifies work arrangements into two systems—the workshop system and the factory discipline system. In the workshop system, workers rented floor space or machinery in factories, received pure piece rates for output (with no base wage), and chose production levels and work hours themselves. In contrast, factory discipline involved a system that set strict work hours, production minimums, regulation of work intensity, and large penalties for even momentary lapses in behavior. Under this system, workers sometimes continued to receive pure piece rate wages, while other times they were paid fixed wages.

Under agency theory, the workshop system fully incentivized workers to provide efficient effort. However, Clark presents evidence that workers under the workshop system had very unsteady attendance and hours, spent a lot of time socializing at work, and concentrated effort in the latter half of the week leading up to paydays. Clark argues that this led firms to transition to the factory discipline system to solve self-control problems.[7] For example—even in factories where workers received pure piece rates—being a few minutes late to work could result in being locked out of the factory for the day and the penalty for being caught talking to coworkers was a fine of one hour's worth of wages. Clark interprets these arrangements as commitment devices that were needed to help workers resist the temptation to shirk. In addition, imposing common work hours may have had co-location benefits, while work pace regulation may have reduced the cognitive demand of self-control exertion. By the end of the industrial revolution, the factory discipline system emerged as the norm in organizing production. Clark argues this was precisely because it had self-control benefits, raising effort provision in a way that would have been too costly or difficult through increases in the piece rate under the workshop system.

These features of factory discipline have persisted in industrialized societies and are still very much recognizable today. For example, in the United States, most jobs come with minimum work requirements, pure piece rate production is incredibly rare, firms punish small amounts of tardiness with the threat of employment termination, and features like assembly lines are used to regulate work pace. Similarly, although the recent information revolution has greatly increased the ability for virtual work, production continues to be organized around physical job sites with common work hours—even in tasks involving fairly independent computer-based work.

IV. Conclusion

Traditional views of labor productivity and motivation rely on features of the production technology, human capital, and agency concerns. We argue that self-control problems also have important relevance for motivation because they can distort effort provision in the workplace. Our empirical results demonstrate that workplace arrangements can mitigate these problems, thereby raising labor productivity. As a result, incorporating self-control into our view of what drives motivation enriches our under-

[6] For example, cloth weavers can sell their wares within days of starting production, as was the case under rural cottage industry production in pre-industrial England.

[7] One potential alternate interpretation of the factory system under fixed wages is that it provided "insurance." Since this came at the cost of moral hazard, the disciplinary rules were necessary to mitigate moral hazard. Under this view, the factory system could raise utility but should not raise effort. However, as described above, this is inconsistent with the historical evidence. Production externalities constitute another alternate explanation for factory discipline. For example, low effort or absence by one worker could generate negative externalities on the productivity of downstream workers. In this case, disciplinary rules could align worker output across different stages of the production process. Clark argues that this explanation is also difficult to reconcile with the historical evidence. The empirical results from our field experiment lend credence to Clark's interpretation that factory discipline was designed to address self-control problems.

standing of endogenous organizational choices. This has implications for the development experience because it helps explain the manner in which the shift from agrarian to industrialized societies leads to increases in labor productivity.

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